

Diagnosing Childhood Apraxia of Speech: You Can Do It!



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Disclosures

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 - No Financial Disclosures
 - No Non-Financial Disclosures
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Goals

- Identify clinical markers of CAS in young children (2-4 year olds)
- Identify key steps of speech sound disorder assessment in young children
- Discuss differential diagnosis of CAS vs. other speech sound disorders

Outline

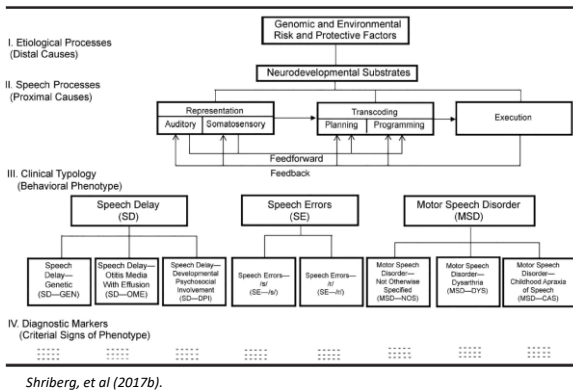
- CAS terminology & clinical markers
- Assessment components
- Analyzing & interpreting assessment data
- Differential diagnosis
- Questions

CAS

Definitions, Terminology, Clinical markers

Want to know in SSD assessment

- Sounds the child is producing
- Are there patterns to errors?
 - If so, Are the errors consistent?
- Does prosody aid or detract from intelligibility?
- Is structure intact?
- Is hearing intact?
- Is the child intelligible?
- How does speech affect activities & participation?
- What are parents' thoughts? How does child respond to treatment strategies?



Childhood Apraxia of Speech

- Type of speech sound disorder
- Motor-based
- Core impairment in
 - Motor planning/motor programming speech movements
- Motor planning disorders affect
 - Motor execution (articulation)
 - Encoding of phonological information (phonology)

CAS Sub-Types

- Idiopathic
- Neurological Damage
 - Caused by multiple factors: seizures, illness, trauma
- Secondary Characteristic of Complex Neurobehavioral Disorder

CAS as Secondary Characteristic/Symptomatic

- Down Syndrome
- Epilepsy
- Fragile X (40% of cases)
- Autism
- Rett syndrome
- Velocardiofacial syndrome
- Chromosomal translocations
- Posterior fossa tumors (post-surgery)
- Galactosemia (40-60%)
 - Rare genetic metabolic disorder
 - Unable to break down galactose into glucose

How is CAS Identified?

- On the basis of behavioral symptoms
 - that exclude it from functional speech disorder or delay
- clinical observation of behavioral markers that
 - Meet inclusionary characteristics
 - Meet exclusionary criteria

Inclusionary Requirement for Diagnosis

- Criterion performance on a required number of speech, prosody, and/or voice signs purported to be diagnostic of apraxia"

• *Shriberg, et al (2017b, p. S1099)*

Signs of CAS

- Segmental Errors (Errors in Consonants and Vowels)
 - Inconsistency in consonant and vowel production in same word or word shape context
 - Observed in independent motor plans
 - Not repetitions of words - same motor plan
- Putting sounds together (Word shape errors)
 - lengthened/disrupted consonant-vowel transitions
 - Greater difficulty in producing phonemes in longer words
- Prosody errors
 - Excess equal stress
 - Inconsistencies in prosody
 - Difficulties regulating suprasegmentals, such as rate, nasality, loudness, pitch

ASHA (2007)

CAS: Potential Characteristics in Infants & Toddlers

- Marginal babbles in infancy
- Oral groping, drooling, uncoordinated feeding patterns
- Limited vocal output: home signs/gestures
- Little variety in consonant and vowel productions
- Stereotypic syllable patterns
- Words used, then disappear
- Single consonants & vowels produced as words

Davis & Velleman, 2000

Promising Directions for Assessment in Older / Verbal Children

Promising findings from recent differential dx of CAS from non-CAS

- 91% predictive accuracy
- Greatest predictors in differentiation of idiopathic CAS from non-CAS SSD were:
 - Real-word polysyllabic test
 - Percentage of stress matches on polysyllabic test
 - Syllable segregation
 - Percent Phoneme Accuracy
 - Nonword /pə.tə.kə/ portion of Oral Motor Exam
- Includes all markers for CAS.
- Murray, McCabe, Heard, Ballard (2015).

What is current path to diagnosis?

- Children with CAS make errors that
- Differ from children with speech delay or speech disorder;
- Differ from children with pediatric dysarthrias;
- Share some characteristics with adults with Adult Apraxia of Speech (AAS)

Shriberg et al (2017b)

CAS and AAS

- Potentially share same speech process:
 - Inappropriate pause due to transcoding deficits in representational and motor speech processes

AAS vs. CAS

- Both assumed to be difficulty with motor planning/programming.
- Important distinction:
 - CAS affects DEVELOPMENT of higher level phonological and linguistic levels (Maassen, 2002)
 - Levels intact and lost in individuals with AOS

Mayo Classification System - Adaptation for classifying CAS

- Segmental
 1. Vowel distortions
 2. Voicing errors
 3. Distorted substitutions
 4. Difficulty achieving initial articulatory gestures or transitional movement gestures
 5. Groping
 6. Intrusive schwa
 7. Increased difficulty with multisyllabic words
- Prosody
 8. Syllable segregation
 9. Slow speech rate and/or slow diadochokinetic rates
 10. Equal stress or lexical stress errors

Proposed CAS Diagnostic Marker

- Pause Marker (PM)
 - Behavioral marker targeted as a means to differentiate CAS from other SSD
 - Any between-word period of 150 ms with no speech.
 - Inappropriate pause at an inappropriate linguistic place in continuous speech
 - One or more inappropriate articulatory, prosodic, or vocalic features within the pause or in a sound segment preceding or following the pause

Shriberg et al (2017a)

Types 1 Inappropriate Pauses

- **Abrupt**
 - Pause preceded or followed by phoneme with sudden strong offset/onset of energy
- **Alone**
 - Pause at linguistically incorrect position
- **Change**
 - Pause immediately preceded/followed by phoneme with abrupt change in rate, amplitude or frequency
- **Grope**
 - Pause with visible acoustic energy consistent with lip or tongue gesture or voicing error

Dynamic Evaluation of Motor Speech Skill (DEMSS)

- Specifically intended to evaluate speech movements of younger children.
- Looks at
 - Length
 - Vowel content
 - Prosodic content
 - Phonetic complexity
- Focus on earlier-developing sounds and word shapes

Dynamic Evaluation of Motor Speech Skill (DEMSS)

- **Examine**
 - Lengthened and disrupted transitions
 - Coarticulatory accuracy
 - Words of varying length
 - Inconsistency
 - Prosodic accuracy

Maximum Performance Tasks

- Behavioral tasks
 - Maximum phonation duration
 - Maximum fricative duration
 - Maximum repetition rate
 - Single syllables
 - Trisyllables
- Acoustic measurements

What are we using now?

- Excess equal stress
- Consistency
- Groping
- Inappropriate breaks in syllables and/or words
- Difficulty with motor plan in longer strings
- Unusual prosody errors

CAS Factors Checklist

- Contrast stress, intonation patterns. Volitional control of
 - Intonation, Stress variation, Loudness, Rate, Pitch
- Compare words and sounds in words that increase in complexity
 - Phonetic
 - Word length
- Understand how sounds are put together
 - Pause, breaks
 - Use Diadochokinesis

ASSESSMENT

Focus of CAS Assessment

- Parent concerns
- How the child communicates on a daily basis
- Phonetic inventory
- Error (phonemic) inventory
- Consistency
- Combining sounds and syllables
- Prosody (stress matches, intonation)
- Speech motor coordination

For CAS, Assess the Following

- In connected speech and/or single word test
 - Contrast stress, intonation patterns
 - Evaluate volitional control of loudness, rate, pitch
 - Compare imitated and spontaneous speech
 - Compare words that increase in complexity (phonetic and length)
 - Repetition of multisyllabic words
 - Not in a string – individual motor plans
 - Trial therapy with cueing strategies
 - Tactile, visual, auditory, kinesthetic

Assessment Components

- Caregiver interview
- Connected speech sample
- Single-word articulation test or sample
- Speech motor exam
- Dynamic assessment/Stimulability
- Other areas

Caregiver interview

- Specific concerns
- Medical history including family history
- History of babbling
- Motor skills
- Current communication and success
- Specific goals of assessment
- For goal and intervention planning consider the Functional Communication Parent Questionnaire (*Wilson & Gildersleeve Neumann*)

- <https://www.pdx.edu/sphr/clinical-resources-0>

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Connected Speech Sample

- Collect spontaneous/^{elicited} connected speech sample with family or clinician
 - Play
 - Conversation
 - Picture description/shared book reading

Single-word articulation test or sample

- May assist in eliciting range of speech sounds even in imitation
- May not be appropriate with younger children
 - Age
 - Cooperation
 - Vocabulary
- May not be necessary (speech sample)

Drawbacks of single word and connected speech for dx (and how to deal with)

- Inconsistency?
- Repeated production of words (not in a row) to consider consistency
- May not yield information about
 - Polysyllabic words
 - Intonation
 - Vowels
 - Intelligibility
 - Pausing

Single-word articulation tests

- DEAP - inconsistency measure
- GFTA
- SPAT
- dEMMS
- Others

Speech motor exam

- To evaluate range of motion, symmetry, coordinated movement
 - Isolated movements
 - Chaining together movements
- Diadochokinesis (DDK)
 - How accurate is /pʌtʌkʌ/?

DDK in Young Children

- At 2;6-2;11
 - 3.7 of same-syllable (puh) in one second
 - 1.3 of patty cake in one second
- 6;6-6;11
 - 5;5 same-syllable (puh) in one second
 - 1.6 of patty cake (Robbins & Klee, 1987)

Note – speed may not be as reliable as consistency and accuracy!

DDK

- CAS may have arrhythmic productions or inability to sustain movement over longer periods
- May be difficult to assess in younger children
 - If a young child completes DDK tasks with ease, that gives us great information.
 - If a young child does not complete DDK tasks with ease then we only know that they didn't complete the task but not necessarily why (age or motor skills)

DDK - some tips with younger children

- Start with one syllable at time
- Imitation
- With toys
- Use words or other sounds
- Other options:
 - Syllable Repetition Task (Shriberg & Lohmeier , 2008)

Syllable Repetition Task

- Syllable Repetition Task (Shriberg & Lohmeier, 2008)
 - Alternating place of articulation in CV...CV syllables
 - Words increase in length
 - Used to differentiate CAS
 - http://www.powershow.com/view1/25bd75-ZDc1Z/The_Syllable_Repetition_Task_SRT_powerpoint_ppt_presentation

Maximum Performance Protocol

- DDK
- Sustained articulatory gestures (vowels & continuous consonants)
- Thought to differentiate CAS from Dysarthria
- Rvachew (2005)

Dynamic Assessment

- Stimulability
 - Does the child produce sounds with cues?
 - Insight into intervention
 - Insight into production

Other areas

- Early language development skills
- Hearing
- Feeding and swallowing
- Oral and/or Limb Apraxia
 - *Some, not all, individuals with CAS exhibit other motor planning difficulties*

Early Language Development Skills

- Joint Attention
 - Behavior Regulation
 - Social Interaction
 - Communicative Intent
 - If not, cognitive delay? Autism?
- General Language skills
 - Grammatical morphemes used & MLU
 - *Be careful not to interpret speech errors or lack of intelligibility as language errors*
 - Vocabulary
 - Communicative Development Inventories

Assessing Young Children

- Consider expressive language
 - *Large enough for phonological system?*
- Other reasons for difficulties
 - *Word finding*
 - *Other impairments*
- Receptive vs. Expressive
 - Can be informative if receptive is high

Analyzing and Interpreting Assessment Data

- Phonetic transcription of speech sample
- Independent Analysis/Inventory
 - What the child is producing regardless of target
- Relational Analysis/Accuracy
 - What the child is producing correctly in relation to the target

Independent Analysis

- Speech sound inventory
 - Consonants
 - Word position
 - Vowels
- Word shape inventory
- Prosody

Relational Analysis

- Speech sound errors
 - Substitutions
 - Omissions
 - Distortions
- Speech error patterns (aka phonological processes)
- Are errors consistent?
- Comparisons of repeated productions of multisyllabic words - did they change?
- Prosody

CAS Factors Checklist

- Does the child produce multisyllabic words - produced on independent motor plans - the same each time?
- Stimulability
 - Does the child produce difficult sounds with cues?
 - Tactile
 - Visual
 - Auditory
 - Kinesthetic
 - Does the child produce longer words with cues?
 - Tactile
 - Visual
 - Auditory
 - Kinesthetic

Differential Diagnosis: Speech Sound Disorder vs. CAS

- Both have
 - Consonant, Vowel, Word Shape Errors
 - Limited phonetic and phonotactic inventory
 - Low intelligibility
- Kids with CAS:
 - Accuracy doesn't match phonetic inventory
 - Vowel errors (beyond developmental)
 - Suprasegmental errors
 - Less likely error patterns
 - More likely inconsistent, unpredictable errors

Differential Diagnosis

SSD

◦General SSD

◦Core impairment in speech production

◦Perceptual

◦Phonological

◦Phonetic/Articulatory

◦CAS

◦Core impairment in motor planning

◦Interrelationship

◦Can't have a motor plan until you make motor movement!

Differential Diagnosis

3 cases of young children referred to our clinic with a concern of possible CAS

Differential Diagnosis: Bill

- 2;7
- healthy but umbilical cord around neck at birth (APGAR WNL)
- h/o VMI disorder
- family hx of dyslexia

Differential Diagnosis: Cedric

- 3;2
- no medical concerns
- family hx of stuttering, dyslexia and autism

Differential Diagnosis: James

- 3;5
- complex medical history
- vision impairment

Analysis: Bill

- Inventory:
 - C= /p, b, d, t, k, m, n, w, f, v, s, h, r, ʃ, ʒ/ (mostly word initial)
 - V=all except /ε, ɔ, ɪ, ə/
- Word shapes= CV (rare CVC); used pitch and prolonged vowels (sometimes glottal stops) to mark closed syllables
- Errors:
 - Final consonant omission, weak syllable deletion, stopping (p/z, t/ʃ), cluster reduction, vowel errors (especially monophthongization)

Analysis: Bill

- Inconsistencies noted in repeated productions
- We understood 25% of his speech productions

Analysis: Cedric

- Inventory:
 - C=/m, b, p, n, t,d, l, s, z, k, g, f, r, ʃ, tʃ, ʔ/
 - Favoring /t, d, ʃ/
 - V=all produced
 - Word shapes: CVCV, VCVC
- Errors:
 - Final consonant omission
 - Fronting
 - Stopping
 - Gliding

Strong use of intonation

Analysis: James

- Inventory:
 - c=/m, n, ʔ/
 - v=/ε, ə, æ/
 - Word shapes= V, C, CVCV, V.V.V, VCV
- Errors:
 - Nasal emissions on air pressure consonants
 - Consistent errors

Other areas: Bill

Receptive significantly greater than expressive.
MacArthur CDI: 159/180 words produced
Uses gestures and facial expression to communicate

Other areas: Cedric

Understanding similar to 18-21 mos (emergence up to 36 months)
Expressive based on CDI= 173/680 words, similar to 21 mos
Expressive communication augmented by gestures and intonation

Other areas: James

Uses over 30 signs and over 40 word approximations (CDI similar to 18-20 mos)
Receptive language on Rossetti similar to 30-33 mos
h/o feeding difficulties

Differential Diagnosis?

What did you observe?

Bill

Cedric

James

Is the speech of any of these children
consistent with criteria for CAS?

Outcomes

Bill

Cedric

James

Quick point about
intervention

Questions?

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