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Foreword

To effectively treat a child with childhood apraxia of speech (CAS), a speech-language pathologist (SLP) needs to consider and understand all of the various components of the child's speech system. The SLP must understand the child's phonetic skills, including consonant, vowel, and syllable shape production capabilities. The SLP must understand how accurately the child uses and combines those consonants and vowels into syllable shapes to realize verbal targets. In addition, the SLP needs to understand the child's suprasegmental production capabilities. Unless working with a child with a motor speech impairment, it is rare for an SLP to assess, analyze, and treat components of a child's suprasegmental system; rate of speech, intonation, word and sentence stress, and rhythm are elements of speech that only infrequently attract the attention of pediatric SLPs. The broad scope and depth of understanding of speech that are required to work with children with CAS present real challenges, ones that can be overwhelming, especially for SLPs who lack education about CAS and/or experience working with children with motor speech impairment. In the American Speech-Language-Hearing Association's recently published Technical Report on CAS (2007), SLPs lacking knowledge about CAS or experience working with children with CAS were charged with obtaining the knowledge and skills necessary to be able to work efficiently and effectively with children with this challenging speech sound disorder.

Even when SLPs possess the necessary knowledge and experience to work with children with CAS, designing, planning, and conducting intervention is difficult because of a dearth of treatment efficacy research specific to CAS. More often than not, SLPs must rely on expert clinical experience to help guide the intervention process. Although researchers continue to investigate specific interventions, clinicians must continue to provide services. Another complicating factor is that children with CAS present with highly individualized speech and language profiles that necessitate developing intervention goals, objectives, and strategies that also are highly individualized. No other disorder of speech presses SLPs to assess, treat, and monitor the many components of a child's speech system on an on-going basis as does CAS.

Therefore, it should not be surprising when, as SLPs, we find ourselves at a loss for intervention ideas when faced with a child with CAS. Luckily, even SLPs with widely varying levels of knowledge and skills in treating children with CAS—from introductory to expert—will find an abundance of appropriate, practical, and when available, evidence-based practice information in Margaret Fish's book, *Here's How to Treat Childhood Apraxia of Speech*. The scope of this book is as broad as the speech symptoms characteristic of CAS.

The book opens with a section on necessary and helpful introductory information that covers the definition and characteristics of CAS (Chapters 1 and 2). Issues regarding assessing children with CAS then are discussed (Chapter 3), with the author providing enough detail to give the SLP a basic understanding of the multifaceted nature of diagnosing this motor speech disorder. Understanding the many facets of CAS builds the foundation from which the SLP can begin to think about intervention.

In Part II, the author presents a framework that can be used to support SLPs as they make decisions regarding the structure of their intervention. Factors such as practice schedule, treatment schedule, selection of treatment targets, feedback schedule, and cueing techniques, among others, need to be decided prior to beginning to work with a child with CAS. The author both summarizes and frames the related literature on CAS that SLPs will find helpful as they structure evidence-based interventions.

Part III contains 10 chapters dedicated to intervention ideas, strategies, scripts, and plans that target a wide variety of areas affected by CAS. The interventions are based on a combination of published and presented research and the author's 28 years of pediatric clinical experience. SLPs will find tried-and-true approaches intermixed with novel intervention ideas. All of the interventions in the book are detailed, developmental (when appropriate), creative, and practical and can be implemented in any setting. Intervention topics span a large range, including how to treat vowel misarticulations (Chapter 9), prosody disturbances (Chapter 10), phonetic complexity challenges (Chapter 11), expressive language delays (Chapter 12), literacy delays (Chapter 14), and social language problems (Chapter 16). Chapter 17 was written to help SLPs design sessions in which books and music can be incorporated into therapy as a means to stimulate a child's interest in therapy and to facilitate his or her verbal output. There also are chapters that address how to work with children with CAS who are minimally verbal and/or on the autism spectrum (Chapters 13 and 18), as well as how to incorporate augmentative communication into intervention (Chapter 15). To put all of those new intervention ideas into action, the author includes a chapter on how to develop and write an effective treatment or individualized education plan (Chapter 19). No other single resource is available today that approaches the comprehensiveness of this text on intervention with its emphasis on the changing nature and structure of treatment over time.

The concluding chapter is devoted to working with parents. Indeed, some of the most rewarding time spent working with children with CAS is the time spent getting to know and work with their family members. SLPs often work with children with CAS for many years, and the author provides suggestions for how SLPs can build a partnership with parents so that intervention does not end when the child leaves each session. Parent support and education, as well as home practice, can be critical to facilitating generalization of the child's new motor speech skills.

The sheer scope of this book, the attention to published literature, and the author's many years of clinical experience and expertise in CAS and severe speech impairment combine to make this a one-of-a-kind and must-have resource. For a disorder that can be so difficult to treat, students as well as new and seasoned SLPs will find this book to be

an invaluable guide. The new and the experienced SLPs among us will find many useful surprises in this book, surprises that we can use to improve and update our work with children with CAS.

Kathy J. Jakielski, Ph.D., CCC-SLP
Florence C. and Dr. John E. Wertz
Professor in Liberal Arts and Sciences
Augustana College
Rock Island, IL

Reference

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Characteristics of Childhood Apraxia of Speech

Researchers have described numerous speech and nonspeech characteristics observed in children with apraxia. Many of these characteristics, however, also are observed in children with other types of speech–sound disorders. For example, a child with CAS frequently has better receptive language than expressive language. This receptive-expressive language gap is not specific to children with CAS. High degrees of unintelligibility and late speech development also are features of CAS that are shared by children with a variety of speech and language disorders. Given that many speech and nonspeech behaviors are common both to children with CAS and children with other severe speech and language disorders, it is important to determine whether a child's cluster of observed behaviors points toward a core deficit in planning and programming of speech movement sequences.

Characteristics Most Specific to CAS

The ASHA Ad Hoc Committee on Apraxia of Speech in Children (ASHA, 2007) described three diagnostic features "that are consistent with a deficit in the planning and programming of movements for speech" (p. 4). These three segmental and suprasegmental features include the following:

- "***Inconsistent errors* on consonants and vowels in repeated productions of syllables or words"**
  This feature refers to *token-to-token variability*, or variations in the way a specific word is produced. For example, within the same session, a child may produce *banana* as "babana," "bana," and "nana."

- *"Lengthened and disrupted coarticulatory transitions between sounds and syllables"*
  Children with CAS may demonstrate prolonged pauses between phonemes, syllables, and words resulting from challenges making smooth articulatory transitions from phoneme-to-phoneme or syllable-to-syllable. The pauses and breaks between phonemes may give the child's speech a staccato quality. When coarticulatory transitions are disrupted, the child also may exhibit articulatory productions that negatively impact speech intelligibility (e.g., frequent phoneme and syllable omissions, vowel errors, voicing errors, resonance differences, and difficulties producing increasingly complex phoneme sequences).

- *"Inappropriate prosody, especially in the realization of lexical or phrasal stress"*
  Children with CAS make a number of prosodic errors including (a) applying stress to the wrong syllable of a word (e.g., "po*ny*" instead of "*po*ny"); (b) using *excessive equal stress* by applying excessive stress equally to each syllable of a word (e.g., "*ba*-*na*-*na*") giving speech a robotic quality; (c) using excessive equal stress on all or most words of a sentence (e.g., "*I want that one.*"), which gives speech a monotone or staccato quality; or (d) applying stress to an inappropriate lexical item within a sentence. Prosody can impact both speech intelligibility to some extent and the listener's impression of the speech.

In addition to these three differentiating characteristics, the ASHA Ad Hoc Committee also described in their report that "notable areas of difference were found in the early and seemingly effortless development of vowels . . . in children who do <u>not</u> have CAS" (p. 14). Children with normal speech, as well as children with articulation disorders, developmental phonological disorders or dysarthria, and children who are late talkers typically do not struggle with attaining correct vowel phonemes and do not make as many vowel errors as children with CAS.

One important note is that the committee's report indicates that a child does *not* need to exhibit each of the features listed to be diagnosed with CAS. It also suggests that different features may be more prevalent than others at different points in time depending on factors such as age, severity, and other characteristics specific to the child.

Research by Davis, Jakielski, and Marquardt (1998) pointed to three speech characteristics most useful in differentiating a child with CAS from other children with severe speech disorders without CAS. These features include the following:

1. Variability of productions
2. Vowel errors
3. Suprasegmental differences (intonation, stress, loudness, and resonance)

The study findings also revealed difficulty on diadochokinetic tasks, specifically reduced diadochokinetic rates, poor rhythmicity, and omissions or substitutions of some phonemes. They point out, however, that difficulties with diadochokinetic performance may be

observed in children with other types of speech disorders. Their research also revealed that other features, such as frequent phoneme omissions and a receptive-expressive language gap (with receptive language exceeding expressive language), while commonly described by researchers as consistent with CAS, were not as useful in differentiating children with CAS from children with other speech disorders.

Diagnostic Features of Young Children with Suspected CAS

Children who are not talking by two years of age frequently are enrolled in speech and language treatment programs, often receiving language stimulation therapy in an attempt to facilitate expressive language development. For children whose primary deficit is language delay or language disorder, this type of treatment would be beneficial. For young children with CAS, however, minimal progress may be realized if the early speech therapy does not address the underlying difficulties with motor planning. The challenge for the speech-language pathologist, then, is to recognize those early signs that point toward a possible CAS diagnosis. Davis and Velleman (2000) describe a wide range of characteristics common to CAS, distinguishing between characteristics more prevalent in infants and toddlers and those that are more prevalent in older children. They describe both speech and nonspeech characteristics observed in children with CAS. The characteristics most common to infants and toddlers are listed in Table 2–1.

Additional Characteristics Associated with CAS

A large number of additional characteristics have been described in the speech and language literature as being observed in children with CAS (Davis, Jakielski, & Marquardt, 1998; Davis & Velleman, 2000; Forrest, 2003; Hall, Jordan, & Robin, 1993; Rosenbek & Wertz, 1972; Shriberg, Aram, & Kwiatkowski, 1997a, 1997b). These characteristics are not necessarily seen in *all* children with CAS, and also may, in fact, be observed in children with other types of speech-sound disorders and language disorders. However, they are observed frequently enough that therapists and researchers often cite them when describing features of children with CAS. The speech and nonspeech characteristics that were described previously as being most sensitive and specific to CAS, as well as additional characteristics frequently cited in children with CAS (but not specific to CAS) are described in the following sections. They are divided into five areas: speech characteristics, nonspeech motor characteristics, suprasegmental characteristics, linguistic characteristics, and educational characteristics. These features also are included in the Checklist of Childhood Apraxia of Speech Characteristics, Textbox 2–1. This checklist of commonly cited speech and nonspeech characteristics for CAS is not a diagnostic tool. Rather, it may serve as a means for organizing and analyzing assessment findings. Findings that point toward challenges in planning and programming of speech movements (e.g., token-to-token variability, reduced vowel repertoire, increased number of errors as length

Table 2–1. Diagnostic Characteristics Observed in Infants and Toddlers with Suspected CAS

* No sensory deficits, muscular weakness, or peripheral organic disorder
* Delayed development of connected play schemes
* Receptive-expressive language gap
* Limited repertoire of consonants and vowels
* Limited canonical babbling
* Limited word shapes; tendency to produce isolated consonants and vowels (i.e., /m/ for *more*, /a/ for *on*)
* Limited intonation patterns
* Limited vocal output
* More frequent loss of previously produced words
* Difficulty combining different syllables
* Groping for sounds
* Use of idiosyncratic signs for functional communication
* Possible uncoordinated feeding patterns
* Possible drooling
* Motor milestones attained later than expected
* More difficulty with volitional than automatic nonspeech oral motor behaviors
* Presence of oral motor incoordination
* Word order errors in simple phrases

Source: Adapted from Davis, B. L. & Velleman, S. L. (2000). Differential diagnosis and treatment of developmental apraxia of speech in infants and toddlers. *Infant-Toddler Intervention*, 10, 177–192. Used by permission of author.

increases, excessive equal stress) will support a diagnosis of CAS far more accurately than features that commonly are observed in children with other types of speech and language disorders (e.g., slow speech development, literacy challenges, or a receptive-expressive language gap).

Speech Characteristics

* **Token-to-token variability.** Children who demonstrate inconsistent errors upon repeated productions of words exhibit token-to-token variability.
* **Phoneme error variability.** Children may produce a phoneme correctly on some occasions but may misarticulate it with variable substitutions (e.g., /s/ produced as /s, p, t, h/).

PART

II

Foundations of Effective Treatment for Childhood Apraxia of Speech: P.R.I.S.M.

Part II of this book focuses on fundamental principles for the treatment of CAS. Five over-riding treatment principles that serve as the foundation for working with children with CAS are described. These principles comprise the P.R.I.S.M. foundation to treating child-hood apraxia of speech. P.R.I.S.M. refers to

- **P**honeme Sequencing
- **R**epetitive Practice
- **I**ntensity of Treatment
- **S**election of Target Utterances
- **M**ultisensory Cues and Feedback

These five foundational treatment principles are described in detail, with a focus on how these principles drive treatment decisions. Evidence-based research in the areas of CAS and motor learning serve to support the P.R.I.S.M foundations. Suggested activities and methods, case examples, scripts, and sample forms are included in order to provide both new and experienced therapists with practical ways to incorporate these principles into treatment.

Following are several principles for effective treatment of children with CAS. The chapters that follow in Parts II and III address each of these principles in greater detail.

1. Because the core impairment for children with CAS involves planning and programming of speech movement sequences, treatment should target

establishing increasingly complex sequenced articulatory movements, rather than individual phonemes.

2. Repetitive practice of target utterances is necessary for acquiring accurate and consistent productions of speech movement sequences and establishing the automaticity of motor productions. An intensive treatment schedule is recommended for children with moderate-to-severe CAS to provide many opportunities for repetitive practice of target utterances.

3. When selecting target utterances for treatment sessions, consider the following:

   a. Avoid challenging the child on more than one level at a time. When targeting a more challenging word shapes, avoid introducing new phonemes at the same time. When targeting new phonemes, use well-established word shapes.

   b. Select utterances that are functional for children to increase opportunities for regular practice and carryover, as well as to help children recognize the communicative power of spoken language.

   c. Choose target vocabulary words that represent different parts of speech to increase opportunities for early phrase and sentence productions.

4. Use multisensory cues (auditory, visual, tactile/kinesthetic, cognitive) to establish accurate productions, but fade the cues systematically to facilitate spontaneous production of the target utterances.

5. Recognize the impact of rate reduction on motor learning. The use of a slower rate can increase significantly a child's accuracy of movement patterns. A gradual increase in rate, however, is essential for facilitating generalization.

6. Consider the benefits of facilitating contexts, such as those described in Chapter 4, when choosing treatment targets.

7. In addition to establishing *consistency* of target utterance production, it is important to address *flexibility* by

   a. Moving from repeated practice of the same target utterances to random practice of a wider variety of utterances within the treatment sessions.

   b. Establishing the ability to produce target phonemes in a wide range of phonetic contexts and word shapes.

8. Prosody should be addressed early on and throughout the treatment process to establish appropriate syllable- and sentence-level stress patterns.

9. A limited vowel inventory and frequent vowel errors and omissions are common in children with CAS. Treatment should address establishing a complete vowel inventory, reducing vowel omissions, and increasing vowel accuracy, because vowel errors have such a significant impact on speech intelligibility.

10. When CAS is part of a larger set of challenges (e.g., autism), consider the relative contribution of the motor speech challenges, as well as the other areas

of concern (e.g., communicative intent and reciprocity) when planning for treatment.

11. Anticipate language and literacy issues that may be part of or coexist with CAS by integrating language goals and phonological awareness goals into therapy throughout the treatment process.

12. Work closely with families and establish regular home practice opportunities to facilitate the transfer of motor skills learned in treatment into other settings.

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Multisensory Cueing and Feedback

Providing multisensory cues and specific feedback is the cornerstone of the successful provision of treatment for children with CAS. The speech-language pathologist may be following the best treatment practices: selecting appropriate vocabulary, creating opportunities for multiple repetitions of target words, and providing an intensive treatment schedule. However, if the cues being provided to the child *from moment-to-moment* in treatment are not carefully selected based on each of the child's responses, the child's learning style, current level of functioning, and patterns of errors, progress will not be realized.

Primary Types of Cues

Numerous books, articles, and programs addressing the treatment for CAS recommend incorporating multisensory cues within the context of treatment to facilitate the accurate production of new motor speech plans (Strand & Skinder, 1999; Square, 1999; Strode & Chamberlain, 2006; Hammer, 2006). The cues provided may be

- visual (what the child sees),
- auditory (what the child hears),
- tactile/kinesthetic/proprioceptive (what the child feels),
- cognitive (what the child thinks about).

Visual Cues

Visual cues provide something for the child to look at, such as having the child watch the clinician's face while the utterance is modeled. Visual associations (hand signals, manual signs, written letters/words, etc.) also serve as beneficial cues for many children.

Auditory Cues

Auditory cues provide something for the child to listen to, typically a model of the utterance for the child to imitate.

Tactile Cues

Tactile cues relate to the sense of touch on the skin. During speech we receive tactile input from the articulators contacting one another (e.g., lip contact when producing bilabials; tongue to alveolar ridge contact while producing alveolars). In treatment we can provide tactile cueing to the child by touching and moving his articulators. Tactile input is particularly useful for the production of consonant phonemes, but less so for vowels because articulatory contacts during vowel production are minimal.

Kinesthetic and Proprioceptive Cues

Kinesthetic awareness is the body's internal sense of movement. *Proprioception* is the internal sense that helps a person recognize the amount of effort/force with which the body is moving, the speed of movement, and how the different body parts are moving in relation to one another in space. By reducing the rate of speech production or by holding an articulatory posture slightly longer, you increase kinesthetic and proprioceptive awareness of speech movements and articulatory positioning.

Cognitive Cues

Cognitive cues offer the child a way to think about speech movements either through specific instruction ("Lift the back of your tongue to make the "k" sound.") or through association ("Be sure to use your 'humming sound' at the end.")

This chapter addresses how and when to provide these various types of cues that facilitate articulatory accuracy in children with motor speech disorders. In addition to providing multisensory cues, therapists provide frequent and specific feedback to children about the accuracy of their performance of the target utterances. The use of feedback in treatment will be described later in this chapter.

The Use of Multisensory Cues in Treatment of CAS

It is not unusual, particularly when a child is beginning to learn a new motor plan, to combine more than one type of cue to facilitate the child's ability to perform the new movement sequence. The cues provided by the speech-language pathologist help a child learn to focus his attention on the *most salient* aspects of the speech movement. Determining the most salient aspect of the speech movement depends on where the breakdown in speech accuracy is occurring. For example, a child who is reducing a two-syllable

word (bunny) to a single-syllable (bu) may benefit from a visual cue (two blocks) as a reminder to incorporate both syllables in the target word. The child who pronounces "bunny" as "nunny" may benefit from a tactile cue to the lips to facilitate production of the /b/ phoneme and reduce the nasal assimilation.

Types of Multisensory Cues

In Chapter 3, the importance of determining what types of cues the child benefits from during the evaluation process is discussed. Recognizing that individual children have unique learning styles and sensory processing systems suggests that there is not a "one size fits all" approach to the treatment of CAS. Therefore, different types of cues work better for different children. For instance, some children are not able to achieve success without the benefit of tactile cueing while others do well with combined visual and auditory input. Some children with autism spectrum disorders have challenges taking in visual and auditory input simultaneously, making it difficult for them to watch the face of the clinician during treatment. In addition, for any given child, the cues provided will change from moment-to-moment depending upon the child's performance.

Table 8–1 provides a way of sorting the cues based on which sensory system(s) is being engaged during the cueing process. Many of the cues target more than one sensory system simultaneously.

Descriptions of Multisensory Cues

To better understand how the various cues are applied in the context of treatment, each of the cues listed in Table 8–1 is described in this section.

Rate Variations

Rate variations involve cueing the child to say the utterance at a reduced rate of speech and gradually increasing the rate until the sound combinations can be produced accurately at a normal rate. Rate reduction typically involves the prolongation of the vowels *within the utterance.*

Magill (2004) suggests that reducing the rate at which a motor skill is practiced is beneficial for learning "complex skills requiring both speed and accuracy" (p. 342). Speech certainly would be considered a complex motor skill that is challenging both in terms of the accuracy required and the speed with which the articulators are moved in space. The definition of CAS (ASHA, 2007), described in greater detail in Chapter 1, suggests that challenges "in planning and/or programming spatiotemporal parameters of movements sequences" (p. 4) are the core deficits for children with CAS. Because children with CAS have difficulty not only with placement (spatio) of the articulators (e.g., difficulty achieving the initially articulatory configuration of closing the lips to produce the word "more"), but also with the timing (temporal) of motor movements, slowing the movements should have a positive impact on motor speech planning. Some children benefit from using a slightly slower rate of production, but other more significantly impaired children may

Table 8–1. Multisensory Cues for Treating Childhood Apraxia of Speech

Cueing Technique	Associated Sensory System			
	Visual	**Auditory**	**Tactile Kinesthetic Proprioceptive**	**Cognitive**
Rate variations		✓	✓	
Simultaneous production/ choral speaking	✓	✓		
Direct imitation & delayed imitation	✓	✓		
Mirror	✓	✓		
Mime	✓			
Hand cues	✓			✓
Manual signs	✓			✓
Written letters and words	✓			✓
Tapping/clapping syllables	✓		✓	✓
Blocks/chips	✓			✓
Metaphors				✓
Phonetic placement cues				✓
Mouth pictures	✓			
Visual syllable words	✓			✓
Tactile-kinesthetic			✓	

require substantial reductions in rate to achieve correct productions. Children can be cued to reduce their rate by doing one of the following.

- Saying the target with the child (see "Choral Speaking" later in this chapter) but at a reduced rate
- Modeling the target utterance (see "Direct Imitation" later in this chapter) at a slower rate
- Reminding the child to use a reduced rate by incorporating
  - Hand signals
  - Verbal reminders
  - Picture cues (e.g., turtle or snail)

Although rate reduction is beneficial for facilitating correct productions of targets within the practice setting, *it is essential to gradually increase rate to approximate a normal rate of speech.* The gradual increase of rate provides the learner with greater opportunities for generalization of the target in other settings and in the context of typical conversational speech.

Simultaneous Production/Choral Speaking

The child and clinician produce the target simultaneously.

When introducing a new motor speech plan, children benefit from producing the target at the same time as the clinician. Producing the target immediately following the clinician's model may be too challenging for some children. The Dynamic Temporal and Tactile Cueing (DTTC) approach (Strand & Skinder, 1999) utilizes simultaneous production as a way of facilitating the correct production of challenging targets when direct imitation alone does not elicit an accurate production. It is the difference between, "Say it after me" (direct imitation) and "Say it with me" (simultaneous production). The DTTC protocol is described later in this chapter.

Mime

The child watches the clinician mime (produce the target without voice) the target word.

Although choral speaking engages both the visual and auditory systems, miming engages only the visual system, making it a less salient cue. If a child is producing the target accurately with choral speaking, the therapist may continue to model the word, but without voice, to see whether the child is able to maintain accurate productions when the auditory cue is removed. During miming, the clinician typically mimes the target while the child is producing it.

Direct/Immediate Imitation and Delayed Imitation

The therapist models the target for the child prior to the child producing the target.

Although many children with CAS are not able to produce the target utterance correctly spontaneously, they are better able to achieve correct production if the utterance is modeled *slowly* for them. Modeling provides both a visual and an auditory cue for the child when the therapist secures the child's visual attention prior to saying the target. Initially, the child will produce the word immediately following the model. As the child progresses, a delay of a few seconds after the model can be added prior to the child producing the target. This delayed imitation can be achieved by the following:

- Producing the model but signaling for the child to wait before producing the target utterance
- Embedding the model in the context of the instruction (e.g., "Puppy is the next word." or "Let's say 'bye' to all the animals. Bye cow. Now you try it.")