

Childhood Apraxia of Speech: Assessment/Treatment for the School-Aged Child

Shelley L. Velleman, Ph.D., CCC-SLP

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I. What Is Childhood Apraxia of Speech?

Definitions

Praxis : "the generation of **volitional movement patterns** for the performance of a particular action, especially the ability to **select, plan, organize, and initiate the motor pattern** which is the foundation of praxis" (Ayres 1985).

Spatial-Temporal Coordination

- Critical to fluent, adult-rate speech-language production
- Dominates the development of speech-motor control over the first six years of life.
- Gradual increase in overall **execution speed** of motor programs over the ages 3-11 years.
- **Segment durations are conditioned or adapted according to the linguistic content of the utterance** (Netsell 1981)

Motor sequencing: ordering the individual gestures that make up the whole motor plan and coordinating them with each other. Includes:

- Determining the order of the elements
- Figuring out how to get from one to the other (Ayres 1985): **transitions**

Apraxia :

- ❖ "a disorder in **carrying out or learning complex movements** that cannot be accounted for by elementary disturbances of strength, coordination, sensation, comprehension, or attention" (Strub & Black 1981).
- ❖ "...a group of phonological disorders resulting from **disruption of central sensorimotor processes** that interfere with motor learning for speech... Paralysis or weakness might be present, but is not sufficient to account for the nature and severity of the observed speech disorder" (Crary 1984).

- ❖ "viewed as a **syndrome**...developmental verbal apraxia might be defined as **a severe and persistent phonological disorder coupled with an expressive syntactic disorder** with **variable neurological and articulatory findings**." (Aram 1984)

Unitary Disorder:

- One consistent symptom or set of symptoms is always present

Syndrome/Symptom Complex:

- A pattern of symptoms, with a common underlying cause, is used for diagnosis
 - No one symptom alone is adequate to identify the syndrome
 - Different children may have varying symptoms of the same disorder
- ❖ "a reduced capacity to form systemic mappings [between articulatory movements and their auditory consequences] might underlie the oral motor and early speech learning difficulties in DAS [CAS] and put the child at a disadvantage for the acquisition of the motor aspects of phonology, that is, the phoneme-specific mappings"... "higher-level [phonological] knowledge ... must be acquired by the child via the problematic speech production and perception skills" (Maassen 2002, pp. 261, 265)

Thus, apraxia or dyspraxia is a disorder of:

1. Volitional movement (Dewey et al. 1988, Maassen et al. 2003, Nelson, 1995)
2. Spatial-temporal coordination (Sussman et al. 2000, Nijland et al. 2002)
3. Motor sequencing (Crary & Anderson, 1991)
4. Carrying out or learning complex movements (Crary & Anderson, 1991)
5. Central sensorimotor processes (Crary 1984)
6. Accommodation to context (coarticulation, etc.; Maassen et al. 2001, Nijland et al. 2003, Nijland et al 2002).

Name?

developmental apraxia of speech

developmental verbal dyspraxia

☞ childhood apraxia of speech ☞

dilapidated speech ??

CAS as a Secondary Diagnosis

- Approximately 60% of children on the autism spectrum have motor speech symptoms; about 13% report primarily symptoms of apraxia; 10% primarily dysarthria; remainder mixed (Marili, Andrianopoulos, Velleman & Foreman, 2004)
- Symptoms of CAS are common among children with Down syndrome (Kumin & Adams 2000; Rupela & Manjula, in submission)

Etiology?

Demographics:

- 86% of kids with CAS have @ least one family member w/ speech-language disorders
- 59% have @ least one affected parent
- Higher rates of family history than for other speech-sound disorders: suggests genetic basis in at least some cases (Lewis et al. 2003)
- Prevalence 1-2 children per thousand (Shriberg et al., 1997a); up to 3-4% of children with speech delay are given this diagnosis (Delaney & Kent, 2004)

FOXP2 (See references): Translocation on chromosome 7q31

A few individuals (e.g., the “KE” family) with this genetic difference have the symptoms of oral and verbal apraxia. However, they also have oral-facial anomalies and non-verbal deficits. Thus, FOX-P2 may be the cause of some cases of CAS, but certainly not all of them.

Commonalities among all dyspraxias/apraxias:

1. Difficulties with **timing** and **sequencing**, including more difficulties with **transitions** between postures or states than within static postures or states.
2. Difficulties in combining smaller units (including units of movement) into larger wholes.
3. Decreased ability to accommodate to context: coarticulation, rate, complexity.

Note: Oral or speech planning must be affected or it's not CAS.

CAS is a “symptom complex”

- No one feature is adequate for diagnosis
- Symptoms can include motor, linguistic, neurological..
- Inconsistency is expected across children and within same child
- Symptoms change over time (Lewis et al. 2004; Shriberg et al. 2003)

II. Assessment

Problems:

1. Studies have been circular
2. Children who stutter or who have "ordinary" phonological disorders may also show some features of CAS (Byrd & Cooper, 1989; McCabe, Rosenthal & McLeod, 1998; Shriberg, Aram & Kwiatkowski, 1997a)
3. Symptoms change over time (Lewis et al., 2004; Shriberg, Campbell et al., 2003)

Core deficits: programming, timing, sensori-motor coordination

Most commonly cited features of CAS (e.g., Davis, Jakielski, & Marquardt, 1998):

1. Receptive-expressive gap
2. *Delayed or deviant syllable and word structures; difficulty with multisyllabic words
3. *Sequencing
4. *Prosody differences, especially lexical stress
5. *Vowel deviations
6. Phonemic awareness
7. *Inconsistency – **of a certain type**

* Core **differential** behaviors

Areas of deficit that are most persistent in older children:

Phonology: Stress (Velleman & Shriberg, 1998), vowels (McCabe et al., 1998; Lewis et al. 2004), voicing, multisyllabic words/syllable structures, sequencing, nonsense word repetition (Lewis et al. 2004)

Language: Persistent receptive and expressive language difficulties (Lewis et al., 2004)

Literacy: word attack, word identification, and spelling (especially of unpredictable words; Lewis et al., 2004)

Oral Mechanism Exam (Velleman & Strand, 1994; Velleman, 2003)

Emphasis within the oral mechanism exam should be on differentiating:

1. functional/automatic vs. volitional actions
2. single postures vs. sequences
3. simple contexts vs. more complex or novel contexts
4. ability to perform action at various cue levels: on command, with auditory model only, with visual model only, with tactile cue
5. ability to perform action smoothly and at an age-appropriate rate as well as accurately (trade-offs may be noted)
6. repetitions of same gesture (e.g., CV syllable) vs. alternations of gestures (e.g., alternating syllables [patapata] or [papupapu]). **Watch for inconsistency.**
7. Recommended "maximal performance measures" for differential diagnosis: mean repetition rate of trisyllables, # attempts required for correct trisyllable production, mean fricative duration (Thoonen et al. 1999)

Score based on rate, accuracy, fluency (smoothness), types of cues required, and amount of training required

Verbal Motor Production Assessment for Children (VMPAC; Hayden & Square 1999).
Normed on 1,000 children; child-friendly.

Divides verbal motor production into five scores:

- Global motor control,
- Focal oral motor control (speech and nonspeech),
- Sequencing of nonspeech, speech, and language,
- Connected speech and language and
- Speech characteristics (voice, fluency, rate).

Children with CAS tend to do fine on Global Motor Control but be impaired on Focal Oral Motor Control and Sequencing (Velleman 2003).

Areas for phonological assessment:

Phonetic repertoire (consonants and vowels)

Phonetic accuracy (articulation test; process test; Percent Consonants Correct – Revised; Shriberg et al., 1997)

Phonotactic repertoire (syllable and word shapes)

Phonotactic accuracy (process test)

Sequencing of sounds within syllables, syllables within words, etc. (TSSS; Kirkpatrick et al., 1990)

Stress patterns and prosody (PEPS-C; Peppe & Wells, 2002)

Communicative effectiveness and intelligibility depend in part on:

- number of homonyms
- level of consistency
- prosodic cues
- pragmatic skills including paralinguistic cues
- repair strategies

Test of Syllable Sequencing Skills (packaged with Moving Across Syllables; Kirkpatrick et al. 1990)

- Criterion-referenced measure of place of articulation feature sequences (e.g., labial-alveolar)
- One, two, and three-syllable words
- Tracking of cue levels (none, auditory, visual or tactile)

(See Behavioral Objectives Worksheet.)

Prosody

Voice:

- Inappropriate loudness patterns (monoloudness)
- Inconsistent hypernasality/hyponasality
- Inappropriate pitch patterns (monopitch)

Stress:

Development of word stress in English (Kehoe & Stoel-Gammon, 1997; Gerken, 1994)

- Children under 3 often omit unstressed syllables
 - especially from initial position in iambic words
 - onset consonant may be preserved
 - also from medial syllable in SWS word
 - final syllable typically preserved
- Learners of AAE tend to do this more often, to older ages

Stress in children with CAS

- Multisyllabic words mis-stressed or **monostressed**, especially excess equal stress
- Weak syllables omitted from multisyllabic words beyond age 6
- Sentences mis-stressed or mono-stressed, especially excess equal stress (Velleman & Shriberg, 1999)
- Ratio of stressed/unstressed syllables inappropriate (Shriberg et al., 2003)
- Inconsistent mis-timing of consonants, vowels, and pauses (Perkins et al., in prep.)

Tests that include Multisyllabic Words:

Test Name	SW	WS	SWW/SWS	WSW	Longer trochaic	Longer iambic
DELV	18	3	1	1		
TSSS	24	1	20	5		
HAPP-3	13		3		1	
HAPP-3 multisyll.			2	1	5	4

DELV: Diagnostic Evaluation of Language Variation; Seymour, Roesper, & de Villiers, 2005.

TSSS: Test of Syllable Sequencing Skills; Kirkpatrick, Stohr, & Kimbrough, 1990.

HAPP-3: Hodson Assessment of Phonological Processes – 3; Hodson, 2004.

Literacy Task Analysis (Adapted from Stackhouse & Wells, 1997)

***Phonological representation:**

Does the task require the child to retrieve and process a previously-stored mental phonological representation of the word?

***Motor program:**

Does the task require the child to retrieve and use a previously-devised motor program for the word?

***Motor programming:**

Does the task require the child to generate a new motor program for the word?

***Motor planning:**

Does the task require the child to make contextual adjustments to the motor program for the word?

Literacy findings indicative of CAS:

- *reduced perception of phoneme sequences (Bridgeman & Snowling 1988)*
- *reduced perception of vowels (Maassen, Groenen & Crul 2003)*
- *reduced perception of syllables (Marquardt, Sussman, Snow & Jacks, 2002)*
- *increased spelling errors not necessarily related to current speech errors (Snowling & Stackhouse 1983; Lewis et al. 2004)*
- *impaired identification and production of rhyme (Marion, Sussman & Marquardt 1993)*
- *reduced word attack, word identification (Lewis et al. 2004)*

Differences between childhood dyspraxia and childhood dysarthria

1. Little or no muscle weakness; few or no problems with muscle tone.
2. Difficulties more pronounced in more volitional contexts.
3. Difficulties far more pronounced for more complex or sequential elements.
4. Errors may appear to **increase** articulatory difficulty (e.g., additions of phonemes or syllables, use of later developing phonemes out of developmental sequence, use of unusual clusters or use of clusters out of developmental sequence).
5. Expressive language delays **not** caused by articulatory/phonological limitations alone. Specific difficulties with syntax, morphology, and metaphonological awareness long after the child has become intelligible (e.g., 3rd - 4th grade; Lewis et al. 2004).

CAS vs. “Garden Variety” Phonological Disorders

Childhood Apraxia of Speech	Phonological Disorder
motor symptoms	no or very mild motor symptoms
phonotactics worse than phonetics	phonetics worse or = phonotactics
prosodic differences esp. EES	prosody WNL
persistent weak syllable deletion	weak syllable deletion fades
sequencing errors	few sequencing errors
vowel deviations	no or very few vowel deviations
inconsistency across contexts	consistency
volitional worse than automatic	no difference or volitional better
increase in errors with increased length and complexity of utterance	
Persistent difficulties with grammar and literacy	

III. Treatment

Automaticity vs. Flexibility (Velleman & Strand, 1994)

The two primary goals in all therapy with children with DVD are the following:

1. Increase the child's repertoire of **automatic speech acts** to increase communicative efficacy: **old forms with old functions**. For young children, this will include animal and other environmental sounds, and simple words to express basic needs. For older children, this will include communicative sentence frames.

However, increasing the automatic speech repertoire does not address the fundamental organizational problem in DVD. Therefore, **over-learning (drill) of specific words and sentences alone is not an adequate remediation program**.

2. Increase the child's oral-motor flexibility. Challenging the system -- very gradually and systematically -- to produce varying sequences of syllables, words, and sentences expands the child's oral-motor organizational capability. It therefore increases the child's ability to handle novel communication tasks.

Old forms with new content, new forms with old content.

New forms or new functions; not both.

Automatic versus volitional speech:

Adults with AOS perform better on "overlearned" or emotional speech

Children with CAS perform better on:

- verbal routines
- less semantically-loaded material (e.g., sound effects)
- emotional utterances (e.g., "uh-oh", "wow")
- vocalizing with focus elsewhere (e.g., sign, pictures, fingerplays)

Occasional "accidental" clear productions cannot be repeated

Other general considerations

Frequent, short sessions with breaks are most successful. Since CAS is a dynamic disorder, system fatigue is a problem.

Work with occupational therapy on sensory integration issues, and with occupational and physical therapy on non-oral/speech motor planning issues.

Oral-Motor Therapy for CAS: Caveats (Lof, 2003; Forrest, 2002)

- Strength required for speech is much less than strength required for other oral-motor activities (chewing, blowing, etc.)
- Stereotypy used for feeding (sucking, chewing, etc.) is much more rhythmic than speech
- For speech, need to overcome those rhythmic patterns
- Speech requires more coordination and flexibility; different types of coordination
- TO IMPROVE SPEECH, MUST PRACTICE SPEECH

Therefore, non-speech oral-motor activities should be used only if and only for:

- Increasing general imitation skills
- Increasing general sequencing skills
- Increasing muscle tone (if low tone is present)
- Increasing awareness of oral structures
- Decreasing tactile defensiveness (e.g., to be able to use tactile cues)
- For function (e.g., feeding skills)

Motor Speech Aspects of Treatment

CAS is a disorder in carrying out or learning complex movements

1. Therefore, principles of motor learning are relevant (Strand, 1995):

- Repetitive practice (many trials) is necessary
- Give occasional to frequent feedback on performance
- Practice of more exemplars will increase generalization
- Alternating practice of different patterns will increase generalization

2. Stimuli should be chosen carefully:

- Length
- Phonetic complexity
- Phonotactic complexity
- Semantic load (real vs. nonsense words)
- Emotional load for child

3. Since CAS is a dynamic disorder, system fatigue is a problem. **Frequent, short sessions with breaks** are most successful.

CAS is a disruption of central sensorimotor processes

1. Auditory discrimination training does NOT address the problem. However:

- multimodal input is often helpful: auditory, visual, tactile
- Integral stimulation and PROMPT are designed to provide such input

2. Awareness of articulators may be addressed via tactile stimulation or oral-motor warm-up activities. Calling attention to articulators during **speech** activities may exacerbate the problem for some children, however.

3. Work with occupational therapy on sensory integration issues.

Decreased ability to accommodate to context:

1. Practice must be provided in a variety of contexts in order for generalization to occur
2. Context should be varied carefully, one aspect at a time (phonological, grammatical, communicative, physical, social, etc.)

Integral Stimulation: Modification of "Eight Step Continuum" for therapeutic intervention.
(Adapted from Strand 1995; Davis & Velleman, 2000).

1. Therapist says the utterance while child watches the clinician's face - child repeats
 - a) if the child is unsuccessful, move to simultaneous production (therapist with client), varying rate and adding tactile or gestural cues as necessary
 - b) maintain both auditory and visual stimuli
 - c) continue productions until the child can easily produce the utterance with the therapist; then slowly fade the simultaneous cue by reducing volume, to the point where there is a simultaneous mime only)

2. Move to immediate repetition
 - a) therapist provides auditory model (again making sure the child is watching the therapist's face)
 - b) child repeats (therapist mouths the gesture during the response if additional support is needed; then fade)

3. Addition of delay
 - a) therapist says target utterance
 - b) insert a delay (one to three seconds) before imitative response
 - c) after the child is successful at repeating the utterance after a 2 or 3 second delay, have the child repeat the target several times without intervening stimuli

4. Work to elicit the utterance spontaneously

A note about repetitive drills of specific words and phrases:

Primary benefit: Automaticity **in context in which drill is practiced**

Vital to go on to more naturalistic activities; otherwise carry-over will not occur

Does not train motor planning flexibility

Prompts for Restructuring Oral Muscular Phonetic Targets (PROMPT; Chumpelik 1984;

<http://www.promptinstitute.com>)

- Use of tactile cues to shape and stimulate articulatory gestures
- Dynamic contexts
- Individualized treatment
- Emphasis on functional communication
- Workshop required to become certified

Phonological Aspects of Treatment

Choosing target positions

Children with CAS may not follow these generalizations, but in general:

- Fricatives, nasals, and velars are mastered first in final, not initial, position
- Early final clusters (e.g., -nd and -mp) start emerging somewhat before early initial clusters
- [s] may be easier in an alveolar cluster (e.g. st-, sn-, -ts, -ns) than as a singleton

Strategies for Remediating Vowels

Facilitating consonant contexts (MacNeilage et al., 2000)

- alveolar for high front vowels
- velar for high back vowels
- labial for low, central vowels

Start from corner vowels and work in
Visual imagery e.g., Lindamood LiPS

Principles for Phonotactic Intervention

Theoretical Basis for the Hierarchical Approach (Velleman & Strand, 1994)

1. All aspects of communication, from articulatory motor gestures (oral or manual) to complex stretches of discourse, are hierarchical. Smaller units combine in specifically structured ways to form larger units.
2. The hardest task for children with DVD is not making the individual the sounds themselves, but putting them together into a smooth, fluent utterance. They have difficulty generating linguistic frames (syntax, morphology, as well as phonology and articulation) and getting the contents in the right order in the frame. Therefore, the main focus of treatment should be **syllable structure control and organization** within a variety of **dynamic linguistic contexts**.
3. There are two aspects of motor sequencing:
 - determining the order of the elements, and
 - figuring out how to get from one to the other (Ayres, 1985)

Both of these aspects of motor sequencing may be impaired in dyspraxia. The difficulty in getting from one spatial target to another is exacerbated by vowels, because their articulatory targets are configurations rather than contacts. Diphthongs are even more challenging in this respect.

For these reasons, a successful program is one that will provide **practice in getting from a certain consonant position to various vowel targets** (e.g., bee, bye, bow, boo, baa) and **from various consonant positions to a certain vowel target** (bee, tea, D, key, we, see, etc.). In addition, it will facilitate correct production of varying syllable shapes (CV, CVV, CVC, CCVC, etc.) and the organization of these shapes into longer and increasingly more complex phonotactic patterns.

Planning Movement Sequences within Syllables

I. Ability to produce repeated phonetic sequences, beginning with "easy" consonants and vowels:

- CV forms with consistency of consonant and vowel production across 4-10 repetitions (baa - baa - baa - baa etc.). Vary consonant or vowel types (place or manner of articulation) as the child's phonetic repertoire permits, changing only one segment at a time (consonant **or** vowel). Maintain the same CV across all repetitions in each instance.

Examples: ba – ba – ba – ba – ba then da – da – da - da – da OR

ba – ba – ba – ba – ba then bee – bee – bee – bee – bee

- Repetition of more difficult phonotactic shapes (CVC and beyond), in the same manner. (See "A Hierarchy of Phonotactic Difficulty" below for guidance choosing an appropriate sequence of phonotactic shapes.)

II. Ability to anticipate articulatory change in repeated phonetic sequences:

- Minimally change CV productions in response to visual (picture or letters) cue after 4-9 repetitions (e.g., baa - baa - baa - baa - boo - boo - boo - boo). Change either the vowel or the consonant, not both, at this stage. Target vowels and consonants should be sounds that are already in the child's phonetic repertoire. Also, they must be sounds that the child produces distinctly enough that changes can be detected. (For example, if both [ɑ] and [o] are pronounced as [ʌ], no vowel change is actually occurring.) Usually, stops and corner vowels ([i, ɑ, u]) are good places to begin.
- Minimally change CV production (consonant or vowel) in an alternating sequence of 4-10 repetitions (e.g., baa - boo - baa - boo etc.).
- Minimally change CV production (consonant or vowel) in randomly alternating sequences of 4-10 repetitions (e.g., baa - baa - boo - baa - boo - boo etc.).
- Continue with a variety of consonant and vowel types (place and manner of articulation, always using pairs within the child's phonetic repertoire that differ only by one consonant or one vowel.
- Continue with increasingly more significant changes required (e.g., both consonant and vowel changed), and/or with increasing numbers of different CV words.
- Continue with more challenging phonotactic shapes (CVC and beyond). See "A Hierarchy of Phonotactic Difficulty" below for guidance on choosing an appropriate sequence of phonotactic shapes.

III. Possible strategies and activities:

- Play routines
- Book-reading (e.g., counting books)
- The "ba-ba board"

A Hierarchy of Phonotactic Difficulty (Velleman, 2002)

- * Simple open syllables (CV)
- * Reduplicated open syllables (CVCV -- same syllable repeated as in "bye-bye")
- * Harmonized (C or V) non-reduplicated disyllabic open syllable forms: CVCV
- * Non-harmonized non-reduplicated disyllabic open syllable forms
- * Harmonized closed syllables
- * Non-harmonized closed syllables
- * CVCVC words (reduplicated, harmonized, or neither)
- * Words with initial, medial, and/or final clusters

Guidelines for Phonotactic Therapy (Velleman, 2002)

1. Do not worry about segmental (articulatory) accuracy! The goal is the structure, not its contents.
2. Within the new structure, model segments that the child can already produce in other structures. Example: The goal is final consonants. The child is able to produce stops and nasals in initial and medial position. Model stops and nasals in final position.
3. Model the correct elements at all times. However, accept attempts which include any trace of any element in the proper position. Example: The goal is production of final consonants. Stops are modeled in final position. Child produces a velar fricative in final position. This meets the objective, because a consonant-like sound was produced in the target position.
4. Use adjacency to facilitate production of elements in new positions. Examples:
 - a. Child can say [ba] but not [bab]. Use sentences such as "Bob bounces the ball", in which the upcoming initial [b] in "bounces" facilitates the production of the final [b] in "Bob".
 - b. Child can produce final stop + [s] clusters, but not initial [s] + stop clusters. Use repetitions of sentences such as "Stop the tops..Stop the tops..", in which the final [s] facilitates the initial [s] in the next production of the sentence.
5. Use fading to facilitate production of new structures.
Example: The goal is production of final consonants. Play with reduplicated CVCV's, then gradually fade the final vowel. For instance, the child should practice [baba] with all elements voiced, then "whisper" the final [a], then open his mouth for the final [a] but not let the sound come out, then finally to just "think" the final [a]. This leads to the production of the CVC [bab].
6. Use the child's earlier patterns or developmentally early patterns as stepping stones to more mature patterns. Examples:
 - a. The goal is the production of words of three syllables or more. The child has a history of reduplication of two-syllable words. Begin the three-syllable goal by targeting reduplications of three syllables ([bababa]), then gradually differentiate by changing the vowel or the consonant of one syllable ([bababo] or [babada]). Then change both ([babado]), or change consonants twice ([badaba]) or vowels twice ([baboba]), etc. Gradually differentiate the syllables more and more.
 - b. The goal is the production of words of three syllables or more. The child has a history of strongly preferring trochaic (stressed + unstressed) two-syllable words (e.g., he/she omitted the initial syllable of "giRAFFE" but did not omit either syllable from "MONkey"). Target first trochaic three-syllable words with a pattern of stressed +

unstressed + unstressed (e.g., "BRoccoli"), then stressed + unstressed + stressed (e.g., "JAMboREE"). Save words with an unstressed syllable at the beginning for last (e.g., "baNAna").

Typical Phonotactic Goals (Velleman, 2002)

1. Complete syllables, including both a C and a V, ideally in CV order but VC is fine if that's easier for the child.

2. Closed syllables.

Initially with one or all of the following:

a. only a final C: VC

b. harmony (same consonant in initial and final position)

c. with target nasals, fricatives, or velars in final position. (However, remember that segmental accuracy in the child's production does not matter, as long as the child produces any kind of final consonant.)

d. with a lax vowel (Kehoe & Stoel-Gammon 2001 have shown that children are more likely to produce a final consonant after a lax ("short") vowel than after a tense ("long") one)

3. Two-syllable words

Initially with one or more of the following:

a. reduplication

b. consonant harmony

c. vowel harmony

d. a high vowel (e.g., [i]) in final position

4. Decrease reduplication or harmony

Again, it doesn't matter whether syllables/segments are accurate, as long as they are different from each other.

5. Varied stress patterns:

For children who can produce two-syllable or longer words, but only in a SW (stressed + unstressed; e.g., monkey) stress pattern:

a. SWS, without omitting the medial weak syllable (e.g., "elephant")

b. WS or WSW, without omitting the initial weak syllable (e.g., "giraffe", "banana")

c. more difficult patterns.

6. Movement patterns (overlap of phonotactic and phonetic goals):

a. Place: e.g., bilabial at the beginning of the word, alveolar at the end

b. Manner e.g., stop at the beginning of the word, fricative at the end

(In either case, only the manner or place is critical; if the child's production is inaccurate in other ways, that's fine.)

7. Consonant clusters

Stop + glide in initial position (or, target stop + liquid but accept stop + glide)

Nasal + stop in final position

Adjust as appropriate to individual strengths and needs.

Prosody Treatment (Velleman, 2003)

Explicit practice of various intonation and stress patterns. For younger children, model without calling attention to the nature of the pattern. For older children with some metalinguistic awareness, increase awareness as well as production of suprasegmentals.

1. Stress Patterns

a. Word Stress:

- Identify the number of syllables in a word (by clapping, with blocks, etc.).
- Identify the stressed syllable in orally-presented multisyllabic words.
- Imitate multisyllabic words with appropriate stress.
- Produce familiar (from steps 1-3) multisyllabic words with appropriate stress.

b. Phrase Stress:

- Correctly match a spoken phrase with its meaning:

EX.: "black+board"

with stress on "black", matches "what the teacher writes on"

with stress on "board", matches "a board which has been painted black".

Other examples include: white house, light house, green house, hot house, big top, fish tank, black bird, blue bird, hot dog.

- Correctly stress a phrase to match the given meaning (production).

c. Sentence Stress:

- Identify the stressed word in spoken sentences. (Stress may need to be exaggerated initially.)
- Given a wh-question, identify which word should be stressed in a written sentence. For example:
"Who ate the cheese?" --> "The **mouse** ate the cheese".
"What did the mouse eat?" --> "The mouse ate the **cheese**".
"What did the mouse do to the cheese?" --> "The mouse **ate** the cheese".
- Correctly repeat the sentence when modeled after marking the word to be stressed.
- Given a wh-question, correctly stress the reply.
- Given a written paragraph from a textbook, identify words which should be stressed (i.e., the most critical pieces of information.) if the paragraph were to be read aloud.
- Given a written paragraph from a textbook, read it aloud after marking correct stress.

d. Carry over these skills to:

- Reading aloud in the classroom when forewarned of which portion of written text (s)he will be asked to read (so that (s)he can independently pre-read it and select words to be stressed).
- Appropriately stress words in controlled conversation (i.e., in therapy).
- Appropriately stress words in conversation when asked to clarify an utterance.
- Appropriately stress words in conversation.

2. Pitch (Sentence-Level)

a. Identify rising pitch vs. falling pitch at the ends of orally-presented sentences:

- In yes/no questions (rising) versus wh-questions and statements (falling pitch).
- In lists (including counting) -- rising pitch on all but last item, falling on last. Signal when the last item is produced (based upon pitch cue).

- b. Given written sentences, indicate where the speaker should produce rising pitch vs. falling pitch in the above environments.
 - c. Given written sentences, produce rising pitch vs. falling pitch in the above environments, first in imitation, then spontaneously.
 - d. Given written paragraphs, mark words which should receive rising versus falling pitch, then read them aloud accordingly.
 - e. Use pitch appropriately in controlled conversation (i.e., in therapy).
 - f. Use pitch appropriately in conversation when asked to clarify an utterance.
 - g. Use pitch appropriately in conversation.
3. Pauses
- a. Identify pauses within orally-presented sentences.
 - b. Given written sentences, identify locations where pauses should occur (at edges of noun phrases, verb phrases, clauses, etc.).
 - c. Repeat sentences with appropriate pauses (based upon prior identification).
 - d. Read sentences with appropriate pauses (based upon prior identification).
 - e. Use pauses appropriately in controlled conversation (i.e., in therapy).
 - f. Use pauses appropriately in conversation when asked to clarify an utterance.
 - g. Use pauses appropriately in conversation.

Other phonological intervention principles

Cycles

A "cycles" approach (Hodson & Paden 1991) is recommended:

- difficulty of choosing the best goal
- stimulation of whole phonological system
- parallel to typical development (less strong argument for CAS)

Goal sets

To avoid confusion:

- Address 1 phonetic, 1 phonotactic (including prosody) and possibly 1 literacy goal at a time (i.e., not two phonetic goals or two phonotactic goals at the same time)
- Change the two/three goals at different times

BEHAVIORAL OBJECTIVES WORKSHEET

(Based upon ideas presented in Kirkpatrick, Stohr & Kimbrough 1990)

I. Movement Pattern Categories: Choose **one** block in **either** the place **or** manner movement charts for each objective. The objective is for the child to achieve that movement pattern (e.g., "alveolar to dental" or "stop to fricative"), **not** to produce perfectly accurate segments. Progress may be charted on this form by dating blocks as they are completed.

A. Place

1st C 2nd C → ↓	Bilabial [p, b, m, w]	Dental [f, v, θ, ð]	Alveolar [t, d, n, s, z, l]	Palatal [j, ʃ, ʒ, tʃ, dʒ, r]	Velar [k, g, ŋ, h]
Bilabial [p, b, m, w]					
Dental [f, v, θ, ð]					
Alveolar [t, d, n, s, z, l]					
Palatal [j, ʃ, ʒ, tʃ, dʒ, r]					
Velar [k, g, ŋ, h]					

B. Manner

1st C 2nd C → ↓	stop [p, t, k, b, d, g]	nasal [m, n, ŋ]	glide [w, j]	fricative [f, v, θ, ð, s, z, ʃ, ʒ, h]	affricate [tʃ, dʒ]	liquid [l, r]
stop [p, t, k, b, d, g]						
nasal [m, n, ŋ]						
glide [w, j]						
fricative [f, v, θ, ð, s, z, ʃ, ʒ, h]						
affricate [tʃ, dʒ]						
liquid [l, r]						

II. Syllable Level, Type, and Position

Each new number of syllables per word or new syllable shape (open vs. closed) is a new skill level and therefore a new objective for the child.

# of syll. # of C → ↓	1	2	3	4
1	open (CV)	closed (CVC)		
2		open (CVCV)	closed (CVCVC)	
3			open (CVCVCV)	closed (CVCVCVC)

A blank version of this chart could be used to track progress as the child masters new phonotactic possibilities.

# of syll. # of C → ↓	1	2	3	4
1				
2				
3				

III. Cueing Levels

- 1: Names without model
- 2: Verbal imitation
3. Visual and/or tactile cue
 - V3: visual
 - T3: tactile
- 4: Unable to produce, no response

IV. Objective Levels: **One** new variable per objective

	Movement Category	Syllable Category	Cueing Level
New			
Old			

Language Intervention

Language Treatment Overview (Velleman, 2003)

(1) Recall that the same phonotactic limitations seen in words (reduplication, consonant harmony, weak syllable reduction, sequencing processes) may occur in phrases and sentences

Impact:

- loss of contrast between words
- difficulty producing phrases beginning with function words, which are unstressed (e.g., “the cat”, “in school”, etc.)
- morpheme sequencing (e.g., “It’s don’t floats”; “mowlawner”)
- word sequencing (e.g., “beep don’t”)

(2) Many morphemes in English require the production of final consonant clusters, which can be very difficult for children with CAS:

- plural ‘s’ [kIdz]
- possessive ‘s’ [hops]
- 3rd person singular ‘s’ [hIts]
- past tense ‘ed’ [kUkt]

Increasing Early Grammatical Skills in Children with CAS

Language remediation as appropriate for any language-delayed child, especially modeling and expansion, with the following additional special techniques/precautions:

I. DO NOT SPEAK TELEGRAPHICALLY!

To learn function words and morphology, the child must be exposed to them, from the beginning. Learning from exposure (**implicit learning**) is very powerful!

II. Stimulate use of early morphology in the following order:

A. Early free (whole-word) morphemes: in, on, etc.

B. -ing.

C. Irregular verb and noun forms that require:

- **significant** vowel change (e.g., mouse-mice but **NOT** woman-women),
- syllable addition (e.g., child-children), or
- other change of greater than one phoneme (e.g., think-thought).

D. **Syllabic** forms of early bound morphemes, such as:

- [əz] plurals (horses, boxes, houses, purses, couches, cheeses, etc.),
- [əz] possessives (Rose's, Mitch's, etc.),
- [əz] third person singulars (kisses, matches, wishes, etc.),
- [əd] past tenses (patted, padded, fitted, kidded, boated, loaded, weeded, etc.).

E. Non-syllabic forms of early bound morphemes in vowel-final words, such as:

- plural: tubas, shoes
- possessive: Rosa's, Joe's
- 3rd person singular: goes, fries
- past tense: skied, tried, etc.

Note: Remember that, like any child, the child with CAS may appear to learn irregular forms and then abandon them temporarily as regular forms are learned.

III. Improve sentence-building skills (if MLU = 2.5+):

- A. Address function words one by one, to 50 - 75% accuracy level.
- B. Use visual or manual cues (e.g., Folkes Sentence Builder).

Considerations for older children with persistent intelligibility and language issues

Don't forget prosody – comprehension as well as production.

Focus on listener awareness, including training the student to:

- Initiate conversation or a new topic with a short, simple, clear topic sentence.
- In longer stretches of discourse, announce the organization of thoughts (e.g., “First, I’ll tell you what happened yesterday.”).
- Produce words that are new, difficult, unexpected, or that provide the answer to the listener’s question as slowly and clearly as possible even if other words in the sentence suffer as a consequence.
- Pause between the subject and the verb of the sentence (and around other phrases, such as prepositional phrases or relative clauses) to cue the listener to the grammatical structure of the sentence and to give the listener additional processing time without seeming to speak unnaturally slowly.
- Make an extra effort to mark morphology in ambiguous contexts (e.g., when discussing a girl and a boy, be sure to clearly produce “he” vs. “she”; when giving background information for a current situation, be sure to clearly mark past tense). If morphology use is inconsistent or unreliable, use adverbs (e.g., to mark tense), number words (to mark plural), and other markers to clarify content.

To motivate participation in therapy

- tie therapy performance to grades. (Example: Oral presentation grade determined in part by effort and time devoted to practice in therapy.)
- devote time to vocabulary and grammatical forms that are useful for peer interactions, for life skills, and for the student’s vocational goals as well as for academic material

Use of Augmentative Communication Systems

Helpful for fostering language development, communicative initiation and repairs

Considerations for selection of type of communication system:

- “Naming insight”
- Use of natural gestures and vocalization
- Manual motor abilities (may need OT involvement or consultation)
- Facilitation of independent communication
- Family and school involvement and resources

See also Cumley & Swanson (1999).

Literacy Treatment Overview:

- Reading and spelling test scoring should be adjusted for speech production patterns (Note: Former speech patterns may recur in spelling even after the patterns have disappeared from speech.)

- Perception of phoneme sequences and word attack skills especially impaired for nonsense words:
 - a. recognition of familiar words (sight-word reading) = automaticity
 - b. So, include nonsense words/ unfamiliar words in treatments to train flexibility

- Because transitions are difficult, sound-by-sound reading approaches are challenging. Instead – or as well – focus on chunks (“word families”, “rhymes”) (Gaskins et al. 1997. Cunningham 1996, Cunningham & Allington, 1996)

- Story grammar: Integration of story components in reading and writing also a challenge.
 - a. Visual/tactile cues (a la Story Grammar Marker, Moreau & Fidrich-Puzzo 1994)
 - b. Other organizational approaches
 - Semantic Organizer, Pehrsson & Robinson 1985
 - ThemeMaker for much older children
 - <http://www.mindwingconcepts.com/pages/products.html>

Roles of classrooms and families

Means, Motives, Opportunities: Who provides which?

What can/should classroom teachers, families, and other significant adults do?

- provide a successful, supportive, communication environment
- avoid communication pressure, especially in stressful contexts
- accept and, if possible, model varying communication modalities
- MODEL:
 - clear but natural speech
 - repeat key words in different sentences
 - DON'T speak telegraphically; use grammatical sentences
- make specific clarification requests, not just “what?”
- give choices
- use “3 times” rule
- use verbal routines whenever possible
- read to the child as much as possible, especially predictable books
- model appropriate respect for the child’s communication attempts to the child’s classmates and playmates
- lay a firm foundation for literacy
- be prepared with extra support for literacy, both at the level of phonemic awareness and at the level of reading and writing paragraphs or even longer stretches of text
- make t.v. an interactive experience
- follow the child’s lead when possible

MOST IMPORTANT OF ALL FOR FAMILIES:

- Let the child be a child
- Fill the home with love and fun

Final thoughts: There’s a lot we don’t know about Childhood Apraxia of Speech. Keep asking questions, trying out different assessment and treatment techniques, and sharing your successes with others. We need each others’ insights and support!

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Apraxia-Kids web site: www.apraxia-kids.org (Don't forget the hyphen!!)

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