The Capute Scales

Cognitive Adaptive Test/ Clinical Linguistic & Auditory Milestone Scale

CAT/CLAMS

Pasquale J. Accardo
Arnold J. Capute

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Cognitive Adaptive Test/ Clinical Linguistic & Auditory Milestone Scale (CAT/CLAMS)

by

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The Capute Scales: Cognitive Adaptive Test/Clinical Linguistic & Auditory Milestone Scale (CAT/CLAMS) Scoring Sheets and Test Kit can be purchased separately. The Test Kit contains a laminated card with images, cup, plastic jar, transparent panel, 10 cubes, notepad, 2 jumbo crayons, cloth, formboard with shapes, pegboard, 6 pegs, 8-inch stick, ring, and bell. To order, contact Paul H. Brookes Publishing Co., Post Office Box 10624, Baltimore, MD 21285-0624 (1-410-337-9580; 1-800-638-3775; www.brookespublishing.com).

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Contents

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Arnold J. Capute, M.D., M.P.H., was a native of Queens, New York, who earned his medical degree from Hahnemann Medical College in Philadelphia, Pennsylvania, and completed his pediatric residency at New York Medical College. After 15 years in private pediatric practice, Dr. Capute returned to The Johns Hopkins University School of Medicine to complete a fellowship in developmental pediatrics. He then directed the Developmental Pediatrics fellowship training program at the John F. Kennedy Institute (now the Kennedy Krieger Institute) for the next three decades. He pioneered research in motor disorders in infants and authored numerous publications in the field of neurodevelopmental disabilities. He founded both the Kennedy Fellows Association and the Society for Developmental Pediatrics. He received the Alexander J. Schaffer Award for Excellence in Clinical Teaching in Pediatrics from The Johns Hopkins Hospital, and the Professors' Award for Distinction in Teaching in the Clinical Divisions at The Johns Hopkins University School of Medicine. He was also the recipient of the Richmond Cerebral Palsy Award, the Warner-Lambert Company Scholars Award, and the prestigious American Academy of Pediatrics Education Award. Until his death in 2003, he held the Arnold J. Capute Chair in Developmental Pediatrics at The Johns Hopkins University School of Medicine. From the perspectives of teaching, clinical research, and national recognition for the field, Dr. Capute was truly the "father of developmental pediatrics."

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Preface

Dr. Arnold J. Capute developed the CAT/CLAMS in the 1970s. The CAT (Cognitive Adaptive Test) is a measure of nonverbal problem-solving ability in children from birth to 3 years of age for use by the primary care pediatrician in the office setting. The CLAMS (Clinical Linguistic & Auditory Milestone Scale) is a quantitative measure of expressive and receptive language skills in children from birth to 3 years of age for use by the primary care pediatrician in the office setting. In both editions of the *Dictionary of Developmental Disabilities Terminology* (Accardo & Whitman, 1996, 2002), I attempted to revert the acronyms of the two scales back to their original intent: Capute Adaptive Test (CAT) and Capute's Linguistic and Auditory Milestones Scale (CLAMS). The effort didn't take but eventually became unnecessary since Dr. Capute finally agreed to put out the combined CAT/CLAMS as the Capute Scales (Capute, 1996) and this term began to take hold in research projects such as the standardization of the Capute Scales that is reported in this volume.

The Capute Scales have followed the many trainees in Dr. Capute's program at the Kennedy Krieger Institute at The Johns Hopkins University School of Medicine. In addition to the Spanish and Russian versions discussed in the present volume, the instrument has been standardized in two Chinese dialects (Chang, Huang, & Hu, 1998) and is extensively used in Israel (M. Schertz, personal communication, 1999) and Korea (H.J. Kim, personal communication, 1999).

The test instrument embodies a philosophical attitude toward the active involvement of the pediatrician in the assessment of infant development that should be useful to all who are concerned with the care of young children. Dr. Capute was able to see the preliminary shape of the present volume before his death in 2003 (Accardo, 2005) and was pleased at the chance to have an impact on the clinical practice of a larger audience.

The publication of this expanded version of the Capute Scales manual results from the completion of the multisite standardization of the Capute Scales. Although more work will be needed to fully assess the utility of the Scales, we would like to thank the many professionals who contributed to completing this stage of the work. Among those not mentioned in the following chapters are Sean D. Cleary, Ph.D., M.P.H., Nancy Lyon, P.N.P., and Siobhan Pittock, M.D.

Pasquale J. Accardo, M.D.

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In Memoriam: Arnold J. Capute, M.D., M.P.H.

If I ever go back to Baltimore
In the state with Mary's name
I will meet no more the master
Of infant reflex fame.

CAT and CLAMS posilipo
Were his favorite measures
Henri Matisse and Montrachet
In blue jay blue his treasures.

When spastic and crippled children
Were reclassified DD,
He pioneered a new field
For the spectrum NDD.

Higher cortical dysfunction
A continuum he read:
Of this Straussian subspecialty
He became the honored "head."

From the sacred halls of Hopkins
His loyal soul is gone
To live in the hearts of his students
And the Heart of Mary's Son.

1

Development of the Capute Scales

MARY L. O'CONNOR LEPPERT

The Capute Scales are among the many contributions of Dr. Arnold J. Capute to the field of developmental disabilities. The Capute Scales are designed to assess the cognitive (language and visual-motor) streams of development in children with a cognitive age of 36 months or younger. The assessment batteries are intended for use in any setting in which the expeditious evaluation of the cognitive levels of young children is required. Dr. Capute began his work in developmental disabilities in the mid-1960s at The Johns Hopkins Hospital and continued shortly thereafter at the John F. Kennedy Institute (later called the Kennedy Krieger Institute), where he spent the rest of his career developing the field and improving the evaluation and treatment of children with varied disabilities. As the "father of developmental pediatrics" in the United States, he contributed a tremendous amount to the body of knowledge, research, care, and advocacy for children with special needs. Dr. Capute left a legacy that includes hundreds of trainees around the United States and the world who are dedicated to improving the care of children with disabilities. Publication of this manual ensures that this important work will continue.

EARLY INTERVENTION AND THE NEED FOR EARLY DIAGNOSIS

In 1986, Congress passed PL 99-457, the Education of the Handicapped Act Amendments, which provided incentives for establishing early intervention programs to chil-

dren with developmental delays who are younger than 3 years of age (DeGraw et al., 1988). Subsequently, the Individuals with Disabilities Education Act and its Amendments have mandated early identification and intervention for infants and toddlers (Sandler et al., 2001). Thus, families have easy access to appropriate services for children who are determined to be eligible for interventions such as special education, audiological assessment, and physical, occupational, and speech therapies. Identification of children who have or are at risk for delay is often determined by the pediatrician or primary care provider, who is uniquely positioned and trained to observe infant development and respond to parental concerns about development. Suspicion of atypical development must prompt further assessment of all streams of development—gross motor, visual-motor, language, social, and adaptive skills—in order to identify the areas of disability.

The care of the child with a disability begins with the identification of delay and medical diagnosis of the disability. The purpose of early diagnosis is fivefold:

1. To define the disorder causing concerns about development (e.g., mental retardation, cerebral palsy, autism, hearing impairment, communication disorders)
2. To investigate the etiology of the disorder (e.g., metabolic derangement, genetic disorder, anoxic injury, toxic exposure)
3. To assess for the presence of associated disorders
4. To direct intervention services and follow up needs
5. To provide appropriate counsel to the child's family regarding the implications of the diagnosis

It is in defining the diagnosis that we can begin to inform the parents about their child's disability and any associated difficulties that may need to be addressed, what the diagnosis may mean for siblings or future offspring, and what the future is likely to hold for the child who is being assessed. However, until now, primary care physicians have been challenged to find tests that can quantify developmental rates and allow them to apply the results of testing to determine the presence of delay in order to formulate diagnoses.

THE BASIS OF EARLY DIAGNOSIS: HISTORICAL PERSPECTIVE

Dr. Capute continually acknowledged the work of Dr. Arnold Gesell, who assiduously recorded the typical sequence and timing of milestone acquisition in each of the five streams of development: gross motor, visual-motor, language, adaptive, and social. Gesell observed that in typical children, development is an orderly, timed, and sequential process that occurs with such regularity that it is predictable (Gesell & Amatruda, 1947). The predictable timing and sequence of milestone acquisition is the basis of all developmental assessment.

Gesell contributed the first developmental assessment measure for infants and young children (Gesell & Amatruda, 1947). Gesell's initial test battery included a large number of test items, employed many test instruments, and took quite a bit of time to administer. The quantification of development was accomplished with the devel-

opmental quotient (DQ), which measures the rate of development within a given stream. Gesell considered the DQ the representation of the proportion of typical development present in a given child at the time of testing (Gesell & Amatruda, 1947). Arithmetically, the DQ is defined as the age-equivalent at which a child is functioning in any given stream of development divided by the chronological age of the child and represented as a percentage. So, for example, a child whose best motor function is to sit unsupported (a 6-month age-equivalent) at a chronological age of 12 months would have a DQ of 50; thus, the child would be exhibiting 50% of the development expected for a 12-month-old child. The regularity and predictability of typical development provides a paradigm by which atypical development may be appreciated. Atypical development may take any one or a combination of three patterns: delay, deviancy, or dissociation. These are discussed in the section that follows.

DEVELOPMENTAL PRINCIPLES

Developmental *delay* is defined as a slower rate of milestone acquisition than is normally expected, but the order and sequence of milestone acquisition are typical. Delay may be seen in a single stream of development or across several streams and is determined by the presence of a DQ that is less than 70%–75%. The pattern of a child's developmental rate over time may be of both diagnostic and prognostic value. Longitudinal assessments of development that portray a consistent, albeit delayed, developmental pattern are prognostic of future delay. A pattern of normal developmental rate followed by a plateau or regression in developmental rate raises etiologic concerns of degenerative disorders. In addition, developmental rate may be used to monitor recovery or the response to therapy in a child who has previously demonstrated a delay.

Deviancy is the nonsequential acquisition of milestones within a specific developmental stream. As an example, a parent may report that a child rolls over at 2 months (the age expected for this milestone is 4–5 months), but examination indicates that the child's highest motor skill is propping up on his or her elbows in prone position (a 3-month age skill). This motor vignette is considered deviant in that propping up to elbows then to wrists in prone position should precede rolling. In the language stream, deviancy is seen in the uncoupling in the rate of acquisition of receptive and expressive milestones, or in the uncoupling of expressive milestones alone, such as the child reported to have a 100-word vocabulary (age expectancy of greater than 24 months) but who cannot speak in phrases (age expectancy of 21 months). In contrast to delay and dissociation, deviancy does not imply a diagnosis but indicates to the clinician that an underlying pathology is likely to be causing the deviancy within that stream and therefore requires further assessment.

Dissociation is an uneven rate of milestone acquisition (DQ) when comparing two or more streams of development. An example of dissociation is seen in a 24-month-old child with gross motor skills at a 12-month age-equivalent (DQ = 50) but with language and visual-motor skills that approximate his or her chronological age (DQs = near 100). In this example, the child demonstrates significant motor delay that is dissociated from other streams of development, suggesting the possible presence of cerebral palsy (see Table 1.1).

Table 1.1. Diagnostic application of delay and dissociation

Motor	Delayed	Normal	Normal
Language	Normal	Delayed	Delayed
Visual-motor	Normal	Delayed	Normal
Probable diagnosis	Cerebral palsy	Mental retardation	Language delay

Gesell's observations and study of normal milestone acquisition, and his contributions of the DQ and the principles of development (delay, deviancy, and dissociation), have provided the necessary components of most standardized developmental assessment tools that have followed Gesell's original test. Gesell's test was revised by Cattell, who considerably shortened the assessment test (Cattell, 1940). Cattell eliminated test items that were cumbersome, items that employed instruments that were used at limited test ages, and items that were subjective in their interpretation and were therefore less likely to be scored consistently. The works of Gesell and then Cattell have been modified further by a number of clinicians dedicated to the study of development in young children, including Ronald Illingsworth (1987), Mary Sheridan (1968), and Nancy Bayley (1969, 1993), among others.

APPLICATION OF DEVELOPMENTAL PRINCIPLES IN EARLY DIAGNOSIS

Language delay is a common complaint that parents bring to the attention of their child's primary care physician. Dr. Capute taught that language delay is a marker for three common disorders in children younger than 36 months but that these three disorders have very different prognoses. The differential diagnosis of language delay includes hearing impairment, mental retardation, and communication disorders.

The three primary differential diagnoses present with similar concerns: failure to understand spoken words, limited vocabulary, lack of phrase or sentence use at appropriate ages, or failure to produce intelligible speech. The age at which children present with these very different diagnoses is similar and therefore not helpful in distinguishing the underlying problem. The average age of presentation for children with mental retardation is 27 months, whereas the average age of presentation for communication disorders is 32 months in the unscreened population (Lock, Shapiro, Ross, & Capute, 1986). Communication disorders consist of a plethora of differential diagnoses including speech production disorders, receptive and expressive language disorders, expressive language disorders, autism spectrum disorders, and selective mutism.

Determination of the etiology of language delay begins with an audiological assessment to rule out hearing impairment. In the presence of adequate hearing, assessment turns to the two cognitive streams of development: language skills and visual-motor abilities. In the primary care setting, one should be able to measure language and visual-motor skills with an instrument that can quantify the rate of development in each stream individually. By using a DQ, one can determine the rate of development within the stream and identify delay. The presence of delay and the application of dissociation form the premises of diagnoses. A child with normal hearing who has

significant delay (DQ < 70) in both cognitive streams is likely to have mental retardation. A child with delay in language but normal abilities in visual-motor skills (dissociation) likely has normal cognition with a communication disorder (see Table 1.1).

THE CAPUTE SCALES

The precursor to the language battery of the Capute Scales was initially introduced in 1973 (Capute & Biehl, 1993). A revised language scale was published in 1978 with the intention of "providing the pediatrician with a scale of linguistic and auditory milestones, which can be rapidly applied within the constraints of a busy practice" (Capute & Accardo, 1978). The original language test battery was known as the Clinical Linguistic & Auditory Milestone Scale (CLAMS). The CLAMS delineated 29 sequential milestones from birth to 24 months of age. In 1986, Capute and colleagues published normative data on the age of attainment of 25 linguistic and auditory milestones in the first 24 months of life, based on parental report of infants and toddlers followed longitudinally (Capute, Palmer, et al., 1986). Following the standardization study, the CLAMS was found to adequately identify children with cognitive delay when correlated to the Bayley Scales of Infant Development (BSID) in a group of children with motor impairment (Capute, Shapiro, Wachtel, Gunther, & Palmer, 1986).

In an effort to provide a means of distinguishing isolated language delays or communication disorders from more global cognitive impairments, a visual-motor battery was added to the existing language scale. The original test measure was called the Cognitive Adaptive Test/Clinical Linguistic & Auditory Milestone Scale (CAT/CLAMS). The visual-motor battery (CAT) was drawn largely from the Cattell test of development but was modified further to make it practical in the office setting. Capute and his colleagues reduced the number of test items and limited the items to those that involve test instruments that cover a wide range of testing ages. Employing test items that can be used across a range of ages minimizes the number of shifts from one test item to another and maintains the engagement of the child. Test items that require subjective interpretation were also removed from the test battery. Finally, the CAT is not timed, in order to avoid penalizing the children with motor dysfunction, who may have poor quality of movement and require more time to execute test items such as arranging blocks or putting pegs into the pegboard.

Hoon and colleagues (1993) assessed the correlation of the CAT/CLAMS DQs and the BSID DQs in children with suspected developmental delay and found strong agreement between the assessment measures. Leppert and colleagues (1998) assessed the correlation of the CAT/CLAMS DQ and the Bayley Scales of Infant Development–Second Edition (BSID-II) DQ in their capacity to detect delay in a population of asymptomatic children with no known risk for delay. Again the DQs proved to correlate well, supporting the use of the CAT/CLAMS as a pediatric assessment tool in the primary care setting.

Most recently, a large multicenter standardization study was undertaken to assess the age-equivalents of visual-motor milestone attainment and to reassess the accuracy

of attainment ages of language milestones as given in the Capute Scales. The details of the standardization study described in Chapter 5 support the current milestone age-equivalents in both streams of the Capute Scales (Visintainer, Leppert, Bennett, & Accardo, in press).

CLINICAL APPLICATION OF THE CAPUTE SCALES

The CLAMS measures both receptive and expressive language milestones. Expressive language milestones are recorded from parental reports of verbal abilities (a great asset of the test because many children younger than 3 years are reluctant to speak to unfamiliar examiners). Because of this reliance on parental history, however the examiner must be assiduous in the collection and verification of language information. In the CLAMS, 26 expressive language milestones exist across 19 test ages. Receptive language milestones combine historical information from the parents as well as directed demonstration of the understanding of specific concepts by the child. Across the 19 test ages, 11 of the 17 receptive language skills require demonstration of understanding in order to be credited. Most of these demonstrations, however, require an action rather than a verbal response; therefore, compliance is generally maintained, even with children who are very shy.

Three phases of expressive language development are reflected in the CLAMS: guttural, prelinguistic, and linguistic (Capute, 1996). The guttural phase (from birth to 2 months) consists of physiological noises, burping, sneezing, crying, yawning, and so forth. Vocalizations in the guttural phase are in no measure an attempt at social interaction. The prelinguistic phase (from 2 to 11 months) consists of true attempts at reciprocal social interaction but at a level that falls short of true word use. The prelinguistic phase begins with cooing, then advances to ah-gooing, razzing, babbling, and saying "mama" and "dada" in a nonspecific manner. The linguistic phase begins at about 11 months with the use of "Mama" and "Dada" specifically for the respective parents and with the introduction of single-word use.

The CAT also consists of 19 test ages across which 57 visual-motor milestones may be measured. The equipment for the CAT consists of only 11 test items that are employed through a wide range of test ages. The child must demonstrate all of the milestones on the visual-motor scale; some spontaneously, and some after demonstration by the examiner. Each testing should begin two age sets below the child's expected functional level and proceed until the highest age set at which the child performs any test items. As with the CLAMS, Capute (1996) described stages of visual-motor development. At 1 month, a child uses eyes only and fixes momentarily on a red ring held 12–18 inches from his or her eyes. At 2 months, the infant can use his or her eyes and head together to follow the red ring in horizontal and vertical planes across the midline. At 3 months, the child's eyes and head are used together in a more mature fashion and can follow the ring in a 360-degree circle. At the same time, the infant exhibits a visual threat response. At 4 months, the infant can employ

the eyes, head, and hands together to do progressively more difficult visual-motor tasks to demonstrate nonverbal cognitive abilities.

The DQ is one means by which the CAT and CLAMS are scored. Again, the DQ and the principles of delay, deviancy, and dissociation are used diagnostically in the interpretation of the Capute Scales. When delay is seen in both cognitive streams—language and visual-motor—and no dissociation occurs between those delays, one considers mental retardation as the primary diagnosis for the child being tested. If, however, delay is only seen in the language stream of development, and a normal developmental rate is present in the visual-motor stream, dissociation is present. This pattern of development, in which language is delayed and visual-motor abilities are within normal limits, indicates that overall cognition is normal but a communication disorder is present. Deviancy can be appreciated within the language stream in a child who has receptive language skills that far exceed his or her expressive language skills. This pattern of deviancy implies the presence of an expressive language delay. If, however, both expressive and receptive language skills are delayed and are dissociated from the visual-motor skills, the communication disorder includes both receptive and expressive language disorders (see Table 1.2).

Capute formulated the Scales for developmental assessment as a tool to enable primary care providers to better diagnose a child who presents with delays at a cognitive age of younger than 36 months. Nearly three decades of clinical and research experience with the Capute Scales attest to the success of Capute's objectives (Capute & Accardo, 1978). The Capute Scales have proven to be a practical tool for use in the primary care setting. The test batteries are generally completed in 6–15 minutes, they require a small number of test items, and they are efficient in quantifying delay in the cognitive streams of development—language and visual-motor skills. The Scales are therefore useful in differentiating communicative disorders from mental retardation as a cause of language delay by applying principles of delay and dissociation to the interpretation of the test scores. Appropriate early primary care assessment is the basis by which care providers make developmental diagnoses, counsel families, and guide them toward appropriate intervention services. Although the Capute Scales have been used extensively for clinical assessment by neurodevelopmental pediatricians, given the limited training requirements they can also be administered successfully by a wide range of pediatric health care providers, including pediatric neurologists, child psychiatrists, general pediatricians, family physicians, fellows in neurodevelopmental disabilities, pediatric neurology, or child psychiatry, nurses, nurse practitioners, physician assistants, pediatric or family practice residents, and medical students.

Table 1.2. Interpretation of language delay and dissociation

Expressive language	Delayed	Delayed
Receptive language	Delayed	Normal
Probable diagnosis	Receptive and expressive language disorder	Expressive language disorder

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