

## **Audiologic Aspects of Learning and Behavior**

**Craig B. Liden**

**(Pediatric Clinics of North America, Vol 28, No 4, November 1981)**

Over the past decade, issues of child development and behavior have moved into a prominent position in the mainstream of general pediatric care. This has been characterized by an expanded definition of health to include not only "quantity of life" but also "quality of life" for the child. Efficient learning and appropriate behavior have become significant measures of outcome of high quality primary health care for the child. Contemporary societal demands have substantially contributed to this trend. Most prominent in this regard has been the passage of Public Law 94-142, the Education for All Handicapped Children Act. This law mandates a role for the physician in the identification, assessment, and development of individualized educational programs for all handicapped children. National figures suggest that 10 to 20 per cent of all children belong to this category (for example, those who are learning disabled, emotionally disturbed, mentally retarded, physically handicapped, or sensory impaired). As a consequence of increased awareness of the interrelationship of educational and health factors, educational professionals and parents have increasingly turned to pediatricians, general practitioners, and otolaryngologists among others for consultation when problems arise in a child's learning or behavior. This frequently takes the form of asking the physician to provide a simple etiology, such as hearing loss, to explain the problem.

For the most part, physicians have been poorly prepared to meet this demand. The absence of a unifying theory of development and behavior and the lack of a universally understood and accepted taxonomy of problems has placed several methodologic constraints on research and clinical activity in this area. Attempts to rigidly apply the traditional "medical model", with its focus on defining etiology, to issues of learning and behavioral failure has generally been unrewarding. Furthermore, by its very nature development (and thereby learning) implies change over time. Similarly, behavior varies depending on the context in which it occurs. Therefore, by definition, a certain degree of ambiguity is a part of all learning and behavioural problems. This inherent uncertainty is magnified when data are reconstructed retrospectively as is often the case when assessing a learning or behavioural problem. Failure to acknowledge these factors when assessing and managing children with learning and behavioral problems may result in applying simplistic solutions to complex problems.

These issues have been clearly demonstrated with respect to audiologic factors and their relationship to learning and behavioral function. Recent studies have suggested that chronic or recurrent otitis media during early life is associated with impairments of language or cognitive development or with poor academic achievement. Others have inferred that this relationship has a cause and effect nature. A critical review of the literature reveals that all reported studies suffer from major limitations in design or method. Despite these weaknesses, some professionals have called for mass screening programs to detect middle ear effusion or have advocated aggressive treatment measures upon the recognition of the presence of middle ear effusion.

In order for physicians to define an appropriate role in responding to specific questions about the contribution of audiologic factors to learning and behavioral failure, it is necessary for them to have an understanding of the relationship of these factors to other aspects of learning and behavior and an awareness of basic principles of child development. This article synthesizes these basic scientific facts into guidelines for decision making for the clinician.

### **Components of Learning and Behavior**

A variety of theories of child development and behavior exist in the contemporary literature which are, for the most part, poorly integrated. Theoreticians from a variety of disciplines have evolved their own terminologies, which are rarely interchangeable, to describe development and behavior. A functional model of these components is presented here as a working foundation for the clinician, and is not intended to be definitive or all inclusive.

The elements of a single learning episode or behavior can be broken down into four basic components: intake systems, information processing, output systems, and neurobehavioral functions.

1. *Intake Systems.* The first component refers to the integrity of sensory systems bringing information or stimuli into the central nervous system. Most important in this regard is auditory and visual acuity. Objective procedures and criteria exist to define the adequacy of these systems.

2. *Information Processing.* This component involves the processing of information which enters the central nervous system. Basic scientific knowledge about this phenomenon is sparse as the discrete processes postulated to be involved occur exclusively within the central nervous system. There is no direct way to describe and characterize these processes. Rather, it is necessary to make indirect inferences about them based on observations of responses to stimuli presented to the central nervous system (CNS) through intact sensory systems.

The various stages of information processing can be viewed as having a sequential relationship to one another. *Perception* entails the initial discrimination of information presented to the CNS through the sensory systems in terms of such parameters as form, space, position, sound, pattern, and sequence. *Integration* includes the interpretation of the pattern or sequence of information, the melding of information input through differing sensory systems, the retrieval of past information, and the formation of ideas. The next component, *encoding*, involves output processing including the selection of mode of output.

Other terminology frequently used to describe these components of information processing includes auditory discrimination, auditory processing, receptive language (comprehension), expressive language (word retrieval), auditory sequential memory, visual perception, spatial organization, visual sequential memory, higher order conceptualization and immediate recall, and short and long memory. A bevy of standardized language, psychological, and educational tests has been developed to attempt to describe strengths and weaknesses of these components in the individual child.

3. *Output Systems*. This level includes the mobilization and integration of motor output systems which result in a demonstrable act of learning or behavior. This includes visual motor integration, articulation, and body movement and control. Information from this act and its consequences feed back into the system through sensory intake systems.

4. *Neurobehavioral Functions*. Each of the three previous components are influenced and modulated by a variety of neurobehavioral functions. *Neuromaturation* can be arbitrarily defined as the underlying neurologic maturity and organization of the developing child. In this sense, it can be postulated to include such things as state of myelination, degree of integration between discrete systems, and efficiency of neuroregulatory processes. Clinically, neuromaturation may be measured through observing the presence of so-called primitive reflexes and soft neurologic signs. *Temperament* refers to those presumed intrinsic behavioral characteristics that influence a child's interaction with the environment. Nine components of temperament have been described. In general, children belong to one of three temperamental types (easy, difficult, or slow to warm up) based on ratings in these categories. Recent studies suggest a relationship between certain extreme temperamental ratings and learning and behavioral problems. Currently, temperament can only be measured through subjective rating scales that are susceptible to observer bias. Although the concept of *attention* is encompassed in several of the categories of temperamental function, it warrants special consideration. Attention refers to more than attention span or vigilance and includes the child's state or level of arousal, cognitive tempo (balance between impulsivity/reflectivity), purposeful focusing and filtering of distractions, and monitoring (quality control) of information attended to. Like temperament, attention and its component parts are most frequently subjectively assessed in a clinical setting.

Although these components of learning and behavior may not bear a linear relationship to one another as implied in the graphic model presented here, it is important to note that inefficiencies in any one component may have overflow or cascading effects on other components. The individual components are reciprocally dependent on each other in order to ensure efficient functioning.

### **Principles of Development and Behavior**

From a review of the contemporary literature on child development, it is possible to synthesize a set of philosophical premises upon which an assessment protocol to address school failure and its possible audiologic components can be based. These premises include the following:

1. *Multiplicity of factors influencing development*. A wide variety of factors significantly impact on a child's development. These include, but are not limited to, biological, psychological, economic, sociological, and educational risk factors.

2. *Continuum of casualty*. These developmental risk factors do not necessarily impact on an individual child in an "all or none" fashion. Furthermore, children may respond differentially to the same risk factors. Outcomes of exposure to risk factors characteristically vary along a continuum ranging from a full expression of a physical or behavioral problem,

to partial expression, to no expression at all. Limitations in our current state of knowledge preclude accurate prediction of a child's specific response to a given exposure.

3. *Transactional scheme of development.* A child's functional status at any point in time is the product of a series of transactions between constitutional factors (intrinsic qualities) and environmental factors and life events. These reciprocal interactions are constantly evolving and are unique for each child. The vast majority of learning and behavioral problems are not simply the result of a unidimensional progression of a single risk factor operating in a cause-effect manner. Rather, research over the past decade has shown that learning and behavioral dysfunctions more often result from reciprocal interactions over time between constitutional and environmental factors. A truly comprehensive assessment of a child's development can only be achieved when the reciprocally interactive relationships between various parameters of constitutional and environmental development are addressed.

4. *Age interacts with risk factors.* The level of dysfunction associated with exposure to a potential risk factor varies as a function of age of occurrence, duration, and intensity.

5. *Manifest dysfunction interacts with environmental demands.* The expression of a dysfunction (ranging along a continuum of casualty) varies as a function of the performance demands made by the environment. Environmental demands vary according to age-related expectancies, culture, socioeconomic level, and the presence of family life stress events. Therefore, dysfunction in childhood (learning failure or behavioral problems) can be seen as the product of constitutional predispositions of a child that have interacted with environmental influences. The intrinsic predispositions may be present at birth but manifest themselves only when the environment requires efficient performance.

6. *Behavioral commonality of heterogeneous underlying weakness.* There is a commonality to the behavioral manifestations of a wide variety of underlying developmental or behavior weaknesses. That is, a child with a conductive hearing loss, one with a receptive language problem, or one with an attention deficit disorder may all clinically be seen as having a short attention span and being highly distractible. Only a comprehensive assessment process can delineate underlying differences which may require vastly different management strategies.

## **Clinical Applications**

*Common diagnostic process applied to learning and behavioral dysfunctions.* Utilizing the model of components of development and behavior and integrating the theoretical framework presented previously, it is possible to define a common diagnostic process that can be applied to a spectrum of learning and behavioral complaints. Although satisfactory approaches to these problems by nature require multidisciplinary input, this flow diagram provides a framework for decision making for the clinician. In this sense, it provides a guideline for defining the diagnostic elements necessary for comprehensive assessment and management of these problems. Similarly, for the consultant asked to attend to potential audiologic aspects of a problem, it reinforces the necessity for a comprehensive approach in order to avoid premature diagnostic closure or the onset of treatment protocols that address only an isolated component of a complex process.

The vast majority of learning and behavioral problems present to the physician as the result of a disparity between an expectation of efficiency and actual performance in any life sphere: home, school, or medical. Owing to the commonality of presenting manifestations of a wide variety of underlying dysfunctions, all learning or behavioral problems warrant some level of execution of this diagnostic process, the depth and intensity varying with the severity of the problem. Whether the physician is the first professional contacted or is brought in later as a consultant, he should ensure that each component of this process has been executed in order to generate a comprehensive management plan. The components of this common diagnostic process are as follows:

*Historical data collection - the child.* This should be a survey of potential risk factors including familial, pregnancy, perinatal, early health, delayed developmental milestones, temperamental dysfunctions, and somatic dysfunction such as enuresis or encopresis.

*Physical assessment.* At the most basic level this should include a functionally relevant physical examination including a traditional neurologic examination and basic sensory acuity screening.

*Neurodevelopmental assessment.* This should include an assessment of the components of development and behavior described previously (information processing, output systems, and neurobehavioral functions). A variety of assessment batteries are available to define strengths and weaknesses in the following areas of function: gross and fine motor skills, sequencing, retention, visual/perceptual, auditory/language, neuromaturation, temperament, and attention.

*Psychosocial assessment.* This should include an assessment of bonding/attachment dysfunction, disordered parent expectations, associated behavioral dysfunction, diminished self-esteem, management/discipline difficulties, inadequate support systems, and life stress events.

*Psychoeducational assessment.* This should include a history of past educational difficulties, manifest performance failure on psychoeducational testing, disordered school expectations, inadequate educational programs, and attention inefficiency.

*Case formulation.* With learning and behavioral problems, case formulation should entail a description of strengths and weaknesses with respect to constitutional medical, behavioral, and developmental function; environmental strengths and weaknesses; and the transactions between constitutional and environmental factors. The goals of this process are to define etiology if possible, focus the need for further evaluation or services, and serve as the basis for re-ordering expectations and setting treatment objectives.

*Addressing the audiologic question.* When a child is referred to the clinician for an evaluation of potential audiologic contributors to a learning or behavioral problem, the same diagnostic process should be applied in a limited fashion. Clearly, the physician needs to answer the specific medical question posed and to judge whether a particular medical factor directly contributes to the presenting behavioral or learning problem. Clearly, sensory deficits, like other medical factors, frequently do occur in children with learning or behavioral

problems; however, they rarely provide a simple answer to the problem. Therefore, the clinician must also search for other variables that may be additional significant contributors (such as temperament dysfunction or chronic inattention). If these are present, it is important to ascertain whether a comprehensive diagnostic approach has been undertaken. A referral to a multidisciplinary team (through the school or other setting) is indicated when this approach has not been taken.

*Screening and early intervention.* Although most professionals agree that early identification and intervention are the ideal with respect to successful outcome of learning and behavioral problems, the clinicians must avoid the temptation to prematurely transfer scientific knowledge to the clinical domain. This is particularly relevant to audiologic aspects of these problems. Most of our basic scientific knowledge in this area is just evolving. Therefore, in the primary care or consultative setting when faced with a child with an audiologic deficit, such as otitis media with conductive hearing loss, the clinician must strike a critical middle ground. The medical problem needs to be addressed in a rigorous fashion. Its *potential* relationship to learning and behavioral dysfunction should *not* alter or influence either the kind or intensity of treatment unless clearly indicated. Rather, this possible association should be acknowledged by the application of a comprehensive data collection process. This means screening such children longitudinally for associated delayed developmental attainment, temperamental dysfunction, school performance failure, attention inefficiency, somatic dysfunction, and behavioral dysfunction and referring these children for more comprehensive assessment and treatment when such factors are present. To do otherwise runs serious risks for the individual child and the family in terms of the damage of self-fulfilling prophecies and for society as a whole in terms of costly interventional procedures that ultimately may do little good. To truly address the needs of children, this phenomenon, which has characterized the fields of child development and education over the past three decades around a variety of medical factors, must be avoided.

*Therapeutic implications.* The efficacy of treatment of learning and behavioral problems is directly dependent on precisely describing the strengths and weaknesses and their interactions which are generated by the diagnostic process. By their nature, these problems require comprehensive treatment plans. For a given child this may mean medical treatment (such as resolution of a sensory deficit or treatment with a stimulant medication for attention inefficiency), behavioral treatment (such as behavioral management guidelines, behavior modification, or psychotherapy), and educational treatment (such as learning disabilities tutoring, language therapy, or remedial reading). Furthermore, success in one treatment modality is rarely independent of others. Therefore, it is imperative for clinicians not to view their roles as providers of an isolated answer and cure, but rather as important team members in a comprehensive process. Although parents and schools often desire such a neatly packaged answer, it rarely can be provided and can be a disservice to the child if it precipitates the withholding of other necessary services.

## **Summary**

To effectively deal with learning and behavioral problems, physicians must acquire a new knowledge base and interact meaningfully with professionals from a variety of disciplines. They must be aware that audiologic factors are only one part of a complex matrix of components contributing to learning and behavior. Although the exact nature of these

components is still being defined, their interrelationship can be hypothesized. An individual can overcome the uncertainties and avoid inappropriate diagnoses in this field by applying a comprehensive, descriptive diagnostic process. With a broad understanding of the transactional model of learning and behavior, physicians can ensure that audiologic problems are defined and addressed appropriately. By acknowledging this approach in the identification, assessment, and management of children with learning and behavioral dysfunction, the physician can become a powerful advocate for these children.