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Differential Diagnosis of Childhood Apraxia of Speech and Use of Dynamic Assessment for Treatment Planning

November 9, 2015

Learner Objectives

- List the core perceptual speech features of childhood apraxia of speech (CAS)
- Describe nonspeech and speech assessment tools and techniques to differentially diagnose CAS from other speech and language disorders
- Describe initial treatment procedures for children with severe CAS based on dynamic assessment results

Introduction: Apraxia of Speech

- Inability or difficulty with the ability to carry out purposeful voluntary movements for speech in the absence of paralysis of the speech musculature
- Apraxia of speech (in adults or children) is a speech diagnosis, meaning that SLPs make this diagnosis

Introduction: Apraxia of Speech

- Primary clinical characteristics of acquired apraxia of speech (AOS) include:
  - Slow rate of speech, typified by lengthened sound segments and intersegment durations
  - Sound distortions
  - Distorted, perceived sound substitutions
  - Errors that are relatively consistent in terms of type and invariable in terms of location
  - Prosodic abnormalities
    - (Wambaugh et al., 2006)

Childhood Apraxia of Speech (CAS)

- "Childhood apraxia of speech is a neurological childhood speech sound disorder in which the precision and consistency of movements underlying speech are impaired in the absence of neuromuscular deficits (e.g., abnormal reflexes)

  […]

- The core impairment in planning and/or programming spatiotemporal parameters of movement sequences results in errors in speech sound production and prosody."

  - (ASHA, 2007)

CAS Etiology

- "… as a result of known neurological impairment, in association with complex neurobehavioral disorders of known or unknown origin, or as an idiopathic neurogenic speech sound disorder."
  - (ASHA, 2007)
- Approximately 5% of children with speech sound disorders exhibit characteristics of CAS
  - (Strand, 2010)
- CAS may be primary or secondary – just as in adults

Speech Motor Control

- Goals for speech production are auditory and somatosensory
  - Sensorimotor skill
- Speech motor control = selecting the appropriate articulator movements to achieve these goals
- Combination of two types of motor commands:
  - Predictive (feedforward), based on past experience
  - Corrective (feedback), based on sensory feedback
- Speech motor learning involves tuning predictive commands based on corrective commands generated by an incorrect speech movement
  - (Guenther, 2006)

CAS: Core Problem (con't)

- Computational neural modeling research
  - Core deficit in CAS is reduced oral sensitivity resulting in degraded somatosensory feedback (e.g., proprioceptive feedback information)
    - Difficulty feeling and hearing self-produced speech
  - Impaired ability to decipher current somatosensory state ⟹ inability to learn feedforward commands ⟹ reliance on (degraded) feedback control subsystem
    - (Terband, Maassen, Guenther, & Brumberg, 2009)

Differential Diagnosis of CAS

- The current gold standard for differential diagnosis of CAS is clinical expert opinion
  - (Mass, Butalla, & Farinella, 2012)

Differential Diagnosis of CAS

- Perceptual speech features:
  - Inconsistent errors on consonants and vowels in repeated productions of syllables or words.
  - Lengthened and disrupted coarticulatory transitions between sounds and syllables.
  - Inappropriate prosody, especially in the realization of lexical and phrasal stress.
    - (ASHA, 2007)

Assessment of Speech Sound Disorders

- Case History
  - Babbling?
  - Family history of speech delay?
- Structural Functional Examination
- Standardized Tests
  - Receptive and expressive language
  - Articulation and phonology
- Informal Speech-Language Assessment
  - Narrative and pragmatic language skills
  - Motor speech evaluation
  - Dynamic assessment

Standardized Assessments for CAS?

- Verbal Motor Production Assessment for Children (VMPAC) (Hayden & Square, 1999)
  - Provides norms
  - Closest to meeting operational definitions for adequacy of its reliability
  - Only test to meet any of the three operational definitions for validation
    - (McCauley & Strand, 2008)

Research Assessment Protocol

- Clinical Evaluation of Language Fundamentals, Fourth Edition (CELF-4)
- Auditory Comprehension subtest of the Preschool Language Scale, Fourth Edition (PLS-4)
- Peabody Picture Vocabulary Test, Fourth Edition (PPVT-4)
- Oral and Speech Motor Control Protocol (slightly modified)
  - (Robbins & Klee, 1987)
- Goldman-Fristoe Test of Articulation 2 (GFTA-2)
  - Standard Score < 85 (< 12th percentile)
- Dynamic Evaluation of Motor Speech Skill (DEMSS)
  - Percentage of consonants correct (PCC)
  - Percentage of vowels correct (PVC)
- Language sampling (narrative samples)

(Maas, Butalla, & Farinella, 2012; Maas & Farinella, 2012)

Differential Diagnosis of CAS: (Murray et al., 2015)

- Study Purpose:
  - Determine whether expert diagnosis of CAS could be predicted from a combination of quantitative measures typically collected during standard clinical practice
- Participants:
  - Screened 72 children (4 – 12 years of age) diagnosed with suspected CAS
  - Forty-seven passed the initial screening
    - (a) clinical diagnosis of suspected CAS, (b) 4 – 12 years of age, (c) no previously identified language comprehension difficulty, (d) normal or adjusted to normal hearing and vision, (e) native English speaker, (f) no other developmental diagnoses not associated with CAS

Differential Diagnosis of CAS

- Diagnostic Evaluation of Articulation and Phonology (DEAP) Inconsistency subtest (Dodd, Hua, Crosbie, Holm, & Ozanne, 2002)
- Single-Word Test of Polysyllables (Gozzard, Baker, & McCabe, 2004)
  - Percent Phonemes Correct (PPC); Percent Consonants Correct-Revised (PCC-R); Percent Vowels Correct (PVC); Percentage of lexical stress matches
- Connected speech sample of at least 50 utterances
  - Articulation rate
- Oral and Speech Motor Control Protocol (Robbins & Klee, 1987)
- Clinical Evaluation of Language Fundamentals, Fourth Edition (CELF-4) (Semel, Wiig, & Secord, 2006)
  - (Murray, McCabe, Heard, & Ballard, 2015)

Differential Diagnosis of CAS

- Murray et al., 2015
  - Core set of perceptual features had to be present
    - 1) Inconsistent errors on vowels and consonants, 2) difficulty transitioning between speech sounds, and 3) prosodic errors such as incorrect or equal stress, and segmented speech (ASHA, 2007)
  - Any four of the 10 features in Strand's 10-point checklist over three or more assessment tasks
    - (Shriberg, Potter, & Strand, 2011)

Strand's 10-point checklist

- Vowel distortions
- Difficulty achieving initial articulatory configurations or transitionary movement gestures
- Equal stress or lexical stress errors
- Distorted substitutions
- Syllable segregation
- Groping
- Intrusive schwa
- Voicing errors
- Slow rate/slow diadochokinetic rates
- Increased difficulty with multisyllabic words
  - (Shriberg, Potter, & Strand, 2011)

Operational Definitions: (Murray et al., 2015)

- Syllable segregation:
  - "Noticeable gaps between syllables"
- Difficulty achieving initial articulatory configurations and transitions into vowels:
  - "Within-speech groping, false starts, restarts, and hesitations"
- Groping:
  - "Non-speech oral groping"

Multisyllabic Word Production

- Typically developing 4-year olds (4;0 – 4; 11) produce multisyllabic words with errors on vowels, consonants, stress patterns, and word shapes
  - (Gozzard, Baker, & McCabe, 2006)

Video Examples: Single Word Test of Polysyllables

Non-CAS	CAS (idiopathic)
Female: 4;9	Male: 4;10
"Potato" = slow rate	"Potato" = syllable segregation
"Hippopotamus" = slow rate; mild /s/ distortion	"Hippopotamus" = difficulties sequencing; schwa intrusion
"Motorbike" = mild /r/ distortion	"Motorbike" = /r/ distortion; frank vowel error
Mild /s/ and /r/ distortion; mildly slow rate (WNL)	Frank vowel errors; syllable segregation; distorted consonant substitutions (e.g., k/g; b/p)

Diagnostic Evaluation of Articulation and Phonology (DEAP)

- Word Inconsistency Assessment
  - Twenty-five pictures
  - Child names pictures in three separate trials; trials are separated by a different task (e.g., oral motor screen)
  - Trial 1, Trial 2, Trial 3
  - Same (S) / Different (D)
  - Divide number of items produced differently by number of items repeated three times; multiply by 100; value reported as a percentage
- Word inconsistency score of 40% or greater meets criterion for diagnosis of inconsistency
  - (Dodd, Hua, Crosbie, Holm, & Ozanne, 2002)

DEAP Interpretation

- Inconsistent phonological disorder?
  - (Dodd, Holm, Crosbie, & Hua, 2005)
- Continuum of motor planning/programming deficits
  - Phonological disorder compromised by mild motor planning/programming deficits
    - (Strand & McCauley, 2008)

Male with CAS: 4;10

- Frank vowel errors/distortions
- Distorted substitution errors
- Voicing errors
- Syllable segregation (i.e., gaps/pauses between syllables)
  - Incorrect prosody 14/31 (45%) opportunities on The Single Word Test of Polysyllables
- DEAP Word Inconsistency subtest = 52% of word productions were inconsistent (criteria = >40%)
  - Video Example: “shark”; “helicopter” (e.g., prosody)
- Inconsistent discoordination of breathing/speaking during fricative productions (i.e., sucks air inward)
  - Video Example: “fish”

Differential Diagnosis of CAS (Murray et al., 2015)

- Conclusions:
  - Percentage of stress matches (polysyllable test)
  - Occurrence of syllable segregation
    - 82% Diagnostic Accuracy
  - Percentage of stress matches
  - Syllable segregation
  - Percent Phonemes Correct (PPC)
  - Accuracy on DDK task
    - 91% Diagnostic Accuracy

Prosodic abnormalities

- Syllable segregation
  - Staccato speech
- Excessive-equal stress
- Incorrect lexical stress

Differential Diagnosis of CAS

- CAS (+/- expressive language disorder)
- CAS+ (CAS with comorbid dysarthria and language impairment)
- Non-CAS (submucous cleft, phonological disorder, and dysarthria)
  - (Murray et al., 2015; Shriberg et al., 2010)

CAS Continuum

Markedly Severe CAS (Non-verbal) | Severe CAS | Moderately Severe CAS | Mild to Moderately Severe CAS | Mild CAS

(Strand, 2010)

Expressive Language Skills: Informal Narrative Language Assessment

- Narrative Language Measures (NML) – narrative language skills and linguistic complexity
  - Preschool
  - School-age
    - (Peterson & Spencer, 2012)

Clinical Protocol for Assessing Oral and Speech Motor Abilities in Children

- 86-item test
- Ages 2:6 – 6:11
- Evaluates the structure and function of the child's developing vocal tract
  - Oral motor (nonspeech) and speech tasks
    - CN VII: Lips
    - CN V: mandible
    - CN XII: maxilla, teeth, tongue
    - CN IX, X: velopharynx
    - CN X: laryngeal and respiratory systems

      - (Robbins & Klee, 1987)

Robbins & Klee (1987)

- Vocal tract structures (24 observations)
- Vocal tract functions (56 observations)
- Rate and duration measures
  - Monosyllabic repetition rate (number/second)
    - "puh", "tuh", and "kuh"
  - Polysyllabic repetition rate (number/second)
    - "patty cake" "buttercup"
  - Maximum phonation time (second)
    - Sustained "ah" production

Example: Robbins & Klee (1987) Clinical Protocol

Structure (CN)	Observation/Task	Instructions	Score
Lips (CN VII)			
Structure at rest	1. Symmetry	(observe 1 – 2; no task instructions)	1 0
	2. Relationship (open vs. closed)		1 0
Oral function	3. Rounding	Round your lips	2 1 0
	4. Protrusion (blowing)	Pucker your lips	2 1 0
	5. Retraction	Smile	2 1 0
	6. Alternate pucker/smile	Pucker and then smile	2 1 0
	7. Bite lower lip	Bit your lower lip	2 1 0
	8. Lip seal	Close your lips	2 1 0
	9. Puff cheeks	Puff your cheeks	2 1 0
	10. Open – close lips	Open and then close your lips	2 1 0

Robbins & Klee (1987) Protocol

- Items needed:
  - Gloves, flashlight, mirror, cup of water with straw
- Directions and Scoring
  - For structural items (with 1 0 scores): Make observation from structures at rest
    - 1 = normal
    - 0 = abnormal
  - For functional items (with 2 1 0 scores): Instruct child and observe. Verbally instruct child to perform each task (e.g., "Puff your cheeks).
    - 2 = adult-like function
    - 1 = emerging skill (e.g., an approximation of the target that lacks adult-like precision)
    - 0 = absent function (e.g., no approximation of the behavior)
  - If child does not perform the task, give child a visual and/or auditory model. For example, instruct child to watch as you puff your own cheeks or hold the /a/ vowel. If target behavior is not elicited after three attempts, proceed to the next test item.
- Total Structural Score (TSS): 24 points maximum
- Total Functional Score (TFS): 112 points maximum
  - (Maas et al. 2012 research protocol slightly modified; 102 points maximum)

Structural-Functional Examination

- Rule out structural abnormalities (e.g., cleft palate); rule out weakness (i.e., dysarthria)
- Rule out or determine nonverbal oral apraxia of speech
- Quick screening of vowels and some consonants in isolation, monosyllabic words, and several multisyllabic words

Motor Speech Evaluation

- Vowel prolongation
- Sentence repetition task
- Reading passage
- Conversational speech sample
- Multisyllabic word repetition task
- Speech AMRs; SMRs
  - (Duffy, 2013)

Example Motor Speech Evaluation: School-Aged Child

- Prolongation of /a/
- Sentence repetition (pressure-loaded)
  - The blue spot is on the key
  - Buy Bobby a puppy
  - We see three geese
- Caterpillar passage (Patel et al., 2013)
- Connected speech sample (e.g., story retell)
- Multisyllabic word productions
  - Single Word Test of Polysyllables
- "pa, pa, pa"; "ta, ta, ta"; "ka, ka, ka"; "pataka"

Motor Speech Evaluation

- What about younger children?

Dynamic Evaluation of Motor Speech Skill (DEMSS)

- Strand et al., 2013
  - Assists in differential diagnosis of CAS in younger children, or those with markedly severe speech sound impairment
  - Focuses on earlier developing consonant sounds paired with different vowel sounds in simple syllable shapes
  - Measures vowel accuracy, whole-word (articulatory) accuracy, prosody accuracy, and consistency
  - Higher scores = poorer performance

DEMSS (con't)

- 66 utterances sampled
- 9 subtests
  - Consonant-Vowel [8]
  - Vowel Consonant [8]
  - Reduplicated syllables [4]
  - CVC 1 (same first and last phoneme) [6]
  - CVC 2 (different first and last phoneme) [8]
  - Bisyllabic 1 (1 consonant, 2 vowels) [5]
  - Bisyllabic 2 (more varied syllable shapes) [6]
  - Multisyllabic [6]
  - Utterances of Increasing Length [15]
    - (Strand et al., 2013)

DEMSS Scoring

- Vowel Accuracy
  - 0 = correct
  - 1 = mild distortion
  - 2 = frank distortion
- Whole-word (Articulatory) Accuracy
  - 0 = correct on 1st attempt
  - 1 = phonological error
  - 2 = correct after first cued attempt
  - 3 = correct after two or three additional cues
  - 4 = not correct after all cued attempts
- Prosody Accuracy
  - 0 = correct
  - 1 = incorrect
- Consistency
  - 0 = consistent across all trials
  - 1 = inconsistent across any 2 or more trials

(Strand et al., 2013)

DEMSS Administration

- Say "ice"
  - Child says "i"
- Score vowel (but remember 1st whole-word production)
  - Vowel score = 0 (vowel is correct)
- Say "ice" again
  - Child says "i"
- Let's try it slowly and together (dynamic assessment)
  - Provide tactile, verbal, and visual cues (treatment)
- Say "ice"
  - Child's production is close but not quite right (mild vowel distortion; /s/ distortion)
- Score whole-word (articulatory) accuracy and consistency
  - Whole-word (Articulatory) score = 4
  - Consistency score = 1 (compared to very first production)

Video Example

- "Ice"

DEMSS: Dynamic Assessment

- Amount of cues needed during DEMSS administration may provide information related to CAS severity
- Provide information about the types of cues that were effective; predict treatment success
- Assist in selecting initial treatment stimuli

Case Study: 5; 4 year old girl

- History of developmental delay – attention, memory, reasoning, perceptual skills
  - BDI-II score = 71
- Mild delay in fine-motor coordination skills
  - Receives occupational therapy services
- Speech (articulation) delay
  - Speech therapy 30 minutes per week
  - Used 4 – 5 signs
- Some social-emotional difficulties?

Case Study: Formal Language Testing

- Clinical Evaluation of Language Fundamentals – Preschool 2nd edition
  - Sentence structure = 7
  - Word structure = 1
  - Expressive vocabulary = 6
- Core Language Score = 69

Case Study: Informal Assessments

- Dynamic Evaluation of Motor Speech Skill (DEMSS)
  - Vowel errors and distortions
  - Inconsistent errors; inconsistent voicing errors
  - Prosodic abnormalities (i.e., equal stress; segmentation)
  - Significant difficulties with production of multisyllabic words and inconsistent error productions
  - Phonological processes: final consonant deletion; velar fronting
- Phonemic Inventory
  - Initial /k,b,p,d,t,f,s,h,m/
  - Final /n,m/
- Speech intelligibility in connected speech = 0 – 10%

Case Study: 5;4 year old girl

- Diagnoses:
  - Markedly severe childhood apraxia of speech
  - Severe expressive language delay
  - Mild receptive language delay
- Video Example – “peep”; “at”

Dynamic Assessment Results

- Able to focus attention to speech production tasks
- Able to quickly produce final consonants using slow, simultaneous productions
- Motivated by positive reinforcement

Treatment Plan

- Twice per day (45-minute sessions) individually, 4x/week + 60-minute group sessions 2x/per week for 6 weeks.
- Integral Stimulation Procedures
  - Dynamic Temporal and Tactile Cueing (DTTC)
- Functional core vocabulary
  - I want, eat, up, Can I, need, “her name”
- Increase utterance length and linguistic complexity
  - iPad with Proloquo2Go software
  - e.g., “I want the big, blue bird and the small, red apple, please.”

Video Examples: Treatment/Treatment Probes

- Within-speech groping (production of 'name')
- Treatment probe data (errors)
- Connected speech (compare to treatment probes)

Differential Diagnosis of CAS: Assessment Protocol

- Structural functional examination
- Standardized receptive and expressive language testing
- Informal language sample analysis; Narrative Language Measure (NLM)
- Standardized Articulation Test (e.g., GFTA-2)
- Motor Speech Examination
  - DEMSS--substitute with the PLS-4 Articulation Screener (not research-based)
    - Calculate PCC and PVC; dynamic assessment – determine consistency
  - Single-Word Test of Polysyllables – prosodic abnormalities; PCC and PVC
  - [DEAP Inconsistency subtest?]
  - Connected speech versus single-word tasks

CAS Assessment Protocol: Strand's 10-point checklist

- Vowel distortions
- Distorted substitutions
- Voicing errors

→ CAS Perceptual Feature #1
  - Inconsistent errors on consonants and vowels in repeated productions of syllables or words

- Difficulty achieving initial articulatory configurations
- Groping
- Increased difficulty with multisyllabic words

→ CAS Perceptual Feature #2
  - Lengthened and disrupted coarticulatory transitions between sounds and syllables

- Equal stress or lexical stress errors
- Syllable segregation
- Intrusive schwa
- Slow rate/slow diadochokinetic rates

→ CAS Perceptual Feature #3
  - Inappropriate prosody, especially in the realization of lexical and phrasal stress

(Shriberg, Potter, & Strand, 2011)

(ASHA, 2007)

Differential Diagnosis of CAS

- Constellation of speech characteristics is consistent with CAS (Severity level? Markedly severe? Mild to moderate?)
  - Continuum of CAS
- Cannot rule out or determine CAS at this time…..
  - I am not/I am suspicious of CAS because……..
- Equivocal evidence for CAS based on presence of ……..
- Phonological delay compromised by mild motor planning/programming difficulties (i.e., CAS)
  - CAS not the primary diagnosis

Case Example: Adult with Residual CAS+

- Male: 20;0
  - History of CAS and dysarthria
- Diagnoses:
  - Residual CAS (moderate)
  - Residual articulation errors (/r/, /l/, /s/)
  - Flaccid dysarthria (hypernasality) (mild – moderate)
  - Ataxic dysarthria (mild)

Videos: Adult with Residual CAS+

- Residual CAS?
- Vowel errors/distortions
- Voicing errors
- Distorted substitution errors
- Difficulties with multisyllabic words
- Inconsistent errors
- Difficulty with speech SMRs (i.e., "pataka")
- Prosodic abnormalities
- Hypernasality???
  - Inconsistent
- Dysarthria?
- Palatal weakness = cranial nerve damage (LMN)
  - Hypernasality (consistent)
- Telescoping of syllables in multisyllabic words
- Irregular speech AMRs (i.e., "ta, ta, ta"; "ka, ka, ka")

Impression Summary:

- Client is a 20 year-old male who currently exhibits prosodic abnormalities (e.g., lengthened sound segments, increased intersegmental durations, incorrect lexical stress), difficulties with transitions in multisyllabic words, voicing errors, distorted vowels, and distorted substitution errors consistent with residual childhood apraxia of speech (CAS). He also exhibits flaccid dysarthria as evidenced by moderate hypernasality secondary to mild weakness on the right side of the soft palate, and mild ataxic dysarthria as evidenced by mildly irregular speech AMRs. Speech intelligibility in connected speech is reduced, particularly when the context is unknown.

Example Impression Summary

- Client is an 8:4 year old who presents with a moderate delay in expressive language skills and low average receptive vocabulary skills. Speech production is characterized by frank vowel errors/distortions, inconsistent productions of error sounds, voicing errors, difficulties with production of multisyllabic words, and prosodic abnormalities. In addition, persistent use of age-inappropriate phonological error patterns (i.e., final consonant deletion, stopping, weak syllable deletion) is noted.
- This constellation of speech characteristics is indicative of a severe motor planning and/or programming deficit (i.e., childhood apraxia of speech). Speech intelligibility is markedly reduced in connected speech as a result. Continued speech therapy (3X per week if possible) in the public or private school setting is recommended.

Another Example Impression Summary:

- Participant is a 6:8 year old who presents with a mild articulation impairment characterized by inconsistent substitution of /w/ for pre-vocalic /r/, consistent distortion of post-vocalic /r/ (e.g., /ar/, /or/), and occasional equivocal distortion of /s/. Participant also presents with probable mild motor planning (i.e., verbal praxis) difficulties as evidenced by difficulties with articulatory and prosodic accuracy of multisyllabic words, occasional vowel errors, and difficulties with speech sequential motion rates. When using an increased speech rate, participant sounds as if telescoping syllables. Otherwise, there is no evidence for dysarthria or non-verbal oral apraxia.
- It is suggested that speech-language services be provided to address correct production of /r/ in all positions, as well as correct production of multisyllabic words, ensuring correct production of vowels and prosody. Decreasing speech rate is also suggested.

Co-Morbidities in CAS

- Cognitive functions:
  - Investigated auditory, memory, and sensorimotor functions in children with CAS compared to age-matched typically developing peers on two separate occasions (15 months apart)
- Expected children with CAS to have difficulty with non-speech complex sensorimotor and sequential memory tasks
  - (Nijland, Terband, & Maassen, 2015)

Cognitive Functions in CAS: (Nijland et al., 2015)

- Complex sensorimotor and sequential memory tasks
  - Auditory rhythm: tap an auditory and visually presented rhythm with one or both hands
  - Hand movements: imitate a sequence of hand movements
  - Number recall: imitate a sequence of digits verbally
  - Word order: Sequentially point to pictures of verbally presented words for objects
- Simple sensorimotor tasks
  - Finger tapping
  - Oral sensory
  - Finger localization
- Control tasks (e.g., spatial memory)

Cognitive Functions in CAS: (Nijland et al., 2015)

- Children with CAS scored lower on all tasks in each of the three domains when compared to typically developing children on both occasions
- No significant difference between typically developing children at Occasion I and children with CAS at Occasion 2 on simple sensorimotor tasks (e.g., finger tapping) and control tasks (e.g., spatial memory)
  - Children with CAS caught up = delayed development
- Complex sensorimotor and sequential memory skills are deviant in children with CAS; residual global sequential processing deficits may exist even when speech has normalized in adulthood (Button et al., 2013; Peter et al., 2013)

Co-morbidities in CAS (con't)

- Language disorders
- Reading difficulties
- Poor spelling abilities
  - (e.g., Lewis, Freebairn, Hansen, Iyengar, & Taylor, 2004)

Subtypes of CAS?

- CAS associated with syndromes
- CAS associated with Autism Spectrum Disorders
- Idiopathic CAS (subtypes within this etiology?)

Suspected CAS?

- Better to treat speech sound disorder as a possible motor planning/programming deficit when suspect CAS
- One or two goals that address possible speech praxis deficits:
  - Client will produce a ***core set*** of functional multisyllabic words with a whole-word (articulatory) accuracy of "2" in 5 out of 6 opportunities over 3 consecutive sessions.
  - Client will produce a ***core set*** of functional multisyllabic words with a prosodic accuracy of "2" in 5 out of 6 opportunities over 3 consecutive sessions.
    - (0 = incorrect; 1 = one feature off; minor vowel distortion; 2 = correct)

CAS & Suspected CAS?

- Ongoing informal assessment of reading and writing skills
- Speech sound production and perception practice in the context of phonological awareness skills
- Direct treatment and/or monitoring of expressive language skills (narrative language and linguistic complexity)
- Sensory issues? Social-emotional difficulties? Pragmatic language? Fine-motor skills? Gross-motor skills?

Non-speech Oral Motor Exercises

- Speech and non-speech tasks are governed by separate, distinct neural pathways
- Practice with one task (i.e., non-speech) will not influence the other (i.e., speech)
- Speech does not rely on strength
  - Skill that requires coordination and speed

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