Childhood Apraxia of Speech: Differential Diagnosis

**Differential Diagnosis:**
- Identifying phonological vs motor speech problems
- If motor speech, identifying CAS vs dysarthria
- These disorders are not mutually exclusive, and have characteristics that overlap
- There may also be overlap with delays in language development

<table>
<thead>
<tr>
<th>Function</th>
<th>Neural Process</th>
<th>Possible Communicative Disorder</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communicative idea</td>
<td>Cognitive</td>
<td>Pragmatic language deficit (difficulty demonstrating communicative intent)</td>
</tr>
<tr>
<td>Word retrieval</td>
<td>Linguistic</td>
<td>Language delay/impairment Phonologic mapping</td>
</tr>
<tr>
<td>Specifying range of motion, Direction, speed and force of movement</td>
<td>Motor planning and programming</td>
<td>Childhood Apraxia of Speech (CAS)</td>
</tr>
<tr>
<td>Execution of movement resulting in acoustic output</td>
<td>Motor execution</td>
<td>Dysarthria</td>
</tr>
</tbody>
</table>

*(Strand & McCauley, 2008)*

**Late Talkers**
- Begin to use some speech by age 2½
- Have difficulty primarily with expressive skills
- Have age-expected receptive language
- General communication skills are intact (nonverbal, social interaction aspects)
- No cognitive delay
- Few/no other risk factors
  
  *(Paul, 1996; Thal, 1991; Whitehurst & Fischel, 1994)*

**Language Impairment**
- Delays in receptive as well as expressive language
- Less use of gestures
- Reduced sound inventory
- Limited play schemes
  
  *(Paul, 1991; Rescorla, 1991; Thal, Tobias & Morrison, 1991)*

**Phonologic Delay/Disorder.** Difficulty with the sound patterns that code meaning.
Childhood Apraxia of Speech (CAS): Differential Diagnosis

**CAS**
1) inconsistent errors on consonants and vowels in repeated productions of syllables or words,
2) lengthened and disrupted coarticulatory transitions between sounds and syllables, and
3) inappropriate prosody, especially in the realization of lexical or phrasal stress.”

Children with CAS are at higher risk for later literacy issues and may need short- or long-term use of alternative/augmentative modes of communication

**Dysarthria**
A group of related motor speech disorders resulting from disruption in the ability to execute movements accurately due to impairment in muscular control.
- Disruption may be noted in:
  - Respiration
  - Phonation
  - Resonance
  - Articulation
  - Prosody

**Challenges in Diagnosis**
- Inconsistent use of terminology
- Lack of a diagnostic gold standard
- Differences among training programs and CEU offerings
- Variability in expression of CAS and potential for change
- Difficulty differentiating types of motor problems
- Identifying the relative contributions of language, phonology, and motor problems
- Recognizing the effects of co-occurring disorders
- Lack of adequately normed, standardized tests (McCauley & Strand, 2008)
**Assessment Procedures**

- Review developmental history
  - “Red flags” for CAS include significantly limited sound repertoire, tending to use a single word for many different things (Davis & Velleman, 2000)
- Evaluate general communication skills
- Assess language skills
- Evaluate speech production skills
  1. Structural-functional evaluation
  2. Documentation of speech sound inventory
  3. Examination of motor speech skill

**Review Developmental History**

Birth history
Ear infections, newborn screening, hearing screening
Illnesses or injuries
History of seizures
Developmental milestones
Feeding history and behaviors (e.g. sitting, walking, talking, etc.)

Evaluate general communication skills
Childhood Apraxia of Speech (CAS): Differential Diagnosis

- Communicative behaviors may be used for joint attention, behavior regulation, and social interaction
- Consider speech output in the context of general development and language skills
- Cannot rule in/rule out CAS if the child is not making active attempts to communicate

Informal observations can be informative
- Parents may report that the child “understands everything”, but language testing may show otherwise.
- Remember the range of variability that is especially true for young children
- Spontaneous sample gives an idea of functional use of language
  - are sentence forms simplified to reduce motor demands?
  - does the child lack confidence in efforts to communicate with others?

Evaluate Language Skills
- Language testing does not rule in/rule out apraxia, but contributes to the differential diagnosis.
- Discrepancy between receptive and expressive language skills may be a red flag for CAS, may also occur in severe phonological disorder

Bilingualism
A speech/language disorder is not caused by exposure to more than one language nor “cured” by monolingualism

Evaluate Current Speech Production Skills
- Structural functional examination – see Appendix A
- Standardized articulation/phonology assessment
- Spontaneous speech sample
- Motor speech examination – see Appendix B
- Informal observations – see Appendix C
- Bilingual considerations

Case Study: Female, age 2:5
- Developmental History
  - No motor delays
  - Normal muscle tone
  - No feeding issues
  - “quiet” baby with limited reduplicated babbling
  - No hearing problems or ear infections
- General Communication
  - Active communicator, uses 3-5 signs in an “utterance”
  - Expresses a variety of pragmatic functions nonverbally

- Language
Childhood Apraxia of Speech (CAS): Differential Diagnosis

- REEL-3 receptive 95, expressive <55 (no credit for signing)
- Following two-step directions consistently
- Age-appropriate play skills, imaginative play schemes

- Structural-Functional Examination
  - No structural anomalies
  - Range of motion, strength, speed of movement sufficient for speech
  - Normal resonance (based on limited sample)

- Speech Sound Inventory
  - /p, m, t, d, tʃ, ʃ, ɪ, ɑ / in isolation
  - No CV, VC, or CVC syllables
  - Limited compliance for standardized test
  - No phonological patterns noted (at least not yet!)

- Motor Speech Exam
  - Produced /oʊ / with assistance
  - Willing to attempt syllable /m ɑ / (more) multiple times in simultaneous production with examiner
  - Frustration and avoidance noted for directed imitation

Are we ready to make a diagnosis?
- What sounds/syllables would you consider for additional probing in a motor speech examination?
  - Try imitation of single consonants from the “early 8” that the child is not yet producing
  - Try imitation of simple CV and VC syllables using some consonants from “early 8” and some from “middle 8”
  - Try imitation of a few consonants from early, middle or late 8 with varied vowels in simple VC and CV syllables
  - Try imitation of a few consonants from early, middle and late 8 with varied vowels in a variety of syllable shapes (CV, VC, CVC, CVCV)

- What other information would be helpful for informing diagnosis?
- What might you be looking for if you recommend diagnostic therapy?

Summary
- Careful assessment procedures are important, because accurate diagnosis leads to appropriate treatment.
- We are trying to
  - determine if there is sufficient evidence to make the diagnosis of CAS versus (or in addition to) other speech-language problems
  - identify a starting point for therapy
- We need to consider the contribution of abilities that include cognition, language, motor praxis and motor execution.
- In some cases, it may not be possible to rule in/rule out CAS initially
  - In some cases where CAS is present, it may not be the primary impairment
• It is likely that diagnostic classification will change over time as a result of maturation and/or treatment
  ▪ Differential diagnosis is an ongoing process
### Appendix A

### Structural-Functional Exam
(Adapted from Strand, Yorkston, & Miller, 1995.)

**Scoring:**
- 0=WNL
- 1=Mild abnormality
- 2=Moderate abnormality
- 3=Severe abnormality

#### Jaw
- structural restrictions
- adventitious movement
- atrophy

<table>
<thead>
<tr>
<th>ROM</th>
<th>Strength</th>
</tr>
</thead>
<tbody>
<tr>
<td>Opening</td>
<td></td>
</tr>
<tr>
<td>Closing</td>
<td></td>
</tr>
<tr>
<td>Right Lateral</td>
<td></td>
</tr>
<tr>
<td>Left Lateral</td>
<td></td>
</tr>
</tbody>
</table>

#### Lips
- atrophy
- resting asymmetry
- adventitious movement

<table>
<thead>
<tr>
<th>ROM</th>
<th>Strength</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pucker</td>
<td></td>
</tr>
<tr>
<td>Retraction</td>
<td></td>
</tr>
<tr>
<td>Upper Left</td>
<td>NA</td>
</tr>
<tr>
<td>Upper Right</td>
<td>NA</td>
</tr>
<tr>
<td>Lower Left</td>
<td>NA</td>
</tr>
<tr>
<td>Lower Right</td>
<td>NA</td>
</tr>
</tbody>
</table>

#### Tongue
- atrophy
- adventitious movement
- resting asymmetry

<table>
<thead>
<tr>
<th>ROM</th>
<th>Strength</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elevation</td>
<td></td>
</tr>
<tr>
<td>Protrusion</td>
<td></td>
</tr>
<tr>
<td>Left Lateral</td>
<td></td>
</tr>
<tr>
<td>Right Lateral</td>
<td></td>
</tr>
</tbody>
</table>

#### Velopharyngeal Function
- Abnormal gag
- asymmetrical gag
- resting asymmetry
## Appendix B

### Motor Speech Exam

(adapted from a worksheet designed by Edythe Strand, 2008, used with permission)

#### Observations during connected speech:

<table>
<thead>
<tr>
<th></th>
<th>Vowels</th>
<th>Consonants</th>
<th>Typical/Maximum word length (any words longer than 2 syllables?)</th>
<th>Syllable shapes C, CV, VC, CVC, etc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conversation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Picture description</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Narrative</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Observations during elicited utterances:

<table>
<thead>
<tr>
<th>CV, VC, CVC syllables</th>
<th>Transcription</th>
<th>Immediate repetition</th>
<th>Repetition after delay, no cues</th>
<th>Needs simultaneous production</th>
<th>Needs gestural or tactile cues</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Syllable sequences and long words:

<table>
<thead>
<tr>
<th></th>
<th>Transcription</th>
<th>Immediate repetition</th>
<th>Repetition after delay, no cues</th>
<th>Needs simultaneous production</th>
<th>Needs gestural or tactile cues</th>
</tr>
</thead>
<tbody>
<tr>
<td>puppy</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>bubbles</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I do</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Childhood Apraxia of Speech (CAS): Differential Diagnosis</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>--------------------------------------------------------</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>banana</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>animals</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>computer</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Helicopter</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>hippopotamus</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I want</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I want one</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I want one more</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I ate a cookie</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I ate a cookie yesterday</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Appendix C
### Comparison of Childhood Apraxia of Speech, Dysarthria and Severe Phonological Disorder

<table>
<thead>
<tr>
<th>Verbal Apraxia</th>
<th>Dysarthria</th>
<th>Severe Phonological Disorder</th>
</tr>
</thead>
<tbody>
<tr>
<td>No weakness, incoordination or paralysis of speech musculature</td>
<td>Decreased strength and coordination of speech musculature that leads to imprecise speech production, slurring and distortions</td>
<td>No weakness, incoordination or paralysis of speech musculature</td>
</tr>
<tr>
<td>No difficulty with involuntary motor control for chewing, swallowing, etc. unless there is also an oral apraxia</td>
<td>Difficulty with involuntary motor control for chewing, swallowing, etc. due to muscle weakness and incoordination</td>
<td>No difficulty with involuntary motor control for chewing and swallowing</td>
</tr>
<tr>
<td>Inconsistencies in articulation performance--the same word may be produced several different ways</td>
<td>Articulation may be noticeably &quot;different&quot; due to imprecision, but errors generally consistent</td>
<td>Consistent errors that can usually be grouped into categories (fronting, stopping, etc.)</td>
</tr>
<tr>
<td>Errors include substitutions, omissions, additions and repetitions, frequently includes simplification of word forms. Tendency for omissions in initial position. Tendency to centralize vowels to a &quot;schwaa&quot;</td>
<td>Errors are generally distortions</td>
<td>Errors may include substitutions, omissions, distortions, etc. Omissions in final position more likely than initial position. Vowel distortions not as common.</td>
</tr>
<tr>
<td>Number of errors increases as length of word/phrase increases</td>
<td>May be less precise in connected speech than in single words</td>
<td>Errors are generally consistent as length of words/phrases increases</td>
</tr>
<tr>
<td>Well rehearsed, &quot;automatic&quot; speech is easiest to produce, &quot;on demand&quot; speech most difficult</td>
<td>No difference in how easily speech is produced based on situation</td>
<td>No difference in how easily speech is produced based on situation</td>
</tr>
</tbody>
</table>
Receptive language skills are usually significantly better than expressive skills | Typically no significant discrepancy between receptive and expressive language skills | Sometimes differences between receptive and expressive language skills

Rate, rhythm and stress of speech are disrupted, some groping for placement may be noted | Rate, rhythm and stress are disrupted in ways specifically related to the type of dysarthria (spastic, flaccid, etc.) | Typically no disruption of rate, rhythm or stress

Generally good control of pitch and loudness, may have limited inflectional range for speaking | Monotone voice, difficulty controlling pitch and loudness | Good control of pitch and loudness, not limited in inflectional range for speaking

Age-appropriate voice quality | Voice quality may be hoarse, harsh, hypernasal, etc. depending on type of dysarthria | Age-appropriate voice quality

Compiled by members of the Advisory Committee of the Childhood Apraxia of Speech Association of North America (CASANA)