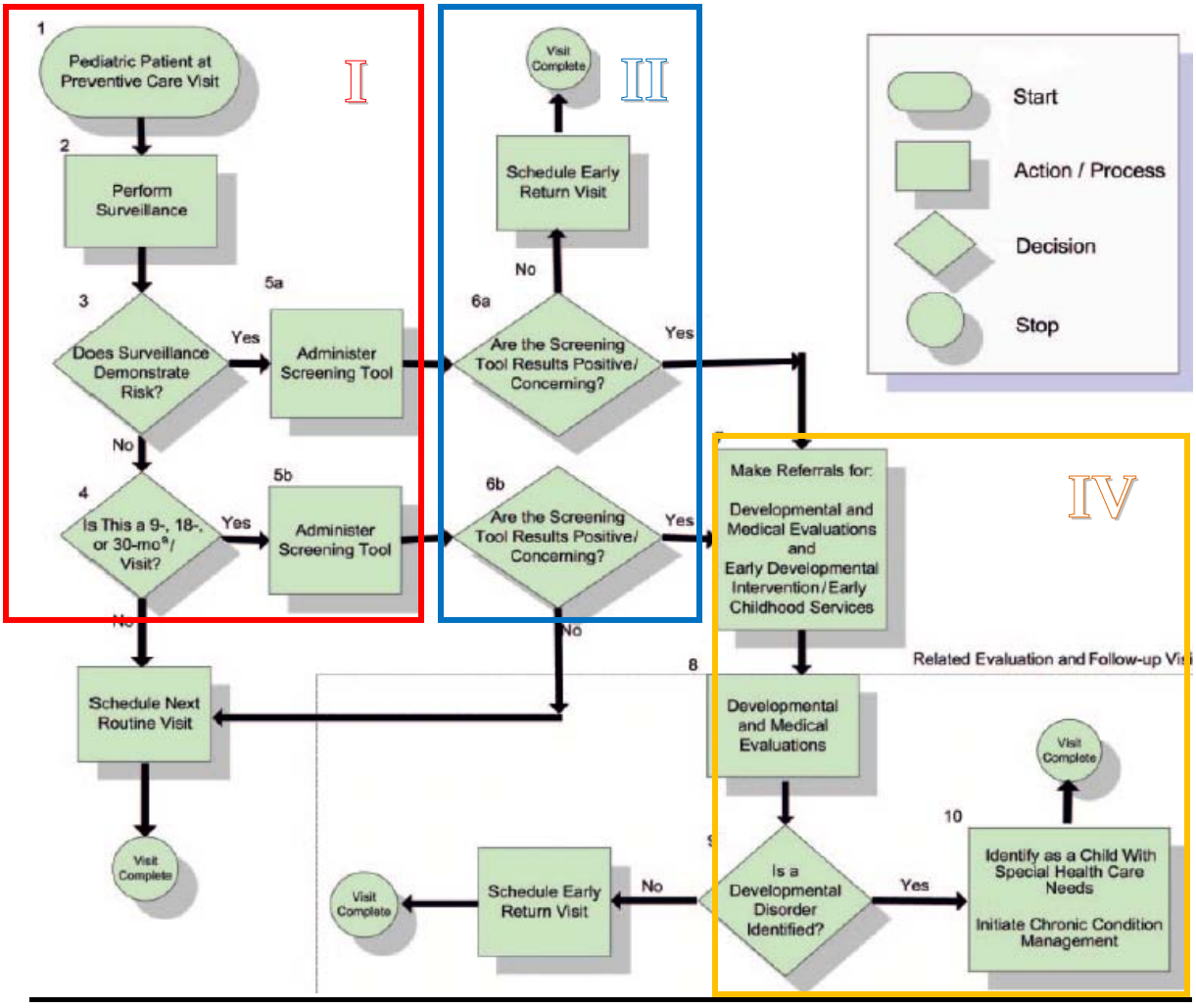
NCC Pediatrics Continuity Clinic Curriculum: **Development I-IV**

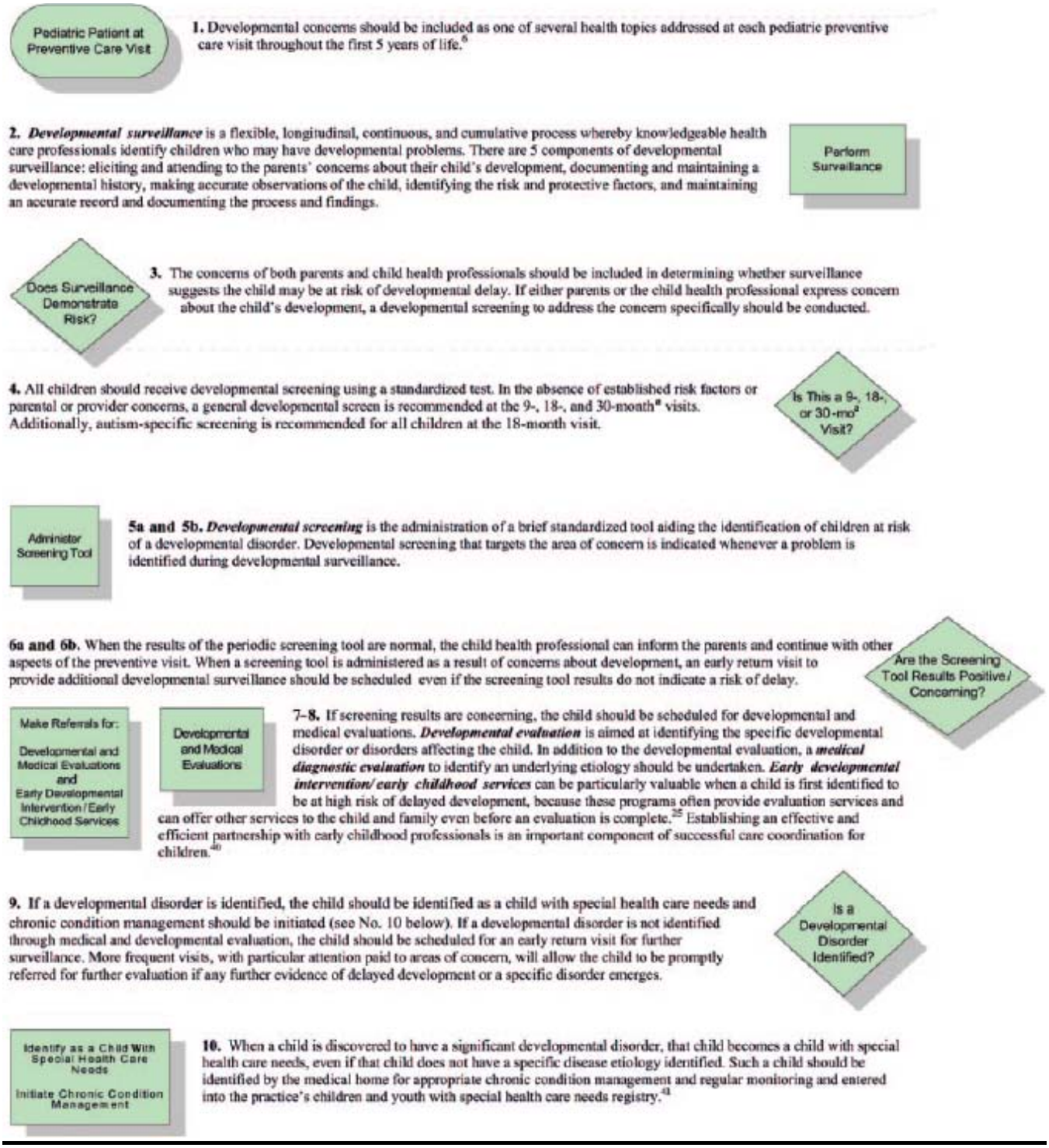
Overall Goal:

Understand the proper use of developmental surveillance in the pediatric office, to include developmental screening, school readiness, & use of community resources.

Overall Objectives:

- **Devo I: Typical Development**
- Devo II: Atypical Development
- Devo III: Milestone Review & "Kids Game"
- Devo IV: Developmental Interventions & Services





Identifying Infants and Young Children with Developmental Disorders in the Medical Home: An Algorithm for Developmental Surveillance and Screening. PEDIATRICS. Volume 118, Number 1, July 2006. *(see "Extra Credit" links)*

NCC Pediatrics Continuity Clinic Curriculum:
Development I: Typical Development

Pre-Meeting Preparation:

Please read the following enclosures:

- Infant Growth & Development (Peds-in-Review)
- Toddler Development (Peds-in-Review)
- "Ages & Stages" Guide

Conference Agenda

- *Review* Development I Quiz: Residents—please attempt prior to meeting!
- Complete Development I Cases
- **Interactive ASQ Exercise:** Divide yourselves into groups of 2-3 residents. There will be completed ASQ tools on the table. Choose one and score it with your partner (*please do not write on tool*). **Discuss your assessment & plan, based on the scores for each domain.** Finally, present your findings to the entire continuity group.

Extra-Credit:

- Zero to Three: website, with links to 9 age-based parent handouts
- AAP Policy Statement on Developmental Screening & Surveillance
  (strongly encourage reading by the conclusion of Devo I-IV modules)
- Promoting Child Development (Chapter from Bright Futures Guidelines)
  (provides good overview of Devo, Behavior, and Adolescent modules)
- AAP Section on Developmental & Behavioral Peds (homepage)

Infant Growth and Development

Chris Plauche Johnson, MEd, MD* and Peter A. Blasco, MD†

IMPORTANT POINTS

1. **Infant development occurs in an orderly and predictable manner that is determined intrinsically. It proceeds from cephalic to caudal and proximal to distal as well as from generalized reactions to stimuli to specific, goal-directed reactions that become increasingly precise. Extrinsic forces can modulate the velocity and quality of developmental progress.**
2. **Each developmental domain must be assessed during ongoing developmental surveillance within the context of health supervision. Generalizations about development cannot be based on the assessment of skills in a single developmental domain (ie, one cannot describe infant cognition based on gross motor milestones). However, skills in one developmental domain do influence the acquisition and assessment of skills in other domains.**
3. **Speech delays are the most common developmental concern seen by the general pediatrician, yet they often are not well understood or diagnosed expediently. A sound understanding of the distinction between an isolated speech delay (usually environmental and often can be alleviated) and a true language delay (a combined expressive and receptive problem that implies more significant pathology) will help the clinician refer appropriately for precise diagnosis and appropriate management.**
4. **It is essential to understand normal development and acceptable variations in normal developmental patterns to recognize early patterns that are pathologic and that may indicate a possible developmental disability.**
5. **Assessment of the quality of skills and monitoring the attainment of developmental milestones are essential to early diagnosis of developmental disabilities and expedient referral to early intervention programs.**

Introduction

"Infant" is derived from the Latin word, "*infans*," meaning "unable to speak." Thus, many define infancy as the period from birth to approximately 2 years of age, when language begins to flourish. It is an exciting period of "firsts"—first smile, first successful grasp, first evidence of separation anxiety, first word, first step, first sentence. The infant is a dynamic, ever-changing being who undergoes an orderly and predictable sequence of neurodevelopmental and physical growth. This sequence is influenced continuously by intrinsic and extrinsic forces that produce individual variation and make each infant's developmental path unique. Intrinsic influences include the child's physical characteristics, state of wellness or illness, temperament, and other genetically determined attributes. Extrinsic influences during infancy originate primarily from the family: the personalities and style of caregiving by parents and siblings, the family's economic status with its impact on resources of time and money, and the cultural milieu into which the infant is born.

Neurodevelopmental sequences can be viewed broadly in terms of the traditional developmental milestones. Developmental milestones provide a systematic approach by which to observe the progress of the infant over time. Attainment of a particular skill builds on the achievement of earlier skills; only rarely are skills skipped. When this happens, the advanced skill may represent a "splinter" skill, that is, a deviant developmental pattern. For example, five-word sentences in a 2-year-old child who does not follow simple commands may represent echolalia typical of autism. The sentences are not meaningful and have no communicative intent. Delays in one developmental domain may impair development in another domain. For example, immobility due to neuromuscular disorders prevents exploration of the environment and, in turn, impedes cognitive development arising through manipulation of objects. Last, a deficit in one domain may compromise the assessment of skill levels in another domain, even though development in the second domain is normal. For example, it is difficult to assess problem-solving skills in a child who has cerebral palsy because the child may understand the concept of matching geometric forms, yet be unable to insert them physically into a formboard.

Developmental milestones serve as the basis of most standardized assessment and screening tools. Although these screening tools provide the clinician with a structured method of observing the infant's progress and help define a developmental delay, many lack sensitivity. Parental concern in the face of normal results in developmental screening should not be disregarded. Focusing narrowly on discrete milestones may fail to reveal atypical organizational processes that are involved in the child's developmental progress. Thus, it is important to analyze all milestones within the context of the child's history, growth, and physical examination as part of an ongoing surveillance program. Only then is it possible to formulate an overall impression of the child's true developmental status and the need for intervention.

Although milestones form the foundation of the discussion, the primary intent of this article is to provide broader insights into infant developmental processes and to help the clinician recognize warning behaviors ("red flags") indicative

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of developmental deficits. The milestone ages are not repeated in the text to allow a more fluid discussion of developmental themes within each domain. Milestones have been organized into domains to assist the clinician in recognizing their independence as well as their interrelationships. Tables illustrating all domains at each age can be found in Vaughan (see Suggested Reading). Problem-solving and language milestones facilitate early identification of cognitive deficits. Adaptive skills (ie, skills related to independence in feeding, dressing, toileting) traditionally have been included within the fine motor domain. However, because these milestones are influenced by the social environment, we have included them in a "psychosocial domain." Lists for emotional and socialization milestones also are included in this domain. In contrast to motor and cognitive milestones, psychosocial behaviors are influenced more by extrinsic factors, making them less well-defined.

Evolution of Developmental Theory

Developmental theory has been shaped by the persistent debate of whether nature (intrinsic forces) or nurture (extrinsic forces) is the predominant influence. At the turn of the century, developmental theories promoted nature as the major influence. Gesell (early 1900s) was one of the first to study infant development systematically and establish developmental norms. Development was seen as a function of neurologic maturation and growth. Because advancing age and genetic endowment were the chief mechanisms for change, babies were believed to develop at a predetermined biological pace, with parents needing to do little more than provide a good nurturing environment.

By mid-century, theories that stressed the importance of nurture began to prevail. Pavlov (1930s), Watson (1950s), and Skinner (1960s) promoted the opposing view that development was a function of learning. Operant conditioning (positive and negative reinforcements through social interactions or environmental changes) promoted learning and shaped the child's development. This line of thinking formed the philosophical basis for the Head Start program of the 1960s. Freud (1920s) and Erikson (1950s) promoted developmental progress as a function of the resolution of conflict. The quality of the infant's relationships with key individuals was considered central to future development.

During the second half of the century, the name of Piaget became almost synonymous with child development. Piaget was the first to describe the infant as having intelligence. For centuries, it had been assumed that the infant's mind was a "blank tablet waiting to be written on." Because infants could not tell us what they were experiencing, it was believed that they saw and heard little and thought even less, with consciousness as adults knew it not existing. Piaget revealed that infants were, indeed, capable of thinking, analyzing, and assimilating. He viewed development as stage-like cognitive changes. The child actively explores objects in an effort to understand his or her environment. Depending on the developmental stage, a child organizes this information to form new theories about the way the world works.

It was not until the last part of this century that emotional and social development began to receive the same degree of attention as that given to the motor and cognitive domains. Research has revolved around theories regarding infant expression of emotion (Mandler, 1970s), attachment (Bowlby, 1960s; Mahler, 1970s; and Ainsworth, 1980s), and temperament (Thomas and Chess, 1970s). Once it was recognized that newborns could demonstrate distress (pain and hunger), interest, and disgust, these facial expressions have been used to study information processing in infancy prior to the age when thoughts can be verbalized. As the 20th century comes to a close, remarkable advances in behavioral genetics, together with recent discoveries regarding innate infant abilities, have swung the pendulum back in favor of nature as the primary influence on the developmental process.

Developmental Snapshots: The First Two Years of Life

Before dissecting infant development into discrete steps within each developmental domain, it is valuable to view the infant at discrete intervals. These 6-month "snapshots" are displayed graphically in Figure 1. This gestalt approach may help the clinician make sense of the interrelatedness of the precise changes within each developmental domain.

One principle of development in infancy is that it proceeds from head-to-toe — thus, arm movement comes before leg movement.

These four snapshots illustrate several generalizations about neuro-developmental maturation over time:

1. Responses to stimuli proceed from generalized reflexes involving the entire body, as seen in the newborn (and fetus), to discrete voluntary actions that are under cortical direction. This specialization allows the child to move from obligatory symmetric reactions when attending to a stimulus (ie, vocalizations, arm waving, and kicking) to voluntary, asymmetric, and precise movements toward a stimulus (ie, grasping with one hand and inspecting with the other).
2. Development proceeds from cephalic to caudal and proximal to distal. Thus, arm movement comes under cortical direction and visual guidance before leg movement. With this, the child progresses from hand-mouth to foot-mouth play. The upper extremities become increasingly accurate in reaching, grasping, transferring, and manipulating. Distal development is seen when the infant can isolate and use the

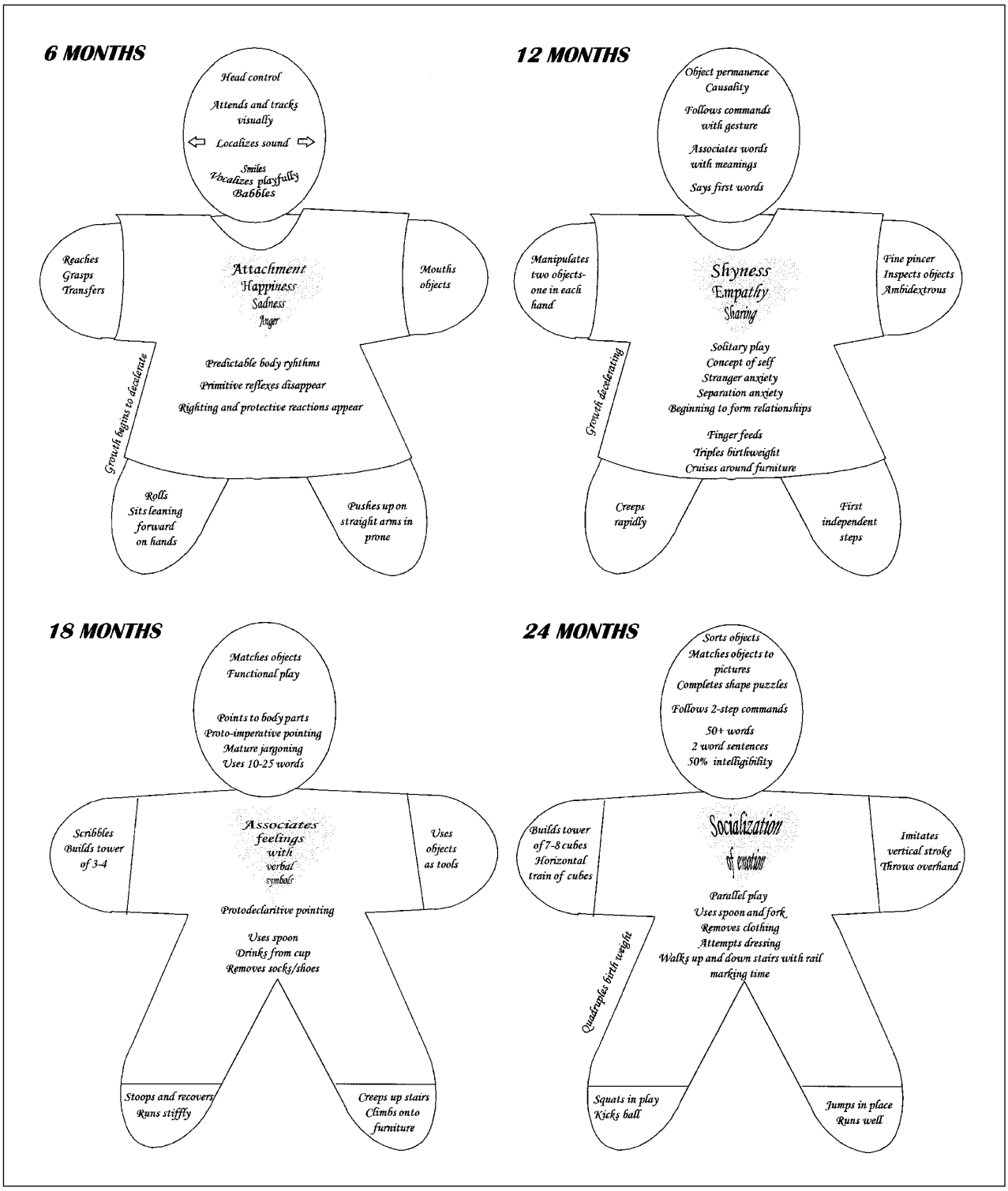


FIGURE 1. Developmental "snapshots" at 6, 12, 18, and 24 months.

index finger to poke and explore object parts. When this occurs in concert with thumb opposition, the fine pincer grasp is mastered. Precise release of tiny objects follows, so that fundamental manipulative skills reach adult levels by the end of infancy.

3. Developmental progression is from dependence to independence. The totally dependent newborn progresses to a toddler who has mobility and manipulative skills that enable him or her to explore most of the environment. Toddlers can move about the house independently, opening doors, maneuvering stairs, and fetching desired objects. They can feed and undress themselves and even may be toilet trained. This new autonomy becomes the foundation for the challenging "twos."

TABLE 1. Average Physical Growth Parameters

AGE	OCCIPITOFRONTAL CIRCUMFERENCE	HEIGHT	WEIGHT	DENTITION
Birth	35.0 cm (13.8 in)	50.8 cm (20.0 in)	3.0 to 3.5 kg (6.6 to 7.7 lb)	Central incisors—6 mo Lateral incisors—8 mo
	+2 cm/mo (0 to 3 mo) +1 cm/mo (3 to 6 mo) +.5 cm/mo (6 to 12 mo) Mean = 1 cm/mo	+25.4 cm	Regains birthweight by 2 wk Doubles birthweight by 5 mo	
1 year	47.0 cm (18.5 in)	76.2 cm (30.0 in)	10.0 kg (22 lb)	First molars—14 mo Canines—19 mo
	+2 cm	+12.7 cm	Triples birthweight	
2 years	49.0 cm (19.3 in)	88.9 cm (35.0 in)	12.0 to 12.5 kg (26.4 to 27.5 lb)	Second molars—24 mo
			Quadruples birthweight	

Physical Growth

Growth milestones are the most predicable, although they must be viewed within the context of each child's specific genetic and ethnic influences. It is essential to plot the child's growth on gender- and age-appropriate charts. Charts now are available for some ethnic groups as well as for a few genetic syndromes (eg, Down and Turner syndromes). Fetal weight gain is greatest during the third trimester. During the first few months of life, this rapid growth continues, after which the growth rate decelerates (Table 1). Birthweight is regained by 2 weeks of age and doubles by 5 months. Height does not double until between 3 and 4 years of age. Head growth during the first 5 or 6 months is due to continued neuronal cell division. Later, increasing head size is due to neuronal cell growth and supporting tissue proliferation.

RED FLAGS IN PHYSICAL GROWTH

Occipitofrontal Circumference

Large and small head size both are relative red flags for developmental problems. Microcephaly is associated with an increased incidence of mental retardation, but there is no straightforward relationship between small head size and depressed intelligence. As a reflection of normal variation, microcephaly is not associated with structural pathology of the nervous system or with low intelligence. Furthermore, microcephaly can be seen with above-average cognitive capability. Microcephaly associated with genetic or acquired disorders reflects cerebral pathology and almost always has cognitive implications.

Macrocephaly may be due to hydrocephalus, which is associated with an increased incidence of cognitive deficits, especially learning disabilities. Macrocephaly without hydrocephalus, far from being a predictor of advanced intelligence, also is associated with a higher prevalence of cognitive deficits. It may be due to metabolic or anatomic abnormalities. In about 50% of cases, macrocephaly is familial, and the implications are benign in terms of intellect. When evaluating infants whose macrocephaly is isolated, the finding of a large head size in one or both parents can be reassuring.

Height and Weight

Although the majority of individuals who are of below- or above-average size are otherwise normal, there is an increased prevalence of developmental disabilities in these two subpopulations. Many genetic syndromes are associated with short stature; large stature syndromes are less common. Again, when considering deviation from the norm in the specific child, family characteristics must be reviewed. The concept of mid-parental height is useful in determining whether a given child's size is appropriate for his or her familial growth pattern.

Dysmorphism

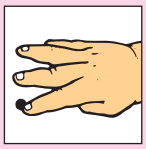
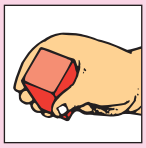
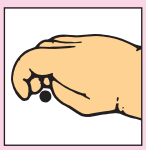
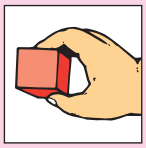
Although most isolated minor dysmorphic features are inconsequential, the presence of three or more may indicate the presence of developmental dysfunction. Almost 75% of these minor superficial dysmorphisms can be found by examining the face, skin, and hands. The presence of both minor and major abnormalities may indicate a more serious genetic syndrome. In many instances, dysmorphic features will lead to the diagnosis of a clinical syndrome during the neonatal period and predate the recognition of any neurodevelopmental deficits.

Motor Development

To make a meaningful statement about an infant's motor competence, the pediatrician should organize data gathered from the history, physical examination, and neurodevelopmental examination according to the following schema: 1) motor developmental milestones, 2) the classic neurologic examination, and 3) cerebral neuromotor maturational markers (primitive reflexes and postural reactions). Motor milestones are extracted from the developmental history as well as from observations during the neurodevelopmental examination. Reference tables of sequential gross and fine motor milestones are necessary (Table 2).

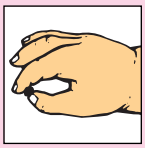
Results of assessment in any domain is summarized best as indicating a developmental age for the

TABLE 2. Motor Development

MOS.	GROSS MOTOR SKILLS	FINE MOTOR SKILLS		RED FLAGS
1	Head up in prone	Hands tightly fisted		
2	Chest up in prone position Head bobs erect if held sitting	Retains rattle (briefly) if placed in hand Hands unfisted half of time		Rolling prior to 3 months may indicate hypertonia
3	Partial head lag Rests on forearms in prone	Hands unfisted most of time Bats at objects Sustained voluntary grasp possible if object placed in ulnar side of hand		
4	Up on hands in prone Rolls front to back No head lag	Obtains/retains rattle Reaches/engages hands in supine Clutches at objects		
5	Rolls back to front Lifts head when pulled to sit Sits with pelvic support Anterior protection	Transfers objects hand-mouth-hand Palmar grasp of dowel, thumb adducted		Poor head control
6	Sits-props on hands	Transfers objects hand-hand Immature rake of pellet		
7	Sits without support Supports weight and bounces while standing Commando crawls Feet to mouth Lateral protection	Radial-palmar grasp of cube Pulls round peg out Inferior scissors grasp of pellet; rakes object into palm	 	W-sitting and bunny hopping, may indicate adductor spasticity or hypotonia
8	Gets into sitting position Reaches with one hand while 4-point kneeling	Scissors grasp of pellet held between thumb and side of curled index finger Takes second block; holds 1 block in each hand		
9	Pulls to stand Creeps on hands and knees	Radial-digital grasp of cube held with thumb and finger tips Inferior pincer grasp of pellet held between ventral surfaces of thumb and index finger	 	Persistence of primitive reflexes may indicate neuromotor disorder

continued

TABLE 2. Motor Development (continued)

MOS.	GROSS MOTOR SKILLS	FINE MOTOR SKILLS		RED FLAGS
10	Cruises around furniture Walks with 2 hands held	Isolates index finger and pokes Clumsy release of cube into box; hand rests on edge		
		Pincer grasp, held between distal pads of thumb and index finger		
11	Stands alone Walks with 1 hand held			
12	Independent steps Posterior protection	Fine pincer grasp of pellet between finger tips Marks with crayon Attempts tower of 2 cubes Precise release of cube Attempts release of pellet into bottle		Failure to develop protective reactions may indicate neuromotor disorder
14	Walks well independently	Tower of 2 cubes Attains third cube		
16	Creeps up stairs Runs stiff-legged Climbs on furniture Walks backwards Stoops and recovers	Precise release of pellet into small container Tower of 3 cubes		
		Imitates scribble		
18	Push/pulls large object Throws ball while standing Seats self in small chair	Tower of 4 cubes Crudely imitates single stroke Scribbles spontaneously		Hand dominance prior to 18 months may indicate contralateral weakness
20	Walks up stairs with hand held	Completes square pegboard		
22	Walks up stairs with rail, marking time Squats in play	Tower of 6 cubes		
24	Jumps in place Kicks ball Walks down stairs with rail, marking time Throws overhand	Train of cubes without stack Imitates vertical stroke		Inability to walk up and down stairs may be the result of lack of opportunity

Illustrations and accompanying text modified with permission from the Erhardt Developmental Prehension Assessment. In Erhardt RP.* Developmental Hand Dysfunction: Theory Assessment, Treatment. 2nd ed. *San Antonio, Tex: Therapy Skill Builders; 1994.

child. This approach makes it possible to consider the child in terms of his or her level of functioning compared against chronologic age. For example, the developmental quotient (DQ) is the developmental age divided by chronologic age times 100 (see Example below). This provides a simple expression of deviation from the norm. A quotient above 85 in any domain is considered within normal limits; a quotient below 70 is considered abnormal. A quotient between 70 and 85 represents a gray area that warrants close follow-up. Values in the upper limit of normal do not particularly indicate supernormal abilities. Whether truly gifted athletes can be recognized early by use of this method is thought-provoking but speculative.

GROSS MOTOR DEVELOPMENT

Gross motor development proceeds from a sequence of prone milestones (beginning with head up and ending with rolling), to sitting, and then through a standing/ambulating sequence (Fig. 2). Motor milestones do not take into account the *quality* of a child's movement. These sequences must be considered in the context of the motor portion of the neurologic examination, including observations of station and gait, where qualitative features can be assessed. However, the neurologic evaluation of tone, strength, deep tendon reflexes, and coordination is difficult in very young infants because of the subjective nature of the assessments and the infant's limited ability to cooperate. Clinical experience is essential for obtaining accurate and useful information.

Eliciting reflexes requires patience and repeated, yet gentle, trial and error. Muscle tone (passive resistance) and strength (active resistance) are a challenge to distinguish in the contrary infant. The best clues can be obtained from *observation*, not handling. Spontaneous or prompted motor activities (eg, weight-bearing in sitting or standing) require adequate strength. Thus, weakness may be appreciated best from observing the quality of stationary posture and transition movements. The Gower sign (arising from sitting on the floor to standing, using the hands to "walk up" one's legs) is a classic example and indicative of pelvic girdle and quadriceps muscular weakness. Not until 2 to 3 years of age does the neurologic examination become easier and more meaningful as cooperation improves.

Station refers to the posture assumed in sitting or standing and should be viewed from anterior, lateral, and posterior perspectives, looking for body alignment. Gait refers to walking and is examined in progress. Initially, the toddler walks on a wide base, slightly crouched, with the arms abducted and slightly elevated. Forward progression is more staccato than smooth. Movements gradually become more fluid, the base narrows, and arm swing evolves, leading to an adult pattern of walking by 3 years of age.

The motor neuromaturational markers are the primitive reflexes, which develop during gestation and generally disappear between the third and sixth month after birth, and the postural reactions, which are not present at birth but develop sequentially between 3 and 10 months of age (Fig. 3). The Moro, tonic labyrinthine, asymmetric tonic neck, and positive support reflexes are the most useful clinically (Fig. 4). As with all true reflexes, each requires a specific sensory stimulus to generate the stereotyped motor response. Normal infants demonstrate these postures

Example: Motor Quotient

A 12-month-old boy is seen for health supervision. He is not walking alone, but he pulls up to stand (9 months), cruises around furniture (10 months), and walks fairly well when his mother holds both hands (10 months). This child has a gross motor age of 10 months at a chronologic age of 12 months. Should this 2-month discrepancy be a concern? To decide, one should calculate the DQ by using these gross motor milestones:

$$DQ = \frac{\text{motor age}}{\text{chronologic age}} \times 100 = \frac{10 \text{ months}}{12 \text{ months}} = 83$$

The motor age and the developmental quotient are good summary descriptors of the child and have more meaning than plotting each milestone. Because the lower limit is 70, this boy's DQ falls within the "suspect" or gray zone. In reality, infants falling into the gray zone of motor domains usually do quite well and rarely require referral to an early intervention program. This is in contrast to those falling in the gray zones of the cognitive domains.

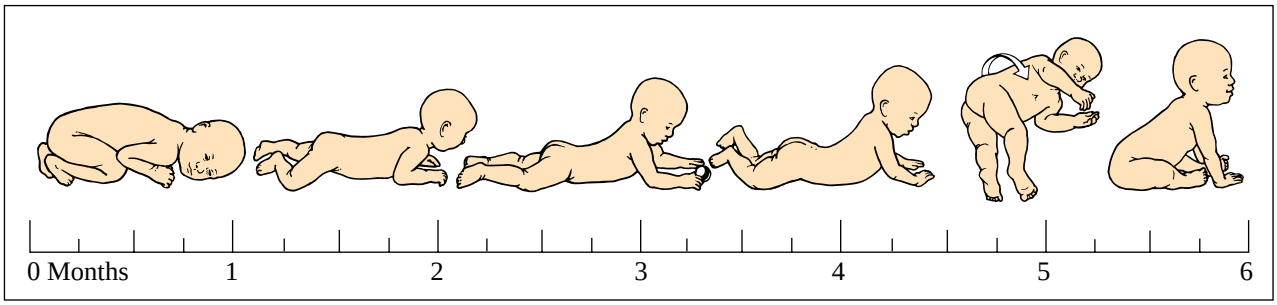


FIGURE 2. Chronologic progression of gross motor development. Adapted with permission from Piper MC, Darrah J. Motor Assessment of the Developing Infant. *Philadelphia, Penn: WB Saunders Co; 1994. Illustrations by Marcia Smith.*

inconsistently and transiently; those who have central neurologic (ie, cerebral) injuries show stronger and more sustained primitive reflex posturing. Primitive reflexes are somewhat difficult to gauge, even in expert hands. The appearance of postural reactions in sequence beginning after 2 or 3 months of age is easier to elicit clinically and can provide great insight into the neuromotor integrity of young infants. Postural reactions are sought in each of the three major categories: righting, protection, and equilibrium. These movements are much less stereotyped than the primitive reflexes, and they require a complex interplay of cerebral and cerebellar cortical adjustments to a barrage of sensory inputs (proprioceptive, visual, vestibular) (Figs. 5 and 6). They are easy to elicit in the normal infant but are markedly slow in appearance in the infant who has central nervous system damage.

FINE MOTOR DEVELOPMENT

In the first year of life, fine motor development is highlighted by the evolution of a pincer grasp. During the second year of life, the infant learns to use objects as tools during functional play. There are many stages in accomplishing these two skills; selected ones are illustrated in Table 2. In the early months, the upper extremities assist with balance and mobility. As balance in the sitting position improves and the infant assumes biped mobility, the hands become more available for manipulation of objects—their ultimate function. Primitive reflexes are integrated, and the upper extremities come under cortical control. Reaching becomes more accurate, and objects are brought to the mouth for oral exploration. As development progresses from proximal to distal, reaching and manipulative skills are enhanced further, and precise manual exploration replaces oral exploration. During the second year, fine motor skills are assessed by observing the manner in which the hands use objects as tools (eg, blocks to build and crayons to draw). The close association between gross and fine motor skills in the first year of life evolves into a similar relationship between problem-solving and fine motor skills during the second year. One skill enables or promotes the development of the other. If progress in manual dexterity is slow, this may impede cognitive development via manipulation of objects.

RED FLAGS IN MOTOR DEVELOPMENT

It is important to begin the motor evaluation by observing the infant. Pay particular attention to the hands; persistent fisting at 3 months of age often is the earliest indication of neuromotor dysfunction. Spontaneous postures (eg, froglegs and scissoring) provide visual clues to hypotonia/weakness and spastic hypertonus, respectively. Delays in the appearance of postural reactions herald future delays in voluntary motor development. An infant will be unable to sit or walk independently without intact protective and equilibrium mechanisms. Abnormal movement patterns may indicate pathology. For example, early rolling (1 to 2 months), pulling directly to a stand at 4 months (instead of to a sit), W-sitting, bunny hopping, and persistent toe walking may indicate spasticity. Hand dominance prior to 18 months of age should prompt the clinician to examine the contralateral upper extremity for weakness associated with a hemiparesis.

Analysis of the information gathered in these areas makes it relatively easy for the practitioner to reassure him- or herself (and the parents) about a child's motor competence or to identify motor impairment at an early age. Once a motor abnormality has been identified, further assessment of its exact nature and etiology is essential. This almost always warrants referral to an appropriate subspecialist or subspecialty team. Based on clinical examination and history, the astute clinician usually can decide into which category the motor disorder falls: 1) static central nervous system disorders, 2) progressive diseases, 3) spinal cord and peripheral nerve injuries, or 4) structural defects.

Cognitive Development

Cognitive processing skills are the substrate for intelligence and include a wide range of abilities (Table 3). Intellectual development depends on learning that contains three components: attention, information processing, and memory (which includes both encoding and retrieval of information). Intellectual development is reflected in advancing abilities to comprehend, reason, and make judgments. Standardized intelligence tests generally measure two forms of intelligence in the school-age child: verbal and performance (or nonverbal). Such standardized

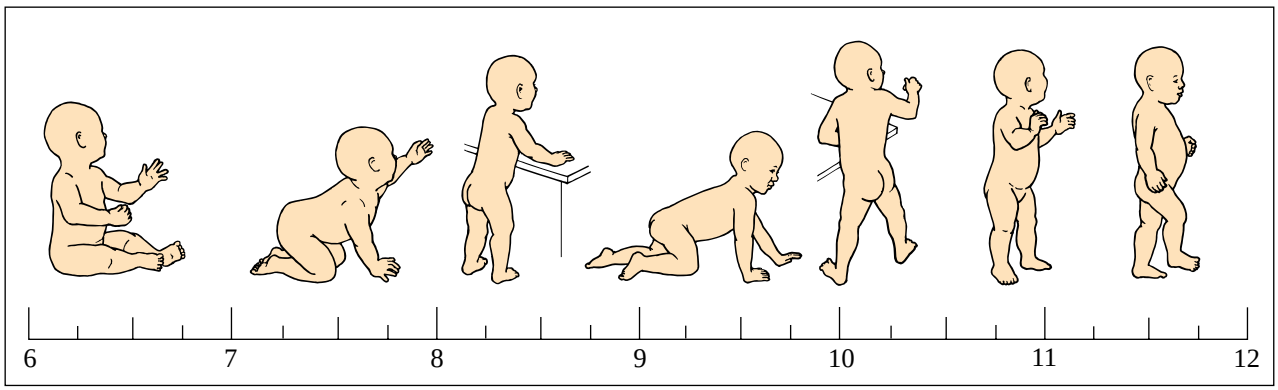


FIGURE 2. Continued

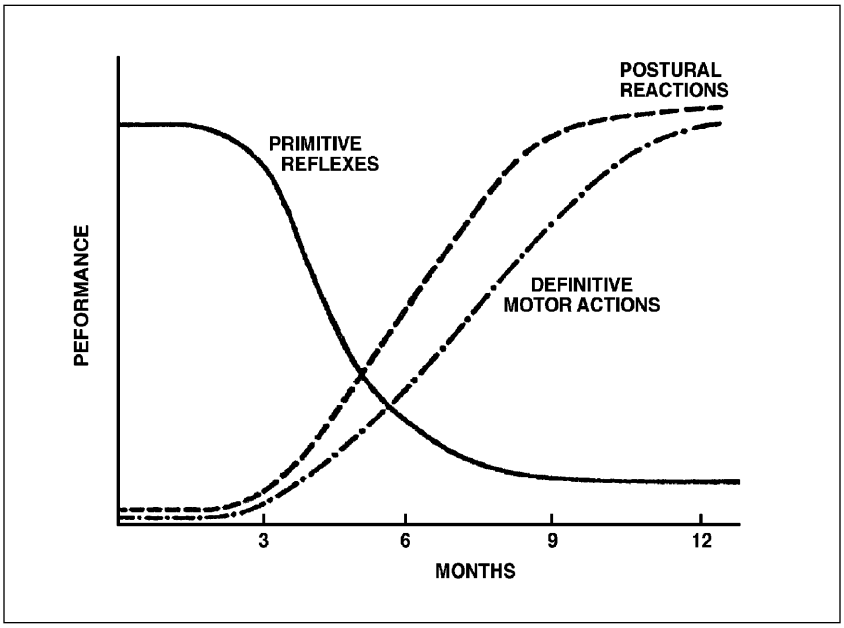


FIGURE 3. The declining intensity of primitive reflexes and the increasing role of postural reactions represent at least permissive, and possibly necessary, conditions for the development of definitive motor actions. From Capute AJ, Accardo PJ, Vining EPG, Rubenstein JE, Harryman S. Primitive Reflex Profile. *Baltimore, Md: University Park Press; 1978. Reprinted with permission.*

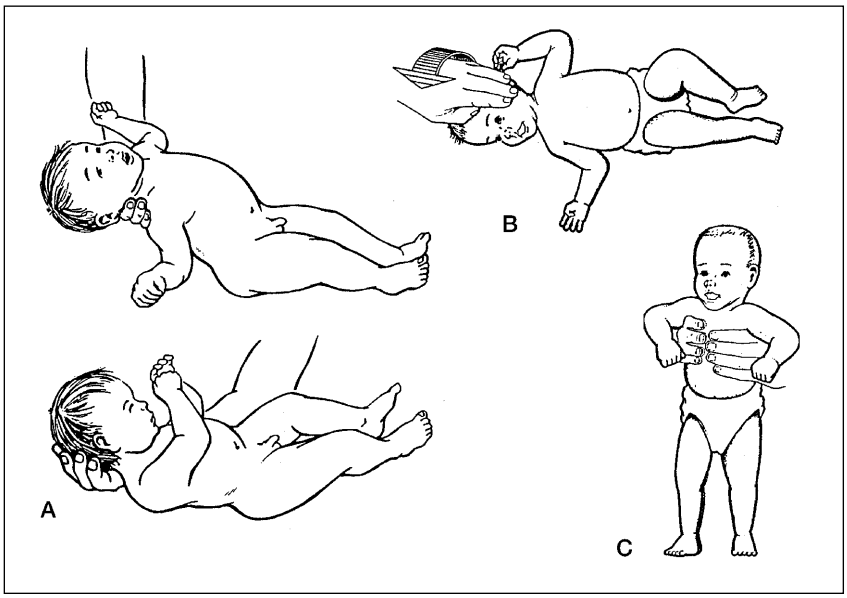


FIGURE 4. Clinically useful reflexes. A. Tonic labyrinthine reflex. In the supine position, the baby's head is extended gently to about 45 degrees below horizontal. This produces relative shoulder retraction and leg extension, resulting in the "surrender posture." With head flexion to about +45 degrees, the arms come forward (shoulder protraction) and the legs flex. B. Asymmetric tonic neck reflex (ATNR). The sensory limb of the ATNR involves proprioceptors in the cervical vertebrae. With active or passive head rotation, the baby extends the arm and leg on the face side and flexes the extremities on the occiput side (the "fencer posture"). There also is some mild paraspinous muscle contraction on the occiput side that produces subtle trunk curvature. C. Positive support reflex. With support around the trunk, the infant is suspended and then lowered to pat the feet gently on a flat surface. This stimulus produces reflex extension at the hips, knees, and ankles so the infant stands up, completely or partially bearing weight. Children may go up on their toes initially but should come down onto flat feet within 20 to 30 seconds before sagging back down toward a sitting position. From Blasco PA. Pediatric Rounds. *1992;1(2):1–6. Reprinted with permission.*

tests are not available to measure infant intelligence. How then, does one recognize the attributes of verbal and nonverbal intelligence in infants? In the past two decades, the discovery of visual habituation techniques to assess infants' attention was considered a breakthrough in the study of infant cognition. It is exemplified by one study that describes 4-day-old infants listening to a long series of "bee-see-lee" sounds. When a novel "da" sound was heard, the infants responded with a change in heart rate and faster, stronger sucking on a pacifier, thereby indicating that very young infants can perceive differences in vowel sounds.

More complex studies using simultaneous auditory and visual stimuli indicate that infants also are capable of organizing perceptions across sensory modalities (cross-modal matching) without the language skills to describe them. For example, 11-month-old infants were presented a sequence of continuous and interrupted pure tones. Two pictures were in the infants' view throughout the experiment: one contained a continuous line, the other a dashed line. The infants consistently matched the correct visual stimulus to the auditory one, inferring cross-modal matching and some rudimentary understanding of the concept of interruptedness. Using these techniques, it has been demonstrated that infants younger than 1 year old can form a wide range of fairly complex categorical representations, including those for faces, color, geometric shapes, and orientation of lines.

The attempts to measure infant responses precisely, such as those described previously, depend on sophisticated technology, including infra-red photography for tracking infant eye gaze and pupillary dilatation, videotaping of facial reactions, and electrophysiologic monitoring of heart rate and evoked potentials. The primary pediatrician can best estimate infant intelligence by evaluating problem-solving and language milestones. Language is the single best indicator of intellectual potential; problem-solving skills are the next best measure. Gross motor skills correlate least with cognitive

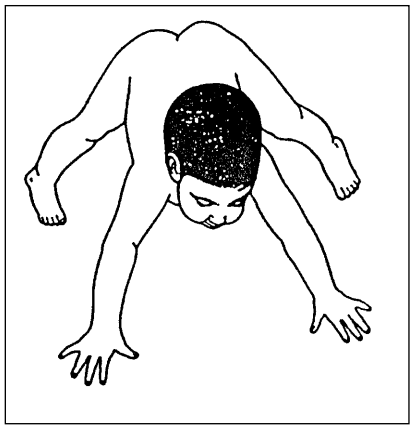


FIGURE 5. Normal parachute reaction. The examiner has suspended the child horizontally by the waist and lowered him face down toward a flat surface. The arms extend in front, slightly abducted at the shoulders, and the fingers spread as if to break a fall. From Blasco PA. Pediatric Rounds. *1992;1(2):1–6. Reprinted with permission.*

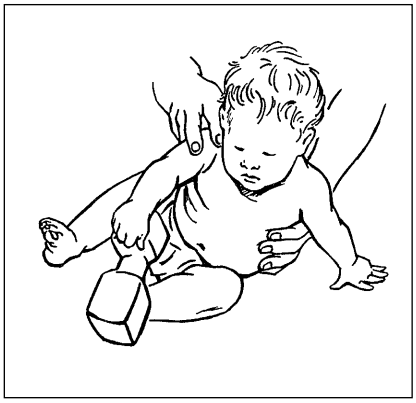


FIGURE 6. The infant is seated comfortably, supported about the waist if necessary. The examiner gently tilts the child to one side, noting righting of the head back toward the midline, protective extension of the arm toward the side, and equilibrium countermovements of the arm and leg on the opposite side. From Blasco PA. Pediatric Rounds. *1992;1(2): 1–6. Reprinted with permission.*

potential; most infants who are diagnosed later with mental retardation walk on time.

PROBLEM-SOLVING

Problem-solving skills consist of manipulating objects to solve a problem (eg, choosing the correct opening for a circular shape in a three-piece form board). The infant's ability to solve a problem depends on intact vision, fine motor coordination, and cognitive processing. During the early weeks of life, the infant explores the environment visually. Later, these visual experiences reinforce movement. As the upper extremities come under visual guidance, reaching and grasping are enhanced. At first, the infant brings objects to the mouth for oral exploration. Later, the infant visually examines an object held in one hand while manipulating it with the other. Isolation of the index finger promotes more refined manipulation of the various parts of objects, and the infant becomes successful in discovering how they work (eg, fingering the clapper of the bell). Mouthing of objects becomes less appealing. This precise manual-visual manipulation, triggered by a heightened curiosity and facilitated by a longer attention span, heralds true "inspection" of objects. The infant is progressing from "learning to manipulate" to "manipulating to learn." Improved macular vision (via myelination of the fovea) and refinement of the pincer grasp promote inspection of progressively smaller objects. As cognitive abilities continue to advance, the infant learns to shift attention between two objects (one in each hand), compare, make choices, and discard or combine objects. This sensory-motor phase of learning is the foundation for ongoing nonverbal intellectual development.

The 1-year-old child recognizes objects and associates them with their functions. Thus, he or she begins to use them functionally as "tools" instead of mouthing, banging, and throwing them. This child has left the period of sensory-motor play and entered the stage of functional play. Play serves as a window into the infant's thoughts and becomes particularly important during the next stage of symbolic play. At this point, the infant uses toys that represent real objects in actions toward him- or herself (putting a toy telephone to the ear and vocalizing) and later in actions toward dolls or teddy bears (putting a toy tea cup to the doll's mouth). The use of symbols lays the foundation for imaginary play. This next stage of play usually does not appear until 24 to 30 months of age.

The interdependence of language and problem-solving development becomes stronger as the child begins to label objects and actions. Midway through the second year, this ability to label and categorize allows the child to match objects that are the same (car to a car and spoon to a spoon) and later to match an object to its picture. Nonverbal intelligence is assessed by observing the infant interact with test objects. In the older child, it is assessed through standardized pencil and paper tasks or computerized tests.

One aspect of nonverbal cognitive development deserves extra attention: object permanence, a concept studied extensively by Piaget. Prior to the infant's mastery of object permanence, a person or object that moves "out of sight" is "out of mind"; its disappearance does not evoke a reaction. The ability to maintain an image of a person develops before that of an object. The child will show interest in peek-a-boo play, and separation anxiety will occur when a loved one leaves the room. Shortly thereafter, the child will begin to look for an object that has been dropped. At first, an auditory cue when it hits the floor is necessary to locate it. Later, the child will experience success in finding an object that was dropped from sight and landed silently. Next, the child will progress to finding an object that has been hidden under a cloth or cup. A more complex task is locating an object that has been wrapped inside a cloth. Success requires persistence and memory of the object long enough to complete the three-part unwrapping process. The next skill in this sequence is the ability to locate an object under double layers (eg, a cube is placed under a cup and then the cup is covered with a cloth). This is followed by the ability to locate an object after serial displacements. In this task, an object is hidden under one cover and then changed to another one. The younger infant always will look for it under the first cover, even though the position change was seen. Later, he or she will become successful with this task, as long as each successive displacement still is witnessed. Not until the end of the second year is the child able to

TABLE 3. Cognitive Development

AGE IN MONTHS	PROBLEM-SOLVING	LANGUAGE		RED FLAGS
		RECEPTIVE	EXPRESSIVE	
1	Fixes on red ring Follows face	Alerts to sound	Throaty noises Cries	Failure to alert to environmental stimuli may indicate sensory impairment
2	Tracks horizontally past midline Tracks vertically	Regards speaker	Social smile Coos Vocalizes single vowel sounds	
3	Regards a 1-inch block Follows ring circularly Visual threat		Chuckles Echoes speaker immediately Cry varies (hunger, pain)	
4	Reaches for objects Mouths objects Shakes rattle Regards objects while handling	Orients to voice	Laughs out loud “Ah-goo” Silent and listens to speaker; vocalizes when speaker stops	
5	Attains dangling ring Regards pellet	Orients Bell—I	Razzes (raspberries) Smiles and vocalizes to mirror Sing-song vocalizations that mimic speaker’s voice	Failure to reach for objects may indicate motor, visual, and/or cognitive deficit
6	Looks to floor when drops toy Attains partially hidden object Removes cloth covering face Discriminates strangers		Babbles: “baba,” “gagaga” Consonant production without symbolic meaning or communicative intent	Absent babbling may indicate hearing deficit
7	Bangs/shakes toys Attempts to grasp second cube; drops first Pats mirror image	Orients Bell—II	Adult reinforcement begins to give meaning to random babbling	Absent stranger anxiety may be due to multiple care providers (eg, neonatal intensive care unit)
8	Pulls string to obtain ring Inspects ring/bell Seeks yarn ball after fall; silent landing	Enjoys peek-a-boo and other gesture games	“Dada” inappropriately Mimics sounds already in repertoire	
9	Rings bell Bangs objects on table Uncovers hidden object under cloth	Associates words with meanings	“Mama” inappropriately Waves “bye bye”	
10	Bangs two cubes together Isolates index finger and explores by poking Looks at pictures in book	Comprehends “no” Orients to name Orients Bell—III	Dada/Mama appropriately	Inability to localize sound may indicate unilateral hearing loss

11	Uncovers toy under cup	Looks for familiar family member when named	First word Imitates simple sounds	
12	Looks selectively at round hole on form board Removes lid to find toy	Follows command with gesture (“Give me.”)	Immature jargoning Protoimpertive pointing (goal = desired object)	Persistent mouthing may indicate lack of intellectual curiosity
13	Solves glass frustration task Unwraps toy in cloth Functional play	Looks appropriately when asked “Where is (familiar object)?”	2 to 3 words “Oh-oh”	Normal receptive language up to this point is compatible with hearing loss
14	Combines two cubes into one hand to take third Dumps pellet after demonstration	Follows command without gesture	Names one object Says “no” meaningfully Protodeclarative pointing (goal = adult’s attention)	
15	Places circle in form board Symbolic play toward self	Points to a body part or favorite toy	3 to 5 words Mature jargoning	Lack of consonant production may indicate mild hearing loss
16	Pellet in and out without demonstration Finds toy hidden under layered covers Follows observed sequential displacements	Fetches object from another room on request Points to 1 to 2 body parts	5 to 10 words	Lack of imitation may indicate deficits in hearing, cognition, and/or socialization
18	Matches pairs of objects Round form in reversed board after searching Symbolic play directed at doll	Points to 3 body parts Points to self	10 to 25 words Giant-words (“Thank you,” “Stop it,” “Let’s go”) Names one picture on command	Lack of protodeclarative may indicate problem in social relatedness
20	Places square in form board Deduces location of hidden object (unwitnessed displacement)	Points to several clothing items on request Selects 2 of 3 familiar objects Points to 6 body parts	2 word combinations (noun-noun) Holophrases	
22	Completes 3-piece form board	Points to 3 to 4 pictures	25 to 50 words Rapid vocabulary expansion	Advanced, noncommunicative speech (echolalia, rote phrases) may indicate autism
24	Adapts to form board reversal after 4 trials Sorts objects Matches objects to pictures Attempts to fold paper	Two-step commands (“Close the book and give the doll to mommy”) Comprehends “another” Points to 6 pictures Understands me/you	50+ words 2 to 3 word sentences (noun-verb) Refers to self by name Intelligibility = 50% + Uses “I,” “you,” “me”	Absent symbolic play may indicate problems in cognitive and/or social development

deduce the location of an object that is hidden without observing the displacement.

Another important concept dominating this period of development is causality. Initially, the infant accidentally discovers that his or her actions produce a certain effect (eg, kicking the side of the crib activates a mobile overhead). The infant learns to repeat these actions to obtain the same effects. Later, he or she will vary actions to cause a novel effect (pulling a string to obtain the ring). The concept of causality parallels social development in which the infant learns to manipulate the environment by crying or smiling to obtain the desired reaction from caregivers. As the infant approaches 2 years of age, he or she will learn that apparent unrelated actions can be combined to produce an effect (eg, winding a key to make a toy move).

LANGUAGE DEVELOPMENT

Delays in language development are more common than delays in other developmental domains. Parents and pediatricians generally are less familiar with language milestones. Language is the most difficult domain to assess by observation because infants rarely vocalize spontaneously in the clinician's office. For this reason, it is essential for the clinician to obtain a thorough and accurate language history. The pediatrician should become familiar with milestone terminology and learn to give examples (eg, "razzing"). Between 10 and 18 months of age, word counts help in assessing a child's expressive skills; after 18 months of age, vocabularies increase exponentially, and it is difficult to keep up with counts.

Language includes receptive and expressive skills. Receptive skills reflect the ability to understand language; expressive skills reflect the ability to make thoughts, ideas, and desires known to others. Expression of language can take several forms: speech, gestures, sign language, writing, typing, and "body language." Thus, language and speech are not synonymous. Speech is simply the vocal expression of language. A child can have normal language and yet be unable to speak. Examples include children who are deaf and children who have severe cerebral palsy. The child who has a hearing impairment may use manual sign language to communicate. A child who has normal intelligence but cannot speak because of oral-motor dysfunction related to cerebral palsy may use a computer that is activated with a head stick. Conversely, a few children talk but fail to use speech to communicate (eg, children who have autism). Their vocalizations consist of "parrot talk" or echolalia that has no communicative intent and, thus, does not represent language.

Language development during infancy can be divided into three periods: prespeech, naming, and word combination periods.

1. Prespeech Period (0 to 10 months): Receptive language is characterized by an increasing ability to localize sounds. Sound localization is assessed by using a noisemaker such as a bell (Fig. 7). Expressive language consists of musical-like vowel sounds (cooing) that are interrupted by crying when the baby has a need. At about 3 months, the infant will begin vocalizing immediately upon hearing an adult speak. One or two months later the infant is silent and assumes a posture that implies he or she truly is "listening" to the speaker. These infants make no vocalizations until the speaker is quiet, mimic the speaker, and then quiet again when the adult speaks. They appear to enjoy the "vocal tennis" and repeat this for several cycles. At approximately 6 months of age, the infant adds consonants to the vowel sounds in a repetitive fashion (babbling). Soon the infant appears to initiate conversations. When a random vocalization (eg, "dada") is interpreted by the parents as a real word, they show pleasure and joy. In so doing, adults give meaning to these first "words" and reinforce their repeated use.
2. Naming Period (10 to 18 months): This period is characterized by the infant's realization that people have names and objects have labels. It is an important turning point in language development. The "dada" and "mama" that

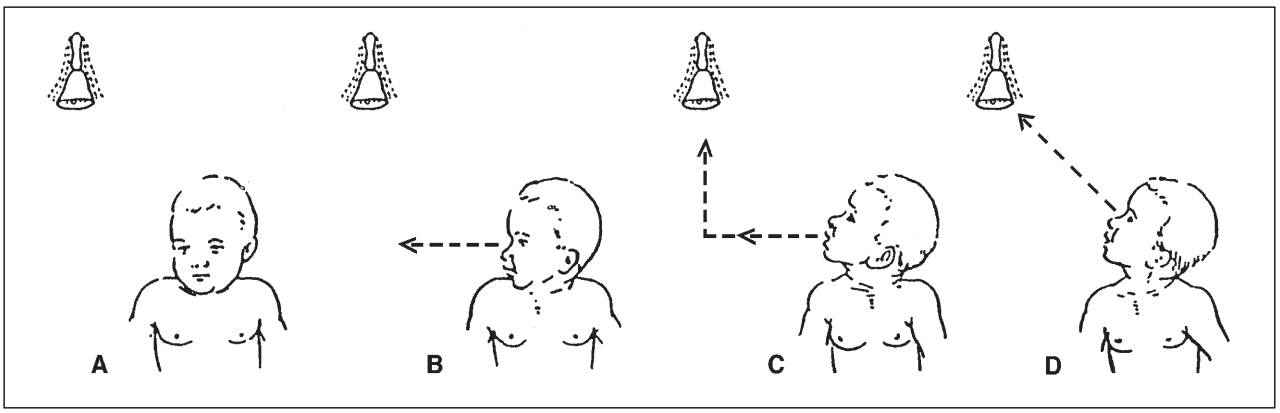


FIGURE 7. Orienting to sound of bell. In the first stage (5 months), when a bell is rung at one side of the infant's head (A), the infant turns horizontally to the correct side (B). In the second stage (7 months), when a bell is rung at one side of the head (A), the infant localizes the sound by a compound visual maneuver consisting of a horizontal followed by a vertical component (C). In the third stage (9½ months), when a bell is rung to one side of the head (A), the infant localizes the sound by a single visual movement (D). From Capute AJ, Accardo PJ. Clin Pediatr. *1978;17:850. Reprinted with permission.*

were vocalized randomly have been reinforced, so the infant now begins to use them appropriately. Infants next recognize and understand their own names and the meaning of "no." This marks the beginning of exponential growth in receptive language. By 12 months of age, some infants understand as many as 100 words. They also can follow a simple command as long as the speaker uses a gesture. Early in the second year, a gesture no longer is needed to aid in comprehension of the command. Expressive language progresses at a somewhat slower rate. The infant will say at least one "real" word (ie, other than mama, dada, or a proper name) before his or her first birthday. At this time, the infant also will begin to verbalize with sentence-like intonation and rhythm (immature jargoning). As the expressive vocabulary increases, real words are added (mature jargoning). By the end of the naming period, the infant will use approximately 25 words spontaneously.

During this period, pointing becomes important to both receptive and expressive language skills. Pointing already has become a method of exploration within the problem-solving domain. The infant beginning to look in the general vicinity where the adult is pointing is a receptive language skill. This ability is facilitated by the infant's new realization that objects have labels. Later, the infant begins to take part in pointing games. He or she will point first to family members, then objects, body parts, articles of clothing, and pictures upon request. These all reflect receptive language skills.

Pointing also is used for language expression. First, the infant points at an object and uses the adult as a tool to retrieve the object, referred to by linguists as protoimperative pointing. The infant first points to the object (eg, a cookie) and then looks back and forth between the adult and the object expectantly. At a later stage, he or she directs attention to the adult and alternately points at the adult and the desired object while vocalizing (eg, "uh...uh"). Next, the infant uses the object as a tool to obtain the parent's attention (protodeclarative pointing). Protodeclarative pointing is a social act; the parent is an active and important partner in a shared world. Rather than acquisition of the object, the infant's goal becomes the parent's acknowledgment of the interesting object. For example, when an infant hears an airplane overhead, he or she points to it and vocalizes to get the parent to look at it. If the parent does not comply with these initial efforts, the infant may approach the parent and turn his or her face toward the plane in a more determined effort to obtain what is sometimes called "joint attention." Finally, the infant will point at an object and vocalize ("uh?") in an effort to obtain the proper label or name for that object from the listener. This is called "pointing for naming."

3. Word Combination Period (18 to 24 months): Typically, children begin to combine words approximately 6 to 8 months after they say their first word. If word combinations appear much earlier, they are likely "giant words." Giant words are two- or three-word combinations that the infant hears frequently, such as "Thank you," "Stop it," or "Let's go." When the infant says one of these, he or she really is treating the phrase as a polysyllabic single word. At this stage of development the infant does not use either word separately or in novel combinations with other words. "Holophrases" also are beginning to appear at this time. For example, an infant may point to a mother's keys and say "mommy" instead of saying "keys." In this context, the single word, "mommy," has a sentence-like meaning, such as "These keys belong to mommy." Single words take on multiple meanings and no longer simply label an object. The infant usually does not combine words into true phrases or sentences until he or she has acquired an expressive vocabulary of approximately 50 words. Early word combinations are "telegraphic" in that they do not contain function words (prepositions, pronouns, and articles). They do, however, convey the same meaning as the more mature sentence. For example, "Go out," in the context of the situation, conveys the same meaning as "I want to go outside." Telegraphic speech is the first stage in the child's ability to "grammaticize" speech, that is, to form sentences with proper morphology and syntax. At this point in development, a stranger should be able to understand at least 50% of the infant's speech (intelligibility). Language blossoms after 2 years of age.

Word combination begins approximately 6 to 8 months after an infant says his or her first words.

RED FLAGS IN COGNITIVE DEVELOPMENT

Language development provides the clinician with an estimate of verbal intelligence; skill development in the problem-solving domain provides an estimate of nonverbal intelligence. If deficiencies are global (ie, skills are delayed in both domains) and significant (ie, >2 standard deviations below the mean), there is a possibility of mental retardation. Mental retardation refers to significant subaverage general intellectual functioning as measured by standardized tests. By current definition, these deficits must be associated with significant deficits in adaptive functioning. About 3% of the population is mentally retarded. If the deficiencies are very mild (ie, in the low range of normal), the child is considered to be of borderline intelligence or a "slow learner."

When a discrepancy exists between problem-solving and lan-

guage abilities, with only language being deficient, one must consider the possibility of a hearing impairment or a communication disorder. If either language or problem-solving skills is deficient, the child is at high risk for manifesting a learning disability later. A learning disability refers to academic achievement that is substantially below what would be expected from a person's general intellectual potential. Approximately 5% to 7% of school-aged children have learning disabilities. A learning disability cannot be diagnosed formally until the child reaches school age and demonstrates an inability to keep up in one or more academic areas. Thus, a reading disability cannot be diagnosed until at least age 6 or 7 years when children normally are expected to read. A delay in language development is a "red flag" and should prompt careful monitoring and further evaluation if the child later demonstrates reading difficulties in school. The neurologic substrate for specific learning disabilities involves patchy dysfunction in cortical information processing that results in specific difficulties with academic tasks.

Unless the deficiencies are severe during infancy, a child rarely presents with a parental concern of "cognitive delay." Concerns usually present as speech delays, but such complaints are infrequent before 24 months of age. The average age at which mental retardation is diagnosed is 3 to 4 years. Usually, the more severe the degree of impairment, the earlier the diagnosis is made. Because the majority of children who are mentally retarded are in the mild category, most children are diagnosed well after infancy. Some are not diagnosed until they enter school. The child who is born with dysmorphic features and has a recognizable syndrome known to be associated with mental retardation will be diagnosed earlier regardless of the degree of impairment. Additionally, abnormal findings on magnetic resonance imaging (performed because of atypical head growth or because of a known cerebral insult) indicate that the child is at risk for intellectual deficits.

Although a cognitive deficit is the most common reason for language delay, all children who have delayed language development should receive audiologic testing to rule out hearing loss. The child who has a hearing loss will demonstrate normal expressive language skills through the babbling stage (6 months). He or she will begin to babble on time, but lack of auditory reinforcement for these vocalizations results in their disappearance and a general decline in verbal expression. Receptive language abilities continue to progress normally for a few more months. A 1-year-old who is deaf will follow a command with a gesture (relying solely on the gestural cue) and may seem to hear. This ability to use environmental cues can fool parents and professionals and is one of the chief reasons that the average age of diagnosis of a severe hearing loss is 2 years. Children who have a mild hearing loss will present even later with articulation errors, inability to localize sounds, or "attentional problems." An infant who is deaf will attempt to communicate by using gestures. If a child has delayed speech and fails to demonstrate a desire to communicate, a more pervasive problem, such as autism, should be considered. Although children who have autism may demonstrate protoimperative pointing (eg, pointing to obtain food or drink), they rarely point to the object for the purpose of having the adult join in the pleasure of admiring an interesting object (protodeclarative pointing) or point to obtain the name of an object. Prodeclarative pointing is a social action, and one of the cardinal features of autism is the lack of social relatedness. Another red flag is the finding that a child's expressive skills are advanced compared with his or her receptive skills. A child who speaks in five-word sentences but does not understand simple commands is at risk of having a pervasive developmental disorder. The advanced speech may not be functional or have communicative intent. Finally, some parents will excuse their child's lack of speech because of an "Uncle Albert" who didn't speak until he was 4 years old but grew up to be a rocket scientist. In reality, this is very rare. Normal receptive language skills in a child who has speech delay would be reassuring and typically are easy to demonstrate.

. . . all children whose language development is delayed should receive audiologic testing.

Other problems may masquerade as cognitive delay or impair the assessment of cognitive abilities. Problem-solving tasks require intact fine motor skills. Having poor fine motor skills puts the child at a disadvantage with certain manipulative tasks used to assess nonverbal cognition. Due to cerebral palsy, a child may not be able to place a square form in a form board; however, he or she might be able to indicate the correct position by pointing or by eye gaze. Thus, the child actually could "pass" the form board item in the problem-solving assessment. Similarly, visual impairment can interfere with a child's ability to perform many problem-solving tasks successfully.

Psychosocial Development

Emotional, social, and adaptive milestones have been assimilated from multiple sources (Table 4). These milestones are more variable than those in motor and cognitive domains because of the greater influence of environmental factors (nurture). An infant inherits a set of emotional-social characteristics and a style of interacting, but these are modified by parenting style, "goodness of fit," and the social environment. Emotions include the infant's feelings as well as the expression of these feelings. Social milestones include the steps necessary to form interpersonal relationships. Temperament influences social relationships and generally reflects a consistent pattern (or style) in "how" a child reacts. It is different from the

TABLE 4. Psychosocial Development

AGE IN MONTHS	EMOTIONAL	SOCIAL	ADAPTIVE	RED FLAGS
1–3	Interest Disgust Distress (pain, hunger) Enjoyment (social smile)	Understands relationships between voices and faces Bonding (parent → infant) Smiles reciprocally Follows moving person with eyes	State regulation Requires only one night feeding	Irritability Sleep/eating disturbances
3–6	Anger Happiness Joy Pleasure Sadness Displeasure	Recognizes mother Attachment (infant → parent) Anticipates food on sight Smiles spontaneously		Absent smile may indicate visual loss, attachment problems, or maternal depression
6–9	Personality unfolds Fear	Discriminates emotional facial expressions and reacts differently Preference for a given person Stranger anxiety Understands means-to-an-end relationship in social interactions (act → clap → repeat act)	Gums/swallows cracker Places hands on bottle Takes solids well Finger feeds dry cereal	Absent stranger anxiety may be due to multiple care providers (eg, NICU care)
9–12	Assertiveness Cautiousness	Differential fear response based on gender and age Concept of self Social interactions become intentional and goal-directed Separation anxiety	Holds bottle Holds, bites, chews cracker/cookie Drinks from cup held for him or her	
12–15	Shyness Empathy Sharing Self-comfort (eg, attachment to blanket)	Solitary play Begins formation of relationships • Love • Friendship • Acquaintance • Strangers Offers ball to mirror image Kisses by simply touching lips to skin or licks	Cooperates with dressing Drinks from cup; some spillage Removes socks/hat	
15–18	Shame/guilt Contempt	Self-conscious period; "coy" stage Hugs parents	Uses spoon; some spillage	Lack of social relatedness may indicate autism
18–21	Associates feelings with verbal symbols Begins to have thoughts about feelings	First application of attributes to self (eg, good, little, naughty) Initiates interaction by calling to adult Kisses with a pucker	Drinks from cup without spilling Moves about house without adult Emerging independence Removes a garment	
21–24	Beginning "socialization" of emotional expression by social/cultural influences • modulation of emotion • masking of emotion Infant's reaction to ambiguous events is shaped by emotional reactions of others	Imitates others to please them Recursive nature of social thought (ie, thinking about "How I behave to you and you to me") Parallel play Tolerates separation; will continue activity	Replaces some objects where they belong Uses spoon well Opens door by turning knob Removes clothes without buttons Unzips zippers Puts shoes on part way	Persistent poor transitions may indicate a pervasive developmental disorder

"why" (motivation) and the "what" (content) of social interactions. The inclusion of adaptive skills (ie, skills required for independence in feeding, dressing, toileting, and other activities of daily living) is unique to the discussion of psychosocial development and reflects the concept that these skills influence, and are influenced by, social factors.

EMOTIONAL DEVELOPMENT

Emotions are present in infancy and motivate expression (pain elicits crying). Emotion has three elements: neural processes, mental processes (feelings), and motor expression (facial, verbal) and actions. Emotions are mediated through the limbic system, which is responsible for receiving, interpreting, and processing emotion-producing stimuli and then initiating and modulating emotional responses. There is evidence that an infant can express emotion without direct cognitive mediation. An infant who has anencephaly or hydranencephaly may show disgust at sour flavors and interest in sweet flavors in ways very similar to a normal infant. Later, in the normal infant, these instinct-like reactions are modified by cognition. Although emotional feelings are constant over the life span, their causes change and become more abstract. The infant may show disgust for a bitter taste; the older child may show disgust for a revolting idea. Other emotions have a definite cognitive foundation. To experience fear, the 7- to 9-month-old child must be able to shift attention, compare, and recognize "familiar" from "unfamiliar" in the development of stranger anxiety. As the child develops, the interrelationship between emotion and cognition becomes increasingly complex. When the child begins to associate language symbols with emotions and memory, he or she can remember prior emotional experiences. A verbal reminder of the event then can evoke feelings identical to those experienced previously. Thus, language and cognition add flexibility and complexity to emotional behavior.

The expression of emotions also evolves with age and developmental advancement. Consider this example of an emotional reaction (fear) to a stranger, based on skill level:

9 months
Cries and turns head away *(mass body reaction)* and *(avoidance reaction)*
24 months
Runs away *(motor development)*
48 months
Says "Go away" or "Help" *(language development);* or tries to alter the threat *(cognitive development)*

In addition to developmental progress, the feedback loop between care providers and child modifies emotional expression. Social forces and cultural factors also modulate emotional expression to produce more restrictive and controlled facial signals. An older child may learn to modulate the expression of pain (a facial grimace only) and appear quite stoic. Furthermore, children can learn to mask emotions such as smiling at a disappointing gift. At early stages, however, the true emotion typically leaks out from under the mask.

Socioemotional milestones at 52 weeks include offering a ball to a mirror image and cooperating in dressing.

SOCIAL DEVELOPMENT

The infant is surrounded by a social network. Sensory processing is influenced by the infant's social needs. The infant has greater discrimination ability for social voices) than for nonsocial (environmental noise) stimuli. There are two primary theories: the Epigenetic Model and the Social Network Model. In the Epigenetic Model, the mother-child relationship is considered to be all important. If this relationship is negative, then other relationships will be poor. If it is positive, then future relationships will be good. The Social Network Model recognizes the relative importance of the mother-child relationship, but also recognizes the ability of other relationships to compensate for absent or poor mother-child interactions. The devastating effect of a poor relationship can be overcome by adequate substitutes and a supportive environment. The latter reflects the popular concept of childhood resiliency.

Social milestones begin with bonding, which reflects the feeling of the caregiver for the child. Attachment takes place within a few months and represents the feeling of the infant for the caregiver. These social relationships are manifested by the evolution of the smile, in which the level of stimulus required to elicit reciprocity decreases. At first, high-pitched vocalizations and a smile from the adult are needed; later, a smile alone is successful. When recognition of and attachment to a familiar caregiver develops, the simple sight of this person (smiling or nonsmiling) will elicit a smile. The infant also becomes more discriminating in producing a smile as he or she begins to differentiate between familiar and unfamiliar faces. As the infant acquires the concept of causality, he or she begins to use smiling to manipulate the environment and satisfy personal needs.

Later in infancy, other social relationships are established. Several behaviors are necessary for the development of these relationships. First, the infant must have a concept of self versus others. Next, he or she must be able to put self in the place of another, that is, to show empathy. The infant must perceive a separate identity with a different set of needs. He or she must realize the consequences of his or her interactions on others. Empathy is critical to forming a relationship. Next the child must be able to share, which is critical to maintaining a relationship. There are four basic types of relationships: with acquaintances, strangers, friends, and loves. Whereas relationships with acquaintances and strangers simply require

a concept of self, friendship and love require all three (a concept of self, empathy, and sharing). About the same time that the child can label emotions (via language), he or she begins to think about social interactions. A child will demonstrate recursive social thoughts, that is, show early signs of thinking about how others behave toward him or her and how he or she behaves toward others.

Temperament, or the infant's overall style of reacting, can affect social relationships. The precise definition of temperament is controversial, but it generally is believed to represent the characteristic style of a child's emotional and behavioral response in a variety of situations. It is determined by genetic factors but is modified by environmental forces. Temperament shows considerable stability over time. Thomas and Chess describe nine traits that determine whether a child will have an "easy," "difficult," or "slow-to-warm-up" temperament:

1. Activity level—proportions of periods of activity to inactivity
2. Adaptability to change
3. Positive or negative mood
4. Intensity of emotional responses
5. Rhythmicity of biologic functions
6. Persistence in the face of environmental counterforces
7. Distractibility or ease of soothing
8. Approach versus withdrawal tendencies in new situations
9. Threshold of stimulation necessary to produce a response

The Carey Infant Temperament Questionnaire often is used to evaluate these traits formally. Approximately one third of infants will be characterized as difficult or slow-to-warm up. The other two thirds will be classified as easy infants. The easy infants fall into three subcategories: 1) gentle, tender, sensitive, affectionate; 2) changeable, variable, adaptable; and 3) social, playful, happy, attention-seeking. A child's temperament can influence developmental testing. The child who is difficult or slow to warm up may refuse to cooperate with test items, thereby receiving lower scores that do not reflect his or her true abilities.

ADAPTIVE SKILL DEVELOPMENT

Adaptive skill development is influenced by the infant's social environment, as well as by motor and cognitive skill attainment. A child who has quadriparesis may not be able to feed him- or herself, even with normal intelligence and a supportive social environment.

In contrast, acquisition of self-help skills by an able-bodied infant may be delayed in the face of mental retardation and the lack of motivation to become independent. In spite of normal motor and cognitive skills, an infant may demonstrate delays in adaptive skills when social support and encouragement are lacking. This is exemplified by delays in self-feeding skills when the caregiver is overly concerned about messy spillage or feels the need to rush mealtime. Additionally, parents may persist in dressing the older child in an effort to rush to child care. The decision to initiate toilet training often is influenced by both family and culture.

RED FLAGS IN PSYCHOSOCIAL DEVELOPMENT

Decreased rhythmicity (eg, colic) may be an early indication of a "difficult child." Delay in the appearance of a reciprocal smile may indicate an attachment problem, which may be associated with maternal depression. In severe cases, child neglect or abuse may be suspected. However, a delay in smiling also may be associated with visual or cognitive impairment. The lack of social relationships plays a key role in the diagnosis of autism when it is accompanied by delayed or deviant language development and stereotypic behaviors. History and observation of an infant's behavior at play may alert the clinician to abnormal social relationships. The emotional status of the parents and parenting styles may affect the infant's development of adaptive skills. A controlling, rejecting parenting style may be revealed in an oppositional child who refuses to cooperate with self-care. Delays in adaptive skills also may indicate overprotective parents or an excessive emphasis on cleanliness.

Conclusion

The journey through infancy truly is fascinating—a time of incomparably rapid changes in physical growth and motor development. By the end of this period, the child is mobile and explores his or her environment independently. The child's pincer grasp and release rival that of the adult. Cognitive and social changes are equally prodigious. The baby has progressed from simple methods of expression (crying and grimacing) to a "little person" who has a complex array of emotional expressions that are becoming "socialized." He or she has learned to use these emotions to manipulate the environment and obtain the attention and the objects that he or she desires. Additionally, the child can think about emotions and feel empathy for the emotions of others. He or she has strong love and friendship relationships with family members and a few significant others. The next few years are characterized by exponential language development, which will reveal the complex thoughts, feelings, and humor owned by this amazing creature destined to become an adult.

SUGGESTED READING

Books:

Ames LB, Ilg F, Haber CC. *Your One-Year Old.* New York, NY: Bantam Doubleday Dell Publishing Group, Inc; 1979

Brazelton TB, Nugent JK. *Neonatal Behavioral Assessment Scale.* 3rd ed. London, UK: Mac Keith Press; 1995

Capute AJ, Accardo PJ, Vining EPG, Rubenstien JE, Harryman S. *Primitive Reflex Profile.* Baltimore, Md: University Park Press; 1978

Fraiberg SH. *The Magic Years.* New York, NY: Charles Scribner Sons; 1959

Gesell A, Amatruda CS. *Developmental Diagnosis.* New York, NY: Paul B. Hoeber, Inc; 1951

Levine MD, Carey WB, Crocker AC. *Developmental-Behavioral Pediatrics.* 2nd ed. Philadelphia, Penn: WB Saunders; 1992

Osofsky JD. *Handbook of Infant Development.* 2nd ed. New York, NY: John Wiley & Sons, Inc; 1987

Piper MC, Darrah J. *Motor Assessment of the Developing Infant.* Philadelphia, Penn: WB Saunders Company; 1994

Saint-Anne Dargassies S. *The Neuro-Motor and Psycho-Affective Development of the Infant.* New York, NY: Elsevier Science Publishing Co, Inc; 1986

Journals:
Algranati PS, Dworkin PH. Infancy problem behaviors. *Pediatrics in Review.* 1992;13: 16–21
Bauer S. Autism and the pervasive developmental disorders: Part I. *Pediatrics in Review.* 1995;16:130–136
Blasco PA. Early developmental indicators of intellectual deficit. *Pediatric Rounds.* 1993;2:1–3
Blasco PA. Normal and abnormal motor development. *Pediatric Rounds.* 1992;1:1–6
Blasco PA. Pitfalls in developmental diagnosis. *Pediatr Clin North Am.* 1991;38:1425–1437
Blizzard RM. The practitioner's dilemmas about growth and short stature. *Pediatric Rounds.* 1992;1:2–5
Capute AJ. Identifying cerebral palsy in infancy through study of primitive reflex profiles. *Pediatr Ann.* 1979;8:589–595
Capute AJ. Marking the milestones of language development. *Contemp Pediatr.* 1987;4:24
Coplan J. Normal speech and language development: an overview. *Pediatrics in Review.* 1995;16:91
Coplan J, Gleason JR. Quantifying language development from birth to 3 years using the Early Language Milestone Scale. *Pediatrics.* 1990;86:963
Dobos AE, Dworkin PH, Bernstein BA. Pediatricians' approaches to developmental problems: has the gap been narrowed? *J Dev Behav Pediatr.* 1994;15:34–38
Dorman C. Microcephaly and intelligence. *Dev Med Child Neurol.* 1991;33:267–269
Finney JW, Weist MD. Behavioral assessment of children and adolescents. *Pediatr Clin North Am.* 1992;39:369–379
Gooskens R, Willemse J, Bijlsma J, Hanlo P. Megalencephaly: definitions and classification. *Brain Dev.* 1988;10:1–7
Green EM, Mulcahy CM, Pountney TE. An investigation into the development of early postural control. *Dev Med Child Neurol.* 1995;37:437–448
Greenspan SI. Clinical assessment of emotional milestones in infancy and early childhood. *Pediatr Clin North Am.* 1991;38:1371–1385
Greenspan SI. The emotional development of infants and young children. *Pediatric Basics.* 1993;63:9–16
Hoon AH, Pulsifer MB, Gapalan R, Palmer FB, Capute AJ. Clinical Adaptive Test/ Clinical Linguistic Auditory Milestone Scale in early cognitive assessment. *J Pediatr.* 1993;123:S1–S8
Howard BJ. Growing together: a guide to how babies—and parents—develop. *Contemp Pediatr.* 1990;7:12–40
Mayes LC. Investigations of learning processes in infants. *Semin Perinatol.* 1989;13:437–449
Medoff-Cooper B, Carey WB, McDevill SC. The early infancy temperament questionnaire. *J Dev Behav Pediatr.* 1993;14: 230–235
Montgomery TR. When "not talking" is the chief complaint. *Contemp Pediatr.* 1994;11:49
Prior M. Childhood temperament. *J Child Psychol Psychiatr.* 1992;33:249–279
Richardson SO. The child with "delayed speech." *Contemp Pediatr.* 1992;9:55
Rovee-Collier C, Boller K. Current theory and research on infant learning and memory application to early intervention. *Infants Young Children.* 1995;7:1–12
Vaughan VC III. Assessment of growth and development during infancy and early childhood. *Pediatrics in Review.* 1992; 13:88–96

PIR QUIZ

1. An infant lies supine on an examination table with his head in the midline, hands clasped together. He grasps an offered throat stick and brings it to the mouth. There is no transfer from hand to hand. In the prone position the infant lifts his head to a vertical axis, with the arms extended to raise the trunk. He rolls over from prone to supine and smiles and coos on social contact. When the contact is broken, the smile disappears. The developmental level of this infant appears to be *closest* to:
   A. 2 months.
   B. 4 months.
   C. 6 months.
   D. 8 months.

2. An infant sits without support on the examination table, with her back straight. When offered a throat stick, she grasps it and transfers it from one hand to the other. When asked to return the throat stick to the examiner's outstretched hand, she touches the stick to the hand, but does not release it. A toy is placed before her, and as she reaches for it, a cloth is thrown over the toy. Without hesitation she removes the cloth to retrieve the toy. When a raisin is placed before her, she reaches for it, puts her hand on the surface of the table next to the raisin, and traps it between the thumb and forefinger. Given a little bell, she uses the forefinger to explore the inside of it. Pulled with both hands to a standing position, she takes a few hesitant steps as her hands are held. The developmental level of this child appears to be *closest* to:
   A. 6 months.
   B. 9 months.
   C. 12 months.
   D. 15 months.

3. An infant sits in a highchair with a tray before him. He is offered paper and a crayon and is asked to imitate a scribbling motion, which he does. When asked to imitate a horizontal stroke, he produces a vertical stroke. Given a circular block and a three-place form board (circle, square, triangle), he successfully inserts the circular block into the form board. Shown how to make a tower of three 1-inch cubes, he clumsily makes a tower of two cubes. He ignores the third cube. He dumps a raisin out of a little bottle and reinserts it with difficulty. His mother reports that he walks alone, that he responds to a simple request to find an object in another room, and that he has two words other than "mama," although he vocalizes with a rich jargon that has some of the intonations of speech. He makes his wants or needs known by pointing and vocalizing. He points to his nose or eyes on request. The developmental level of this child appears to be *closest* to:
   A. 12 months.
   B. 15 months.
   C. 18 months.
   D. 21 months.

4. A child is sitting in a highchair, with a tray in front of her. Given paper and crayon and asked to scribble, she does so with gusto. Asked to copy a circle following a demonstration, she produces a circular scribble rather than a closed circle. She draws a vertical line upon demonstration. She builds a tower of six cubes and completes the three-piece form board. Her mother reports that she has become somewhat self-assertive, with a firm "no," and a wish to do things for herself. The developmental level of this child appears to be *closest* to:
   A. 18 months.
   B. 21 months.
   C. 24 months.
   D. 30 months.

5. In a 2-year-old child, the *best* indicator of future intellectual achievement will be the child's status in:
   A. Adaptive behavior.
   B. Fine motor activity.
   C. Gross motor activity.
   D. Language development.

Toddler Development

Eve R. Colson, MD* and Paul H. Dworkin, MD†

IMPORTANT POINTS

1. **Physical growth in toddlers occurs more slowly than in infants, but at a predictable rate.**
2. **The temper tantrum is a common manifestation of the toddler's struggle for autonomy and independence.**
3. **A toddler's behavior style, or temperament, is highly visible and influences all interactions.**
4. **Toddlers make the important transition from sensorimotor to preoperational thinking, as described by Piaget.**
5. **Language development, which occurs very rapidly during the toddler years, is a classic example of the preoperational use of symbols.**

Introduction

The toddler years (1 to 3 years of age) are ones of rapid change and can be among the most exciting and challenging for parents and pediatricians. The most dramatic advances occur in language and interpersonal skills, but progress is evident in all areas as development proceeds along the traditional lines of affective, motor, cognitive, and physical growth (Fig. 1).

Themes in affective development include the toddler's striving for autonomy and independence from caregivers, the continuing importance of attachment to family, and the initial work on achieving impulse control. In addition, the child's behavior style, or temperament, is highly evident and shapes all social interactions.

Cognitively, the toddler makes the transition in the second year from sensorimotor to preoperational thought, as defined by Piaget. The transition is characterized by the acquisition of language and the development of pretend play. The young toddler may know only a few words and relies primarily on motor skills to manipulate the environment. In contrast, the 3-year-old can speak in sentences and uses these verbal skills to communicate and achieve goals.

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Physical growth continues more slowly than during infancy, but at a predictable pace. In contrast, fine motor and gross motor skills progress quickly. The young toddler walks with a wide gait and somewhat hesitantly, but quickly will be running and jumping. The increasingly independent 3-year-old can manipulate a fork and pour from a pitcher.

Tables 1 through 5 provide specific milestones in these areas during toddlerhood. Familiarity with such developmental data will enable the clinician to monitor children's development more effectively during health supervision visits as well as address typical, stage-related behavioral and developmental issues with families.

Physical Appearance

GROWTH RATE AND APPEARANCE

Following the rapid growth of infancy, the speed of growth slows in the toddler years. After age 2, toddlers gain about 5 lb in weight and 2.5 inches in height each year. Head circumference only increases by about 1 inch from 2 to 12 years. Growth does not increase steadily; rather, it often occurs in spurts. It is not unusual for a toddler's weight to remain the same for weeks at a time. Increases in height of the preschool child result primarily from growth of the lower extremities and, to a lesser extent, elongation of the trunk. Body proportions change, with upper-to-lower segment ratios ranging from 1.40 at age 2 years to 1.15 to 1.20 at age 5 years. Between the ages of 2 and 2.5 years, the child will have reached 50% of his or her adult height.

With a newly erect posture, the classic and endearing toddler pose includes lordosis and a protuberant abdomen. Growth of the lower extremities often is accompanied by tibial torsion and physiologic bowing of the legs, which usually corrects itself by age 3 years. The percentage of body fat steadily decreases from 22% at age 1 year to about 12.5% to 15% at age 5 years. By the end of toddlerhood, increased muscle tone and decreased body fat give the child the appearance of being more lean and muscular.

GROSS MOTOR SKILLS

Gross motor skills develop rapidly during the toddler years. Complex gross motor patterns develop, while balance and coordination improve. Most children walk without assistance by 18 months. Soon, they begin to walk faster with few falls.

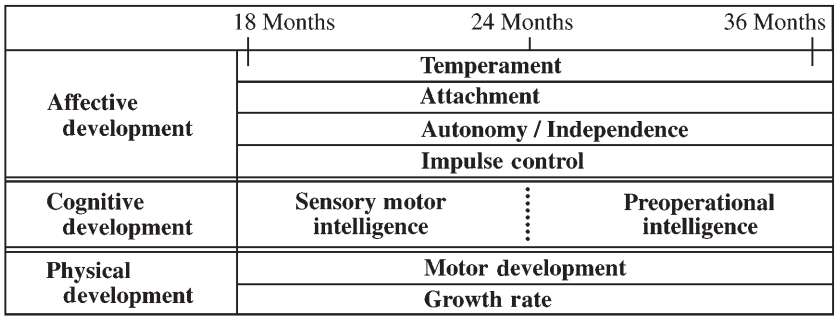


FIGURE 1. Developmental themes during the toddler years. Modified from Telzrow RW. Anticipatory guidance in pediatric practice. J Cont Educ Pediatr. *1978;20:14–27.*

TABLE 1.
Gross Motor Abilities

18 Months
• Walking fast, seldom falling
• Running stiffly
• Walking up stairs with one hand held
• Seating self in a small chair
• Climbing into an adult chair
• Hurling a ball
24 Months
• Running well without falling
• Walking up and down stairs alone
• Kicking a large ball
36 Months
• Walking up stairs by alternating feet
• Walking well on toes
• Pedaling a tricycle
• Jumping from a step
• Hopping two or three times

TABLE 2.
Fine Motor Abilities

18 Months
• Making a tower of four cubes
• Releasing 10 cubes into a cup
• Scribbling spontaneously
• Imitating a vertical drawing stroke
• Piling three blocks on a formboard
24 Months
• Building a six to seven cube tower
• Aligning two or more cubes to form a train
• Imitating a horizontal drawing stroke
• Beginning circular strokes
• Inserting a square block into a performance box
36 Months
• Copying a circle
• Copying bridges with cubes
• Building a tower of 9 to 10 blocks
• Drawing a person's head

TABLE 3.
Social/Emotional Skills

18 Months
• Removing a garment
• Feeding self and spilling food
• Offering an empty plate
• Hugging a doll
• Pulling a toy
24 Months
• Using a spoon; spilling little food
• Verbalizing toileting needs
• Pulling on a simple garment
• Verbalizing immediate experiences
• Referring to self by name
36 Months
• Showing concern about the actions of others
• Playing cooperatively in small groups
• Developing the beginnings of true friendships
• Playing with imaginary friends

At approximately age 2 years, the stiff, wide-leg gait of early toddlerhood becomes a flexible, steady walking pattern, with an adult-like heel-toe progression. By 36 months, they have developed their balance and can stand on one foot briefly. Toddlers delight in their new-found skills and often can be seen experimenting with them. As any person who has cared for a toddler can attest, they climb, they jump, and they run. Supervision is key to preventing injury because toddlers sometimes test their skills beyond their abilities in an attempt to learn and do more.

FINE MOTOR SKILLS

Increasing fine motor abilities during toddlerhood result from refinements in reaching, grasping, and manipulating small objects. The average 18-month-old can make a tower of four blocks. Just 1 year later, with practice and improved control, he or she can stack eight blocks (Fig. 2). Most 18-month-olds have developed an interest in crayons and, if given the opportunity, will hold the crayon in a fist and scribble spontaneously on paper (or anywhere else). Only 1.5 years later, the toddler has developed the control and sophistication to pick up a crayon by placing the thumb at the left and fingers at the right of the shaft and make a circle; by age 3, the child even may begin to draw a primitive stick figure.

Affective Development

AUTONOMY AND INDEPENDENCE

Fostered by improved motor skills, the transition from infancy to toddlerhood is marked by a new drive for autonomy and independence. The child finds that he or she can move freely and easily away from the parent and begins to test boundaries and limits. Struggles over autonomy may occur daily. The toddler may refuse to eat unless allowed to feed him- or herself. In addition, the child no longer may be willing to try new foods, despite parental coaxing. The classic manifestation of the struggle for autonomy is the temper tantrum. The toddler develops unbridled opinions and preferences about everyday activities. If he does not get his way, he may cry, hit, or throw himself on the ground.

IMPULSE CONTROL

Toddlers also begin to develop impulse control, which may be described as "the process of becoming civilized." The 18-month-old may have minimal impulse control and display several temper tantrums each day. Two-year-olds typically exhibit wide variations in impulse control, with the degree of control often varying with the struggle for autonomy. Most 3-year-olds have mastered some degree of self-control, in part because they are developing the ability to delay gratification. From experience, they learn that sometimes they must wait for rewards.

Impulse control, improved motor skills, and the struggle for autonomy are highly evident during toilet training. Successful toileting usually

TABLE 4.
Intellectual Abilities

18 Months
• Pointing to named body parts
• Developing an understanding of object permanence
• Beginning to understand cause and effect
24 Months
• Forming mental images of objects
• Solving problems by trial and error
• Understanding simple time concepts
36 Months
• Asking "why" questions
• Understanding daily routine
• Appreciating special events, such as birthdays
• Remembering and reciting nursery rhymes
• Repeating three digits

TABLE 5.
Language Skills

18 Months
• Looking selectively at a book
• Using 10 to 20 words
• Naming and pointing to one picture card
• Naming a test object (eg, ball)
• Following two-directional commands
24 Months
• Discarding jargon from speech
• Using two to three word sentences
• Using "I," "me," "you"
• Naming three picture cards
• Naming two test objects
• Knowing four-directional commands
36 Months
• Using four to five word sentences
• Telling stories
• Using plurals
• Recognizing and naming most common objects

occurs toward the end of the third year. At this time, the necessary physical skills (ie, controlling the sphincter, walking to the bathroom, undressing, and getting onto the potty) come together with the emotional willingness to participate. Although toilet training may be introduced at an earlier age, success with consistent daytime dryness usually is not achieved until about 2.5 years of age.

ATTACHMENT

Although toddlers strive for autonomy, issues of attachment remain important developmental themes. Attachment refers to the bond that forms in time between an infant and a caregiver. A secure bond is important in both social and emotional development during infancy and the preschool years. The toddler who seeks autonomy and independence relies on secure parental ties for the confidence to venture out and explore the environment. Although he or she may wander, the toddler always is cognizant of the caregiver's presence and intermittently returns for reassurance. If the caregiver cannot be found, the toddler likely will become distressed.

Disorders of attachment may result from inconsistent caregiving and are more common in the presence of family stressors, such as poverty, drug use, or emotional illness. Affected toddlers may not show interest in exploring the environment, may display separation problems, or may distrust the primary caregiver. It should be particularly worrisome when a 2-year-old does not seek out the primary caregiver for reassurance in a stressful situation, such as during a physical examination or painful procedure.

TEMPERAMENT

How a child approaches a given situation is influenced by his or her behavioral style, also known as temperament. Pediatric clinicians are acutely aware of the wide variability in behavioral style among toddlers during health supervision visits. Some 2-year-olds sit close to their parents and shy away from the approaching stethoscope. Others bounce all over the room, showing a fleeting, although intense, interest in their surroundings but wanting no part of the physical examination. Then there are those who sit on the floor, methodically flipping the pages of their cardboard book, nearly unfazed by the examination. Temperament has strong genetic elements and often is apparent during earliest infancy. By the toddler years, the child's behavioral style is generally evident and predictable.

Temperament influences all toddler interactions. Chess and Thomas followed more than 100 children from birth into adulthood, focusing on nine characteristics of temperament, among them a child's adaptability, activity level, quality of mood, and distractibility. They found these characteristics to define three temperamental constellations: "difficult," "easy," and "slow-to-warm-up." About 10% of children were generally less adaptable, had increased activity levels, and tended to be emotionally negative. These children were considered "difficult." "Easy" children, about 40% of the group, had regular eating and sleeping schedules, adapted well to new situations, and tended to have positive moods. A third group, compris-

FIGURE 2. A 24-month-old demonstrates fine motor skills by stacking blocks. By this age, most children can build a tower of seven blocks.

ing about 15% of the sample, was characterized as "slow-to-warm-up." These children tended to be quiet and take longer to adapt to new situations.

Conflict, stress, and behavior difficulties may result when a toddler's temperament conflicts with caregivers' expectations and parenting style. For example, conflict may arise between a "slow-to-warm-up" 2-year-old and an out-going parent who expects the child to adapt quickly to social situations. A positive social environment is created when a child's temperament is compatible with the caregiver's style and expectations, a situation referred to as "goodness of fit."

Families benefit from understanding the concept of temperament and realizing that, to a large extent, behavioral style is an intrinsic characteristic of a child. Parents should not feel that they have "created" a difficult child, particularly during the "terrible twos," when the struggle for autonomy may be accentuated by such temperamental traits as poor adaptability and negative mood.

Cognitive Development

Toddlers make the transition from sensorimotor to preoperational thinking, as outlined by Piaget. During the sensorimotor period, the infant primarily learns about the world by touching, looking, and listening. Preoperational thought is marked by the development of symbolic thinking, as the child becomes capable of forming mental images and begins to solve problems by mental trial and error. This progression from sensorimotor to symbolic thought occurs typically between 18 and 24 months of age. The child's recognition that one object can represent another becomes highly evident during play. A block conveniently serves as a car and a bucket becomes a hat. At this age, the toddler also uses symbols or actions to imitate past events. For example, hours after watching his father do the dinner dishes, he might begin imitating the event with his own makeshift sink and pans. In addition, he now has developed complete object permanence, finding an object, such as a ball under a blanket, despite not seeing it hidden.

The older toddler continues to develop symbolic thinking. By 3 years, she can draw primitive figures that represent important people in her environment. In addition, she develops elaborate play and imagination. At this age, however, she still has a number of limitations in cognitive skills. She remains unable to take the viewpoint of another person, continuing to see the world egocentrically and assuming that others think and feel as she does. In addition, she can attend only to one aspect of a problem at a time, as illustrated by Piaget's classic conservation experiment: When shown equal volumes of colored water, and one is poured into a tall, thin container and the other into a short, fat one, the 3-year-old always will pick the tall, thin container as having more water because it appears "bigger" to her.

LANGUAGE

Language is the classic example of the preoperational use of symbols. Beginning around age 2 years, toddlers use language to convey their thoughts and needs (such as hunger and pain) (Fig. 3). Language skills develop at an extraordinary pace. The average 18-month-old has a vocabulary of at least 20 words, consisting primarily of the names of familiar caregivers and favorite foods and activities, and may be starting to put two words together. His receptive language skills will be somewhat more advanced than the expressive skills; he will understand the meaning of more complex instructions.

FIGURE 3. This toddler demonstrates language skills by naming a picture. Most children begin naming pictures at about 18 months of age.

Over the next few months, this child will experience a burst in vocabulary. He begins to put together phrases but often omits pluralization, prepositions, and adjectives. These early sentences are referred to as "telegraphic speech." At this point, 50% of what the child says should be intelligible to strangers. By the age of 3 years, the vocabulary increases to about 500 words, and 75% of speech is understandable to strangers. He begins to make complete sentences and experiments with speech and language, varying word usage and changing the intensity, as well as intonation, of speech. He typically now begins a myriad of daily "why" questions, so characteristic of the preschool years.

Progress in language development is influenced by environmental factors as well as by innate abilities. Bilingual children, for example, may mix languages initially but ultimately will "catch up" in their language skills by 2 to 3 years of age. Parents can be encouraged to provide an environment that will foster language growth. For example, parents or other caregivers can read aloud to toddlers every day. Libraries often offer story hours for young children.

Developmental Monitoring and Anticipatory Guidance

Pediatricians can monitor toddler development both during scheduled health supervision visits and during all other office encounters. The goal of developmental monitoring is early identification of problems to provide appropriate services at a young age. Monitoring can be accomplished best by eliciting parental concerns, making skilled observations, and taking a developmental history. Over time, the child's skills, interests, and behaviors are considered within the context of overall well-being, rather than

viewed in isolation during a test. Recording developmental observations at all opportunities is particularly important during the toddler years, when change is rapid but scheduled health supervision visits may occur only once a year. This longitudinal approach to monitoring development is known as developmental surveillance.

If, during developmental surveillance, the pediatrician suspects developmental delay, an appropriate screening test can be chosen as a second stage of evaluation. A comprehensive review of developmental screening and testing can be found in Gilbride's article in the September 1995 issue of *Pediatrics in Review*. In general, screening tests are useful in providing objective information about the child's development for both the clinician and parents. When screening tests confirm suspicions of delay, the pediatrician should refer appropriately for a more extensive developmental assessment. Depending on local regulations and the child's age, referral may be made to a state Birth-to-Three program or to the regional school system.

In addition to monitoring development, pediatricians can use their knowledge of themes in toddler development to provide parents with age-appropriate anticipatory guidance. During the 12-month visit, for example, the pediatrician might explain that the child soon will begin to experience struggles over autonomy and independence. More frequent temper tantrums can be expected in the second year of life, as the toddler inevitably encounters frustration while seeking autonomy, despite remaining heavily dependent on caregivers.

Summary

The toddler years are ones of exciting and challenging changes in cognitive, affective, and physical growth. Physical growth is particularly remarkable for the child's increasing skills and ability to navigate the environment. Affective development is marked by the push for autonomy and independence and the highly visible nature of the child's temperament or behavioral style. The toddler also enters the wonderful years of imagination and pretend play. Perhaps most noteworthy is the child's dramatic increase in ability to communicate with others through speech and language, as evidence of the progression to symbolic thinking. The dynamic changes in children's development during the toddler years have important implications for child health supervision. Familiarity with toddler development will enable the pediatrician to monitor children's development effectively and to address common, stage-related behaviors with families during anticipatory guidance.

SUGGESTED READING

Brazelton TB. A child-oriented approach to toilet training. *Pediatrics*. 1962;29: 121–128

Coplan J. Normal speech and development: an overview. *Pediatrics in Review*. 1995; 16:91–100

Dixon S, Stein M. *Encounters with Children*. St Louis, Mo: Mosby-Yearbook; 1992

Dworkin PH. British and American recommendations for developmental monitoring: the role of surveillance. *Pediatrics*. 1989; 84:1000–1010

Fraiberg S. *The Magic Years*. New York, NY: Charles Scribner's Sons; 1959

Gilbride K. Developmental testing. *Pediatrics in Review*. 1995;16:338–346

Ginsburg H, Opper S. *Piaget's Theory of Intellectual Development*. Englewood Cliffs, NJ: Prentice-Hall, Inc; 1979

Levine M, Carey W, Crocker A, eds. *Developmental-Behavioral Pediatrics*. Philadelphia, Penn: WB Saunders Company; 1992

Parker S, Zuckerman B, eds. *Behavioral and Developmental Pediatrics*. Boston, Mass: Little, Brown and Company; 1995

Thomas A, Chess S. *Temperament and Development*. New York, NY: Brunner/ Mazel, Inc; 1977

SUGGESTED READING FOR PARENTS

Brazelton TB. *Touchpoints: Your Child's Emotional and Behavioral Development*. Reading, Mass: Addison–Wesley Publishing Company; 1992

Leach P. *Your Baby and Child*. New York, NY: Knopf; 1989

Shelov SP, ed. *The American Academy of Pediatrics Caring for Your Baby and Child: Birth to Age 5*. New York, NY: Bantam; 1993

Turecki S, Tonner L. *The Difficult Child*. New York, NY: Bantam; 1989

PIR QUIZ

1. Which of the following would generally be considered beyond the developmental level of 18 months?
   - A. Has a vocabulary of 20 words.
   - B. Imitates a horizontal stroke of a crayon.
   - C. Makes a tower of 4 cubes.
   - D. Puts 10 cubes into a cup on request.
2. Which of the following would generally be considered beyond the developmental level of 24 months?
   - A. Builds a tower of 7 cubes.
   - B. Copies a cross on demonstration.
   - C. Copies a vertical stroke of a crayon.
   - D. Makes a circular scribble with a crayon.
3. Which of the following would generally be considered beyond the developmental level of 36 months?
   - A. Draws a stick figure that has eyes, nose, arms, and legs.
   - B. Puts together sentences of four to five words.
   - C. Rides a tricycle.
   - D. Stands momentarily on one foot.
4. The transition during the toddler period from the sensorimotor to the preoperational level of development (Piaget) is exemplified *best* by:
   - A. The emerging struggle for autonomy.
   - B. Fine motor development.
   - C. Language development.
   - D. The relationship between temperament and social development.

Guide to Ages & Stages Questionnaires (ASQ-3)

What is the ASQ?

The ASQ is one of numerous developmental screening tools on the market. It consists of a series of 19 parent-completed, age-specific questionnaires (2 thru 54mo, at ~2mo intervals), screening the following domains: communication, gross motor, fine-motor, problem-solving, and personal-adaptive skills. It results in a pass/fail score for each domain. It was normed on 2008 children from diverse ethnic and socioeconomic backgrounds, including Spanish speaking. Sensitivity: 0.70–0.90 (moderate to high). Specificity: 0.76–0.91 (moderate to high).

For a comparison with other developmental screening tools, see Table I in the AAP Policy Statement (2006). In addition, Harriet Lane includes a discussion of the **Denver II** Assessment (0-6 yrs; GM, language, FM, personal-social); the **Capute Scales** (0-36 mo; CAT = Clinical Adaptive Test for problem-solving skills, CLAMS = Clinical Linguistic and Auditory Milestone Scale); the **Goodenough-Harris Draw-a-Person Test** (3-13 yrs); and the **Gessell figures and block skills** (3-11 yrs). *You will learn more about these latter tests during your Devo rotation.*

How do I score the ASQ?

There are 6 questions for each of the 5 developmental domains. A "yes", "sometimes", and "not yet" receives 10, 5, and 0 points respectively. Add up the points and record for each domain.

SCORE AND TRANSFER TOTALS TO CHART BELOW: See *ASQ-3 User's Guide* for details, including how to adjust scores if item responses are missing. Score each item (YES = 10, SOMETIMES = 5, NOT YET = 0). Add item scores, and record each area total. In the chart below, transfer the total scores, and fill in the circles corresponding with the total scores.

Area	Cutoff	Total Score	0	5	10	15	20	25	30	35	40	45	50	55	60
Communication	22.77		●	●	●	●	●	○	○	○	○	○	○	○	○
Gross Motor	41.84		●	●	●	●	●	●	●	●	●	○	○	○	○
Fine Motor	30.16		●	●	●	●	●	●	●	○	○	○	○	○	○
Problem Solving	24.62		●	●	●	●	●	●	○	○	○	○	○	○	○
Personal-Social	33.71		●	●	●	●	●	●	●	○	○	○	○	○	○

A score in the gray or black zone denote "at risk" or "delayed" development, respectively.

ASQ SCORE INTERPRETATION AND RECOMMENDATION FOR FOLLOW-UP: You must consider total area scores, overall responses, and other considerations, such as opportunities to practice skills, to determine appropriate follow-up.

If the baby's total score is in the ▭ area, it is above the cutoff, and the baby's development appears to be on schedule.
If the baby's total score is in the ▭ area, it is close to the cutoff. Provide learning activities and monitor.
If the baby's total score is in the ■ area, it is below the cutoff. Further assessment with a professional may be needed.

Should I be doing the ASQ in clinic?

In the old WRAMC clinic, parents received the appropriate ASQ packet at the check-in desk and completed the questions prior to their appointment, at which time the provider would score the ASQ and provide developmental guidance. Logistically, this ideal has not yet been achieved in the new WR-B clinic (but may be the topic of a resident PI project).

Given these constraints, the recommendation would still be to complete the ASQ *at least* at the 9, 18, and 30 month visits, when the AAP Periodicity schedule recommends developmental *screening*. Remember, developmental *surveillance* is recommended at nearly *all* scheduled visits. As the algorithm on the 1st page of this module indicates, if surveillance demonstrates risk, then a screening tool should also be administered.

Ask your preceptors what THEY do!

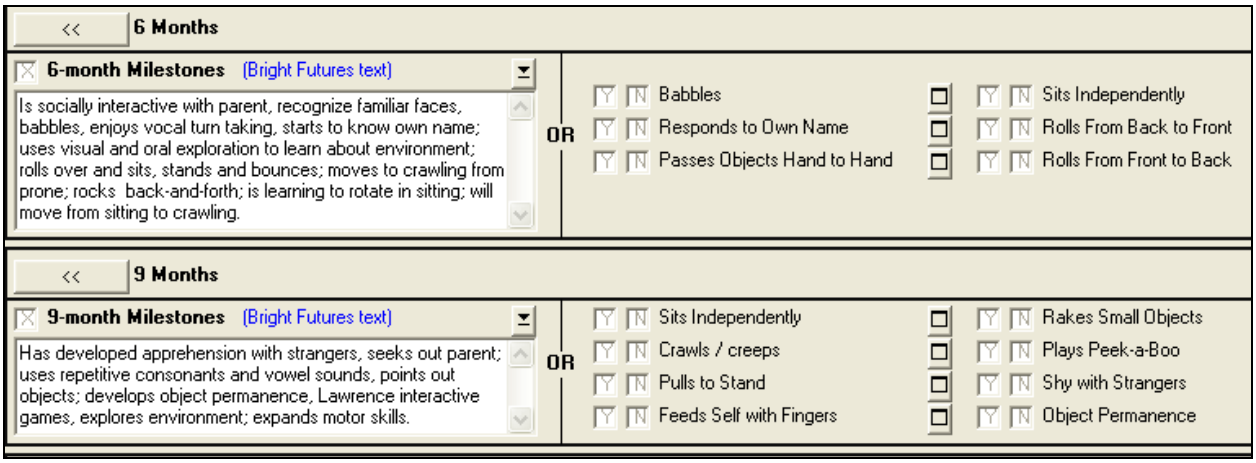
Where can I find the ASQ?

- http://www.nccpeds.com/DST.htm (Resources → Developmental Screening)
- Pediatrics Folder→ "Ages and Stages" on your desktop
    - Includes links to "**Intervention Activities**" by age-group (1-66mo), "Child Monitoring Sheet", and "Parent Conference Sheet".

How do I record the ASQ scores in my AHLTA note?

There is no specific ASQ tab or importable questionnaire. Most providers record the total score *by domain* in either the "developmental" section of their subjective portion or in the A/P section. Remember, developmental screening (96110-96111) receives 0.54 RVUs as a "procedure code".

Developmental screening can also be done less rigorously using the TSWF templates. The development/behavior tab includes drop-down boxes for all of the key well-baby/child visits.



What action(s) should I take for an abnormal ASQ?

This topic will be discussed in more detail in Devo IV: Interventions & Services. As the color key above indicates, a "gray zone" score requires "learning activities" and monitoring, with re-screening at subsequent visit. A "black zone" score requires further assessment, either with county Early Intervention or Developmental Peds consult, to include PT & OT. You can also consider hearing and vision screening, depending on the answers to the "Overall" section.

Development I Quiz: *(based on Bright Futures Chapter)*

Milestone Round-Robin: Please complete& review the following table as a group:

DEVELOPMENTAL MILESTONES AT A GLANCE — INFANCY[31]

Age	Gross Motor	Fine Motor	Cognitive, Linguistic, and Communication	Social-Emotional
2 Months			Laugh Vocalize	
4 Months		Follow to 180° Grasp rattle		
6 Months		Look for dropped yarn Reach		
9 Months				Wave bye-bye Feed self
1 Year				•Protodeclarative pointing* •Wave bye-bye •Imitate activities •Play pat-a-cake
15 Months	•Walk backwards •Stoop and recover •Walk well			
18 Months		•Dump raisin, demonstrated •Tower of 2 cubes •Scribble		•Remove garment •Help in house
2 Years	•Throw ball overhand •Jump up •Kick ball forward •Walk up steps			
2½ Years			•Know 2 actions •Speech half understandable •Point to 6 body parts •Name 1 picture	•Wash and dry hands •Put on clothing
3 Years	•Balance on each foot 1 second •Broad jump •Throw ball overhand			•Name friend •Brush teeth with help
4 Years		•Draw a person with 3 parts •Tower of 8 cubes		

KEY
Black Color: 50% to 90% of children pass this item.
Green Color: More than 90% of children pass this item.
***Absence of these milestones should trigger screening for autism.**

Development I Cases:

Case 1:
You are seeing a 9 month-old male in clinic today. He was the product of a full-term uncomplicated vaginal delivery and has, thus far, been developing normally.

What motor skills do you expect him to have at this age?

How would your answers change if he were a 26-week preemie?

Guided by the prompts on the Tri-Service Work-flow (TSWF) templates, you learn that he sits without support and commando crawls, but does not pull to stand or creep on hands and knees. For fine motor milestones, he has a mature pincer grasp and can point with his index finger.

Calculate his Developmental Quotient (DQ) for Gross Motor and Fine Motor domains.

Other than by parental recall, how else can you assess motor development in clinic?

Please describe/demonstrate for the group the following primitive reflexes and postural reactions, and fill in the approximate ages of appearance and disappearance:

	Description	Appears	Disappears
Primitive Reflexes			
Moro			
Asymmetric tonic neck reflex			
Postural Reactions			
Parachute			
Lateral propping			

Flashback: What immunizations should he have received so far?

Case 2:
You are seeing a 30-month-old female in clinic today for a preschool physical. She has an unremarkable past medical history, and normal growth and development thus far. She will be starting a Montessori school, and her mother is concerned about her "pre-academic skills".

According to the AAP Periodicity Table, what type of developmental assessment should be performed at the 30-month visit? ***Are you routinely seeing patients for 30-month visits?***

Which developmental milestones best estimate IQ and, in turn, predict school success?

What intellectual abilities & language skills do you expect her to have at this age?

In taking a developmental history, you learn that your patient has been cared for by a French-speaking nanny since 6 weeks-old. **How do your answers for language skills change?**

Your patient's mother informs you that Montessori schools emphasize "purposeful play" and "free discovery" within a "prepared environment". **What Piaget stage of cognitive development should your patient be in? How should this manifest in her play?**

Please define/ demonstrate for the group the following language terms, and their ages:

Language Term	Definition/Example	Age
Razzing		
Babbling		
Immature jargoning		
Proto-imperative pointing		
Proto-declarative pointing		
Mature jargoning		
Giant words		
Holophrases		
Telegraphic speech		

Flashback: What is a major theme in affective development for toddlers and how does this affect their nutrition?

Development I Board Review:

1. During the health supervision visit of an infant, you place her prone on the examination table. She is able to track your penlight, following it 180 degrees by lifting her head and shoulders off the table.

Of the following, these developmental milestones are MOST typical for an infant who is
A. newborn
B. 1 month of age
C. 2 months of age
D. 4 months of age
E. 6 months of age

2. A mother and father bring in their infant for a routine health supervision visit. The mother gently places the child on the examination table, and the child laughs out loud. As you approach the child, he squeals and reaches for his father.

Of the following, these developmental milestones are MOST typical for a child whose age is
A. 2 months
B. 4 months
C. 6 months
D. 8 months
E. 10 months

3. During the health supervision visit for an infant, her mother mentions that the child has been tolerating solid foods with no problem. When placed on her back to be examined, she brings her feet to her mouth. Her mother holds a small mirror to the child's face to distract her during your examination, and the baby reaches for the mirror and pats her image.

Of the following, the developmental milestones are MOST typical for an infant whose age is
A. 2 months
B. 4 months
C. 6 months
D. 9 months
E. 12 months

4. A mother brings in her child for a health supervision visit. He is able to pull to stand, take a few independent steps, and use two fingers to grasp pieces of cereal.

Of the following, these developmental milestones are MOST typical for a child whose age is
A. 6 months
B. 9 months
C. 12 months
D. 15 months
E. 18 months

5. You observe a child as he walks into the examination room, accompanied by his parents. He is holding a small ball. When you ask him to let you see the ball, he gives it to you. You hand the ball back to him, and he throws the ball to you. When you throw him the ball, he reaches to catch it but almost loses his balance. He stoops to the floor but recovers to a standing position while laughing and smiling at his parents. You offer him a crayon and a piece of paper, and he draws a straight line. When he sees a few blocks on the floor, he picks up two and stacks one on top of the other.

Of the following, these developmental milestones are MOST typical for a child whose age is
A. 9 months
B. 12 months
C. 15 months
D. 18 months
E. 24 months

6. You are examining a young boy during a health supervision visit. His mother reports that he says “mama,” “dada,” ” bye,” “up,” and “ball.” Following the examination, he sits on the floor in front of his mother while playing with a toy car. When he sees a jack-in-the-box on a shelf, he points to it. After being instructed to do so by his mother, he brings the jack-in-the-box to her.

Of the following, these developmental milestones suggest that the child is CLOSEST to
A. 12 months of age
B. 15 months of age
C. 18 months of age
D. 21 months of age
E. 24 months of age

7. You observe a child entering the waiting room, accompanied by her mother. She looks at the receptionist and says "Hi." While holding her doll, the child turns to her mother and says "juice." The mother gives her a cup of juice, and the child says "doll" and tries to give the doll a drink. The mother shakes her head, and the child says "no." The child then points to her own mouth, smiles, and says "mouth." The mother takes a tissue to clean the doll’s face. The child says "me" and begins to imitate her mother’s action with another wipe. The child looks at her mother, says "ma ma," and gives her mother a hug.

Of the following, these developmental milestones are MOST typical for a child whose age is
A. 12 months
B. 15 months
C. 18 months
D. 24 months
E. 30 months