Here's How to Treat Childhood Apraxia of Speech

Second Edition

Margaret Fish, MS, CCC-SLP

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Contents

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 required to work with children with CAS presents 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. The American Speech-Language-Hearing Association's Technical Report on CAS (2007) charged SLPs lacking knowledge about CAS or experience working with children with CAS with obtaining the knowledge and skills necessary to be able to work efficiently and effectively with children with this challenging speech sound disorder. Margaret Fish's book, *Here's How to Treat Childhood Apraxia of Speech*, *Second Edition*, is a one-stop resource for novice and experienced SLPs seeking background information, differential diagnostic protocols, and intervention approaches and strategies related to even the most complicated cases of individuals with CAS.

In this second edition, Margaret Fish delves further into the research related to CAS from diagnosis to intervention, including the newest research on evidence-based treatment approaches. The author provides a helpful review of the research on the principles of motor learning, incorporating those findings into five chapters on factors that need to be considered when trying to design effective treatments. While SLPs do have some research on which to base our interventions, other aspects of our practice have not yet been researched. When research cannot guide our practice, we need to be informed by expert clinical experience—such as the decades of experience that the author shares with her readers. Understanding the many facets of CAS builds the foundation from which the SLP can begin to think about intervention.

No other disorder of speech presses us 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 strategies and

ideas when faced with a child with CAS. Luckily, even the most seasoned SLPs will find an abundance of appropriate, practical, and when available, evidence-based practice information in this book. The scope of this book is as broad as the speech symptoms characteristic of CAS.

Part I offers readers an understanding of CAS by providing a thorough explanation of the ASHA's definition of CAS, characteristics associated with CAS, and a protocol for assessment and differential diagnosis. In Part II, the author presents a framework that can be used to support SLPs as they make decisions regarding the nature of their intervention. Research on motor learning provides a solid foundation for this entire section. Motor learning 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 necessary to develop evidence-based interventions.

Part III contains 15 chapters—four brand new chapters in this second edition—that are dedicated to intervention ideas, strategies, scripts, and plans that target a wide variety of areas affected by CAS. In one invaluable new chapter, the author reviews a variety of commercially available, evidence-based CAS intervention programs. The interventions the author reviews are based on a combination of published and presented research, as well as the author's many years of specializing in the treatment of children with severe speech sound disorder, including CAS. SLPs will find tried-and-true approaches intermixed with many 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 11), prosody disturbances (Chapter 12), early sentence production (Chapter 13), literacy delays (Chapter 16), augmentative communication (Chapter 17), and social language problems (Chapter 18). Chapter 20 was written to help SLPs incorporate books and music into therapy as a means to stimulate a child's interest and facilitate his or her verbal output, and Chapter 21 addresses the careful selection and creative use of apps in intervention. The special and changing needs of children who are minimally verbal, older, and/or on the autism spectrum also are addressed in three chapters. Putting all of those new intervention ideas into action, the author also includes a chapter on how to develop and write an effective treatment or individualized education plan (Chapter 23). There is no other single resource 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 book concludes with a chapter 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. Parental 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 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, PhD, CCC-SLP
Florence C. and Dr. John E. Wertz Professor
in Liberal Arts and Sciences
Augustana College
Rock Island, Illinois

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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.

It is hypothesized that children with CAS may have poor feedforward programs (anticipatory motor plans), and thus, rely on auditory feedback (Terband, Maassen, Guenther, & Brumberg, 2009) to increase accuracy of speech productions. A recent study by Iuzzini-Seigel, Hogan, Guarino, and Green (2015) compared speech production parameters in children with CAS, speech delay, and typically developing speech when auditory masking was introduced during speaking. The auditory masking made it difficult for children to employ auditory feedback to monitor their speech productions. Their findings further supported the premise that children with CAS are more reliant on auditory feedback than typically developing or speech delayed children. Because reliance on auditory feedback is inefficient in the process of speech, it is essential that SLPs provide cueing (including tactile and proprioceptive) that facilitates greater internal representations of the motor speech plans so they are not reliant on auditory feedback for accurate productions of target utterances. A wide variety of cues that help children gain greater motor control of speech are described below.

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 include

- **visual** (a visual model or image of the way the mouth looks during production of the target utterance),
- **auditory** (an auditory model of the target utterance),
- **tactile/kinesthetic/proprioceptive** (what the child feels during production of the target utterance), and
- **metacognitive** (an associative cue that helps the child focus on a specific aspect of the target utterance).

Visual Cues

Visual cues provide a model of the way the mouth looks during production of the target utterance. The child receives a visual cue when he watches the clinician's face while the clinician is modeling a target utterance or when he observes himself in a mirror during production of the utterance. Static photos or drawings of a specific lip or tongue position also may serve as a visual cue.

Auditory Cues

Auditory cues are those cues that provide a verbal model of the target utterance.

Tactile, Kinesthetic, and Proprioceptive 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 clinicians can provide tactile cueing to the child by touching and moving the child's 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. Input to the lips/cheeks, however, may help the child achieve correct lip rounding or retraction for accurate production of some vowels.

   Kinesthetic awareness is the body's internal sense of movement. *Proprioception* is the internal sense that helps a person recognize the amount of effort or 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 aware-ness of speech movements, the positioning of the articulators, and the relationship of the articulators to one another in space. Tactile cues can enhance a child's tactile, kinesthetic, and proprioceptive awareness and facilitate accurate productions.

Metacognitive Cues

Metacognitive cues provide the child ways to think about speech movements either through specific instruction or through some type of associative cue. Metacognitive cues encom-pass most of the cues described in this chapter. They include such strategies as providing phonetic placement cues ("Lift the back of your tongue to make the "k" sound."), tapping out syllables of a word to reduce syllable deletion, and using metaphors ("Be sure to use your 'humming sound' at the end.") to facilitate the use of a specific phoneme or combi-nation of phonemes. For associative metacognitive cues to be effective, the child must already have an internal representation of the motor plan. The cues simply provide a way for the child to access the motor plan. It has been my experience that when metacognitive cues are paired with visual, auditory, and/or tactile cues early in treatment, the clini-cian can begin to fade from the more salient visual, auditory, and tactile cues to the less salient metacognitive cues. For example, the clinician can pair a simultaneous produc-tion with a metaphor cue, then begin to fade the simultaneous production and provide only the metaphor cue to trigger an accurate response from the child. By laying down a variety of metacognitive cues externally for a child, the child eventually develops greater internal access to these cues, and can call upon them as needed to achieve an accurate production.

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, clinicians provide essential 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

Clinicians typically provide a variety of cues to facilitate accurate production of target utterances. The cues provided by the SLP help a child learn to focus his attention on the specific change(s) required to achieve accurate production of all 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 facili-tate production of the /b/ phoneme and reduce the assimilation.

Decision Making in the Selection 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 unique ways of processing sensory input suggests that there is not a "one size fits all" approach to provision of cues in the treatment of CAS. Different types of cues work better for different children. For instance, some children are more successful when provided with tactile cues, while others do well with combined visual and auditory input. Some children have challenges taking in visual and auditory input simultaneously, making it difficult for them to watch the face of the clinician during treatment.

The cues provided by the clinician will change from moment-to-moment depending upon the child's performance. It is important for the clinician to develop flexibility in providing beneficial cues as needed and fading cues as the child demonstrates increased production accuracy.

Table 9–1 provides a way of sorting the cues based on which sensory system(s) is being engaged during the cueing process. Some 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 9–1 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; however, slight prolongation of a target consonant phoneme (especially continuent phonemes, such as fricatives, nasals, or liquids) may help to draw the child's attention to that phoneme.

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, rate reduction should have a positive impact on motor speech planning. Children can be cued to reduce their rate by doing one of the following:

Table 9–1. Multisensory Cues for Treating Childhood Apraxia of Speech

Cueing Technique	Associated Sensory System			
	Visual *(child sees a model of production)*	**Auditory** *(child hears a model of production)*	**Tactile Kinesthetic Proprioceptive** *(child is provided with tactile input)*	**Metacognitive** *(child is provided with an associative cue)*
Rate reduction		✓	✓	
Simultaneous production	✓	✓		
Direct imitation & delayed imitation	✓	✓		
Mirror	✓	✓		
Mime	✓			
Backward chaining	✓	✓		
Forward chaining	✓	✓		
Hand cues for place, manner, voicing				✓
Manual signs				✓
Graphic cues				✓
Tapping/clapping syllables				✓
Blocks/chips				✓
Metaphors				✓
Phonetic placement cues				✓
Mouth pictures and videos	✓			
Visual syllable words				✓
Tactile-kinesthetic-proprioceptive cues			✓	
Ultrasound biofeedback	✓			✓

- The clinician produces the word at the same time as the child (see "Simultaneous Production" later in this chapter), but at a reduced rate
- The clinician models the target utterance (see "Direct Imitation" later in this chapter) at a reduced rate

- The clinician reminds 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.

There is a phenomenon in the acquisition of motor skills of "*speed-accuracy trade-off*, meaning simply that when performers attempt to do something more quickly, they typically do it less accurately" (Schmidt & Lee, 2005, p. 33). Some children, especially children with severe CAS, may not be able to achieve a rate of speech that matches their typically developing peers without substantial reduction in accuracy and speech intelligibility. Helping children establish a rate of speech that still allows for the best possible speech intelligibility may be required for children with more profound speech challenges.

Simultaneous Production

The child and clinician produce the target utterance simultaneously.

When introducing a new motor speech plan, children benefit when the clinician and the child produce the target utterance together. Producing the target 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 in greater detail in Chapter 10. Simultaneous production is used only to achieve initial acquisition of a correct production of the target utterance for a few productions and then is faded and replaced with a less salient cue, such as miming or direct imitation.

Miming

The child watches the clinician produce the target utterance without voice.

Although simultaneous production 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 simultaneous production, the clinician may continue to model the word, but without voice, to see if the child is able to maintain accurate productions when the auditory cue is removed.

Direct Imitation and Delayed Imitation

The clinician models the target for the child prior to the child's producing the target.

Although many children with CAS are not able to produce the target utterance correctly spontaneously, they may be able to achieve correct production if the utterance is modeled

for them. Modeling provides both a visual and an auditory cue for the child when the clinician secures the child's visual attention prior to modeling the target. Initially the child will produce the word immediately following the model. As the child progresses, a delay of one to three seconds after the model can be added prior to the child producing the target. This delayed imitation can be achieved by one of 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.")

The clinician's models of the targets may be provided at a reduced rate, with the rate of the modeled productions increasing to a normal rate of production as the child's accuracy level improves.

Mirror

The child watches in the mirror while producing the word.

Having a child observe himself in a mirror while producing the target may be beneficial, particularly for establishing sounds and sound sequences that are highly visible. The mirror serves two functions, including:

- It facilitates the use of appropriate movement gestures
- It inhibits the use of incorrect movement gestures

For example, the child who is trying to achieve lip rounding during production of the /w/ phoneme can watch himself in the mirror to be sure lip rounding is achieved during the initial articulatory configuration. A child who tends to protrude his tongue when producing /l/ may use the mirror to cue himself to keep his tongue at the alveolar ridge when producing the /l/ phoneme. It is essential that the child not become dependent upon the visual mirror cueing, as the auditory and tactile/kinesthetic feedback should serve a greater and greater role in facilitating a stronger internal representation of correct versus incorrect production of target utterances. Nevertheless, in initial stages of practice the mirror can be helpful in facilitating or inhibiting articulatory movement gestures for speech production.

Backward Chaining

The clinician presents a multisyllabic word or a word containing an initial or final cluster by starting at the end of the word, producing the final sound or syllable first, and moving from the back of the word to the front of the word systematically.

Some children are more successful when producing a word when presented with models of the word starting from the end and working toward the beginning. For example, to produce the word *movie*, the child would practice "vie" several times before linking the final syllable to initial syllable to practice "movie." To achieve accurate production of

the /sk/ cluster in *skate,* the child may practice the portion of the word without the cluster "kate" several times before adding the /s/ to establish correct production of the cluster. When linking sounds and syllables together, it is important both to model and facilitate smooth coarticulatory transitions so as not to exacerbate the tendency of children with CAS to produce gaps between sounds and syllables.

Forward Chaining

The clinician presents a multisyllabic word or a word containing an initial or final cluster by starting at the beginning of the word, producing the initial sound or syllable, then moving from the front to the back of the word.

Children may benefit from practicing portions of the word in smaller segments and adding sounds or syllables as they are able to manage the increased word shape complexity. If the target word is *ladybug*, the child may practice producing "lay," then "lady," then "ladybug." For a word with a final cluster such as *hops*, the child may practice producing "hop" and then be cued to add the /s/ to the end of the word to produce the target word, "hops," correctly.

Hand Cues

The clinician uses specific finger/hand positions or hand motions representing a specific articulatory placement, lip shape, or manner of production of a phoneme or series of phonemes to cue the child to produce that phoneme or sequence of phonemes accurately.

Any hand position or hand motion that is meaningful to the child and offers the necessary reminders for production of a speech sound or sound sequence is appropriate. Hand positions and hand motions can be used to reference individual consonant or vowel phonemes or can be combined to facilitate accurate production of movement sequences for production of consonant clusters, syllables, or entire words. Hand cues can be provided alone or while modeling or miming the target utterance. Refer to Table 9–2 for suggestions of hand cues that help to facilitate accurate phoneme *placement* (e.g., child substitutes [ti] "tea" for *key*) or *lip shape* (e.g., facilitating lip rounding for accurate production of /u/). Table 9–3 provides suggestions of hand cues to facilitate the child's accurate *manner* of phoneme production (e.g., child substitutes [toʊp] "toap" for *soap*). The suggested hand cues provided here tend to be transparent, that is, they suggest the place or manner of production of the specified phonemes. Some materials for children with speech disorders recommend hand cues that are more arbitrary and do not relate to the placement or manner of articulatory production.

The cues described in Tables 9–2 and 9–3 provide suggestions for gestures that have been beneficial in the treatment of children with CAS. Some children, however, benefit from bigger, more robust gestures. For example, the vowels /oʊ/ and /u/ may be cued by shaping two hands together like a broad circle and extending them forward from the face. The vowel /i/ may be cued by pointing your fingertips toward the corners of the mouth and moving both arms sideways away from the mouth, whereas the /a/ vowel would be