Differential Diagnosis of Severe Speech Impairment in Young Children

by Edythe A. Strand and Rebecca J. McCauley

Severe speech impairment may result from a variety of etiologies and may represent linguistic impairment, motor speech impairment, or both. Differential diagnosis typically refers to the process of determining the appropriate classification or label for the speech sound disorder, such as phonologic impairment, childhood apraxia of speech, or dysarthria. More important than the label, however, is the determination of the relative contribution of cognitive versus linguistic versus motor impairment, because children with speech sound disorders frequently exhibit impairment in more than one area. Determining the degree to which the child is struggling to learn the rule-governed system of phonology, compared with having problems with planning and programming movement gestures for speech, directly affects appropriate treatment planning.

This article offers a look at the clinical decision-making processes used in differential diagnosis for children suspected of speech sound disorders. Because the focus will be on children with severe impairments, it deals with territory in which clinicians may feel uncertain or at least less confident.

Terms, Labels, and Categories

Before beginning a discussion of differential diagnosis, it is important to delineate the different terms used frequently to denote levels of impairment. The term "phonological disorders" often is used to refer to the entire range of developmental communication disorders in which sound production is principally affected. More recently, however, the broad range of disorders involving speech sound production is referred to as "speech sound disorders." This usage also reserves the term "phonological disorders" to refer to a linguistic level of impairment.

Another subset of speech sound disorders is "childhood apraxia of speech" (CAS). Most definitions of CAS focus on the child's difficulty planning and/or programming purposeful voluntary movements for speech in the absence of weakness or paralysis of the speech musculature. Until recently there has been controversy regarding the specific behavioral markers that should be used to identify this level of impairment. The ASHA position statement on CAS now provides a definition of the disorder and a list of behavioral characteristics associated with it (ASHA, 2007). That document defines CAS as:

> *"a neurological childhood (pediatric) speech sound disorder, in which the precision and consistency of movements underlying speech are impaired in the absence of neuromuscular deficits (e.g., abnormal reflexes, abnormal tone). CAS may occur as a result of known neurological impairment, in association with complex neurobehavioral disorders of known or unknown origin, or as an idiopathic neurogenic speech sound disorder. The core impairment in planning*

and/or programming spatio-temporal parameters of movement sequences results in errors in speech sound production and prosody." (p. 6)

"Dysarthria" is a collective term for a group of related motor speech disorders resulting from disturbed muscular control of the speech mechanism due to damage to the central or peripheral nervous system. Dysarthria manifests as disrupted or distorted oral communication due to paralysis, weakness, abnormal tone, or incoordination of the muscles used in speech. Processes of phonation, respiration, resonance, articulation, and prosody are affected. Movements may be impaired in force, timing, endurance, direction, and range of motion. In some types of dysarthria, involuntary movements (dyskinesias) occur, disrupting articulatory output. Symptoms may include slurred speech, weak or imprecise articulatory contacts, weak respiratory support, low volume, incoordination of the respiratory stream, and hypernasality. Table 1 shows phonologic impairment, CAS, and dysarthria in relation to a very basic model of speech production.

Another term frequently used in diagnostic reports is "oral-motor deficits." The use of this term can be problematic because it can mean different things. Clinicians sometimes use this term to indicate problems with speech production and other times to mean deficits in nonspeech oral movement. A child who has nonverbal oral-motor problems because of actual weakness or paralysis will also have associated problems in speech production, for which we use the term dysarthria. Alternatively, a child may have nonverbal oral-motor problems because of difficulty with praxis, which is defined as the ability to conceptualize, plan, and program skilled volitional movement. Children may have difficulty with praxis for volitional nonspeech oral movement (e.g., blowing, kissing), which is called nonverbal oral apraxia. If the child has difficulty with praxis for the intentional action of movement toward a speech goal, we use the term CAS for the type of communicative disorder. Nonverbal oral apraxia sometimes, but not always, occurs in combination with CAS (see Figure 1. p. 12).

Differentiation between movement planning versus movement execution can be conceptually and practically difficult and is often at the heart of differential diagnosis of severe speech impairment. Our assessment procedures and interpretation of assessment data help in that challenge.

Table 1. Relationship between specific functions and possible communication disorders.

Function	Neural Process	Possible Communicative Disorder
Communicative idea	Cognitive	Pragmatic language deficit (difficulty demonstrating communicative intent)
Word retrieval Phonologic delay/impairment Syntactic/grammatical ordering	Linguistic	Language delay/impairment Phonological mapping
Specifying range of motion, direction, speed and force of movement	Motor planning and programming	Childhood apraxia of speech (CAS)
Execution of movement resulting in acoustic output	Motor execution	Dysarthria

Assessment Procedures

Differential diagnosis results from a full battery of assessment tasks and standardized tests, including complete language testing. This discussion, however, focuses on those aspects of the assessment that relate to differentiating the relative contribution of phonologic impairment versus CAS versus dysarthria in children with severe speech sound impairment.

*See **Diagnosis** page 12*

Diagnosis from page 11

Differential diagnosis is difficult and it is not always possible to be "sure." It is important to think in terms of relative contribution of phonologic, motor planning, and motor execution problems, and plan treatment accordingly.

History

As we obtain information about the course of speech development and identify suspected etiological factors and co-existing problems, certain observations can provide supportive evidence toward diagnosis. Table 2 (p. 13) shows comparative findings across children with different speech-sound disorder classifications. Note that findings often overlap, and these observations alone are not sufficient for decisions regarding diagnosis.

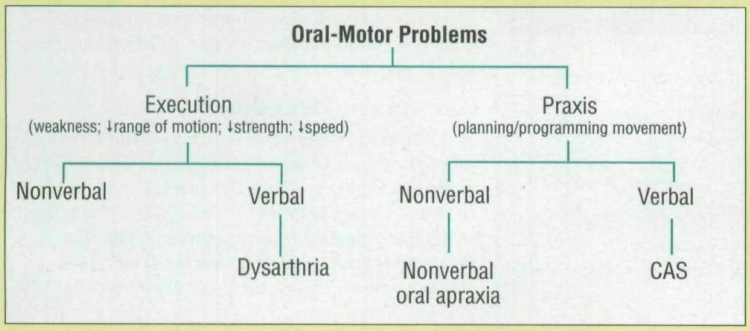
Sound System Assessment

The description of the sound system may involve describing phonetic and phonemic inventories (independent analysis) as well as standardized tests (McCauley & Strand, 2008) in which the child's phonologic performance is compared to a normative sample (relational analysis). Observations of processes seen in normal development (e.g., assimilation, fronting, cluster simplification, stopping) are noted, along with those that are nondevelopmental (e.g., use of favorite sound, glottal replacement, initial consonant deletion, idiosyncratic cluster reduction). Observations regarding syllable and word shapes used by the child can aid in differential diagnosis. For example, children with phonologic impairment and children with CAS both may exhibit reduced phonetic and phonemic inventories, but children with CAS will often show relatively fewer vowels and less vowel differentiation. Children with CAS will also show more inconsistency over repeated trials and more nondevelopmental types of errors.

Oral Structural-Functional Examination

An oral structural-functional exam will determine or rule out the presence of nonverbal oral apraxia and dysarthria. This task is appropriate for these purposes because interpretation of movement is made in a nonspeech context. Observations of the size and relative position of each structure allow the clinician to formulate hypotheses regarding possible structural deficits related to sound-production disorders. Interpretation of the function (range of motion, strength, speed, coordination, and the ability to vary muscular tension) of each moveable structure of the speech mechanism during nonspeech tasks allows the clinician to determine whether neuromuscular deficits contribute and/or if there are praxis problems for nonspeech oral movements.

Figure 1. Specific terms related to "oral-motor" problems.



Typically, children with phonologic impairment and children with CAS exhibit normal performance for range of motion, strength, speed, coordination, and the ability to vary muscular tension, and children with dysarthria will exhibit impairment. Oral nonverbal apraxia is more likely to be seen in children with CAS than in children with dysarthria or phonologic impairment, but many children with CAS exhibit normal oral praxis.

Clinical reports sent to us commonly note the observation of "weakness." We see this description even for children who come in with good bilabial or lingual alveolar plosing during vocal play or babbling. One must be careful in judgments of weakness. For example, even children with low tone can have normal strength. Tone relates to the state of the muscle contraction at rest. Strength relates to the degree the child can recruit motor units to contract muscle fibers to move a structure. A child who can produce a plosive sound with good clarity and volume likely has adequate strength for speech.

The structural-functional examination includes testing each of the five parameters (range of motion, speed, strength, the ability to vary muscular tension, and coordination) for each structure in isolation. The motor-speech examination includes observations about interaction of movement among structures (Strand & McCauley, 1999). These observations are important because during connected speech, the relative severity of impairment across structures and across the five parameters may be difficult to determine. Consider, for example, that a child with weak tongue movement can use the jaw to compensate during speech.

It is also important to remember that children exhibit a large range of variability in their responses to these tasks. For example, it would be a mistake to say that a delay in talking is due to "weakness" or "incoordination" when the child really just didn't understand

the task or was unwilling to perform it. The results of the structural-functional exam should be interpreted in conjunction with all other assessment observations.

Motor-Speech Examination (MSE)

The MSE is an essential tool for clinicians faced with the challenge of differential diagnosis of severe speech-sound disorders. In this task the child is asked to imitate utterances of increasing length and phonetic complexity. The purpose of the MSE is to examine the child's ability to sequence phonetic segments imitatively in various contexts. This examination allows the clinician to make observations of those behaviors frequently associated with deficits in speech praxis, including vowel and consonant distortions, timing errors, dysprosody, and inconsistency across hierarchically organized stimuli. These observations allow the clinician to determine the degree to which motor-planning deficits may contribute to the child's difficulty with speech acquisition. By adding dynamic assessment strategies (e.g., observing the child's responses to hierarchical cueing such as slowing the movement, providing tactile and gestural cues) to the MSE, decisions regarding severity and prognosis can also be made. The MSE also helps with decisions regarding the phonetic content and syllable shapes appropriate for the initial stimuli.

Children with phonologic impairment and CAS will perform differently on motor-speech examinations, although performance will vary with severity. In general, children with CAS will exhibit relatively more vowel distortions, occasional groping for articulatory positions for utterances they have not previously produced, inconsistency over repeated trials, inconsistent voicing errors, lexical stress errors, and segmentation of multisyllabic words.

From Diagnosis to Treatment

Differential diagnosis for children with severe speech-sound disorders is critically important because correct diagnosis leads to the appropriate treatment. Different treatment approaches and techniques are indicated for deficits in motor execution (dysarthria), the planning required for skilled movements of speech (CAS), or the child's underlying knowledge of the sound structure of the language (phonologic impairment). The clinician must also differentiate speech delay that reflects deficits in and therefore dictates treatment of the language from cognitive bases for communication, such as those found in many children with more severe mental retardation or autism spectrum disorders.

Differential diagnosis of severe speech-sound disorders is difficult and it is not always possible to be "sure." It is important to think in terms of the relative contribution of phonologic, motor planning, and motor execution problems, and plan treatment accordingly. To do the best we can for children, clinicians need to consider all the assessment data and avoid placing too much importance on any one observation. It is important to be careful in the use of terminology such as "oral-motor deficits," to be precise in denoting problems with praxis for nonspeech movement versus speech, and to denote speech praxis problems versus problems with execution of movement.

Finally, we need to remember that classifications or labels may change over time with neural maturation and appropriate treatment. For example, children with CAS often progress to the point at which speech characteristics are more appropriately labeled phonologic impairment or residual articulation errors. Assessment does not end with the initial differential diagnosis; it continues as we measure the effects of treatment. Differential diagnosis also continues as children exhibit changing speech production characteristics as a result of our intervention.

Table 2. Comparison of typical findings across children with phonological disorders only versus CAS versus dysarthria.

Phonological Disorder Only	CAS	Dysarthria
Delays in intelligible speech	Delays in intelligible speech	Delays in intelligible speech
Frequent family history of communication disorders, often similar to the child's	Frequent family history of communication disorders, often similar to the child's	Possibly no family history
Frequent reports of otitis media	Some reports of feeding problems and oral-motor concerns	Frequent reports of feeding problems and oral-motor concerns
Usually no problem with babbling	Reduced quantity of vocalization/babbling in early history; frequent report of few babbled consonants and lack of vowel differentiation	Ability varies depending on the type and severity of the dysarthria
Usually no neurologic signs	Reports of soft neurologic signs (e.g. gross- and fine-motor delays)	Reports of frank neurologic signs

***Edythe Strand** is a consultant in the Division of Speech Pathology, Department of Neurology, at the Mayo Clinic (Rochester, Minn.) and an associate professor in the Mayo Medical School. Her primary clinical and research interests include assessment and treatment of children and adults with neurologic speech, language, and voice disorders. Contact her at strand.edythe@mayo.edu.*

***Rebecca McCauley,** a professor in communication sciences at the University of Vermont, will soon join the faculty of the Department of Speech and Hearing Science at Ohio State University. She has served on ASHA committees related to the effects of oral motor exercises on speech and swallowing and childhood apraxia of speech (ASHA, 2007). Contact her at rebecca.mccauley@uvm.edu.*

Photos by Ben Sledge of the Language-Learning Early Advantage Program at the University of Maryland (UM), College Park. Pictured are UM students Jessica Bauman, Lauren Graham, and Lauren Polovoy.

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