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CAS Intervention throughout the Childhood Years

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Childhood Apraxia of Speech (CAS): Defining the Territory

Presenter: Peter Flipsen Jr., Ph.D., S-LP(C), CCC-SLP

Moderated by:
Amy Hansen, M.A., CCC-SLP, Managing Editor, SpeechPathology.com

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Childhood Apraxia of Speech (CAS): Defining the Territory

Peter Flipsen Jr., Ph.D., S-LP(C), CCC-SLP
Professor of Speech-Language Pathology
Idaho State University

flippete@isu.edu

Childhood Apraxia of Speech (CAS)

- Known by many labels, including:
  - Developmental Apraxia of Speech
  - Developmental Dyspraxia
  - Developmental Verbal Dyspraxia
  - Childhood Verbal Apraxia
- CAS = ASHA's current preferred term
  - Parallel term to adult form
  - Avoids problems with the term "developmental"
  - Speech is the issue

Childhood Apraxia of Speech (CAS)

- Type of Speech Sound Disorder (SSD)
  - Broad category that includes any difficulty with output of speech sounds and includes:
    - Articulation (phonetic) disorders, and
    - Phonological (phonemic) disorders

Childhood Apraxia of Speech (CAS)

- Considerable controversy until recently
- Does it even exist?
- What causes it?
- How do we define it?
- How do we distinguish it from other childhood speech disorders?
- Is intervention different from what we do with other SSDs?

Childhood Apraxia of Speech (CAS)

- To help resolve the controversy, ASHA convened an expert panel and they developed:
  - CAS Position Statement (2007)
  - CAS Technical Report (2007)
    - Available at the ASHA website

Childhood Apraxia of Speech (CAS)

- ASHA (2007) expert panel did an extensive literature review and evaluation of that literature and concluded (among other things) that:

YES, IT EXISTS!

Childhood Apraxia of Speech (CAS)

- Prevalence (how common?):
  - No large population studies yet available
- Current best estimate = 0.1–0.2% of the general population (Shriberg, Aram, & Kwiatkowski, 1997).
  - Probably translates to no more than 1-2% of the average SLP caseload
- One large study showed 3-4% of the caseload at a large urban hospital (Delaney & Kent, 2004)
  - 516 cases out of 12-15,000 children with SSD

Childhood Apraxia of Speech (CAS)

- Prevalence estimates probably seem low but …
- Recent increases in diagnoses, especially in the last decade
- Actual increase in cases?
  - Greater survival rates of high-risk infants?
- May also be due to:
  - Legislative changes
  - Funding issues
  - Inconsistency of definitions

ASHA's CAS definition

- " Childhood apraxia of speech (CAS) is a neurological childhood (pediatric) 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, abnormal tone). CAS occurs 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. The core impairment in planning and/or programming spatiotemporal parameters of movement sequences results in errors in speech sound production and prosody."
- - ASHA 2007 position statement

Causes of CAS

- Neurological impairment
- No single cause. ASHA (2007) expert panel suggested three broad routes:
  - 1. May be idiopathic.
  - 2. Result of known neurological impairment
    - Specific nervous system damage?
    - Specific events or disease processes known to cause neurological insult?
  - 3. Co-occurring with some complex neurobehavioral disorders

Some Complex Neurobehavioral Disorders Associated with CAS

- **Autism – CAS in 1% of cases??**
- Chromosome Translocations
- Coffin-Siris syndrome (7q32–34 deletion)
- Down syndrome (Trisomy 21)
- Rolandic Epilepsy
- **Fragile X syndrome (FMR1) – CAS in up to 40% of cases??**
- Joubert syndrome (CEP290; AHI1)
- **Galactosemia – CAS in 40-60% of cases??**
- Rett syndrome (MeCP2)
- Russell-Silver syndrome (FOXP2)
- Velocardiofacial syndrome
- (22q11.2 deletion)
- Williams-Beuren locus duplication (7q11.23)

CAS and Genetics

- 80% of cases are male
- Nuclear family aggregation
  - CAS and other SSDs often "run" in families
- Has been associated with mutations of the FOXP2 gene
  - Based on findings from different studies using different labs.
  - Not all individuals with CAS have this mutation, however.
- May accompany some genetic syndromes

Core Impairment in CAS

- Problem in planning or programming the movement sequences for speech
- In the absence of neuromuscular deficits (i.e., tone and reflexes not necessarily impaired)
  - But may have co-existing dysarthria
- In the absence of problems with planning for "non-speech" activities such as chewing and swallowing.
  - But may have co-existing oral apraxia

Other Key Issues

- Speech often (though not always) normalized by adulthood
  - Because of Tx? In spite of Tx?
- Often slow to respond to therapy
  - Not a clear diagnostic sign, however
  - Could simply mean we've erred on the diagnosis and/or have been applying the wrong treatment

CAS vs. Adult Form (AOS)

- Both are assumed to represent problems with programming and/or planning for speech
- AOS involves damage to an intact speech and language system
- CAS occurs before speech and language system has been fully developed
  - May affect the DEVELOPMENT of the higher levels of speech and language (Maasen, 2002)
  - No "automatic" speech yet – often spared in AOS

Key Differential Signs?

- Emerging literature suggests the following MAY be unique to CAS:
  - 1. Inconsistent output on repeated attempts at the same words
    - May include vowel errors, especially atypical errors
  - 2. Disrupted and lengthened transitions
    - Difficulty with articulatory sequencing
    - Problems more apparent as words get longer
    - Breaks between consonants and vowels
  - 3. Disordered prosody
    - Excessive equal stress?
    - Monotone?
    - Possible problems controlling rate, nasality, pitch, loudness?

A Note on "Inconsistency"

- 1. Sound used correctly in some word positions but not others?
  - NOT unique to CAS; could just be incomplete learning
- 2. Sound used correctly in some words but not in others?
  - NOT unique to CAS; could be "fossilized" forms
- **3. Multiple attempts at the same word yield different outputs?**
  - **Consistent with planning difficulties of CAS**

Features Shared with Other SSDs

(NOT unique to CAS)

- Delayed speech onset
- Limited vocal output
- Reduced intelligibility
- Limited phonetic inventory
  - Likely reliance on early sounds
- Limited syllable shape inventory (V, CV, VC, CVC, etc.)
- Tendency to rely on gestures over vocal communication

Long-term Risks and CAS

- Persistence of speech problem well into the school years?
- Difficulties with expressive language?
  - Look like they may have co-existing language impairments (Lewis et al., 2004)
  - Suggests planning problem extends beyond speech (Ball et al., 2002)
- Difficulties with the phonological foundations of written language?
  - ASHA, 2007

Who makes the diagnosis?

- According to the ASHA expert panel (ASHA, 2007):
  - "It is the certified speech-language pathologist who is responsible for making the primary diagnosis of CAS, for designing and implementing the individualized and intensive speech-language treatment programs needed to make optimum improvement, and for closely monitoring progress."

Diagnostic Challenges

- 1. Separating CAS from other SSDs
- 2. Separating CAS from possibly co-existing dysarthria and/or oral apraxia
- 3. CAS signs likely vary with:
  - Age
  - Severity
  - Particular task being used

Formal Assessment Approaches

- Several published procedures available:

Test / Procedure	Age Range
1. Apraxia Profile (Hickman, 2000)	3;0 – 13;11
2. Kaufman Speech Praxis Test (Kaufman, 1995)	2;0 – 6;0
3. Screening Test for Developmental Apraxia of Speech-2 (Blakely, 2001)	4;0 – 7;11
4. Verbal Dyspraxia Profile (Jelm, 2001)	None listed
5. Verbal Motor Production Assessment for Children (Hayden & Square, 1999)	3;0 – 12;11

- **NOTE: All were developed before the release of the ASHA position statement. NONE examines all the key features of CAS.**

Basic Dx Protocol

Need to gather fairly typical data:

- Case history
  - Family background, oral motor history, speech and language milestones
- Single word artic test
- Oral facial exam – include DDK tasks
- Conversational speech sample – transcribe
- Language comprehension testing
- Phonological awareness testing

Assessment in Infants / Toddlers

- Often see limited vocal output
- Limited variety of consonants and vowels
- May see single sounds used as words

- **Need speech output or at least attempts at speech to make a diagnosis!**
  - Means diagnosis before age 3 years is very difficult
  - Non-speech problems (drooling, dysphagia) may only indicate co-existing oral apraxia

Assessing the "Key Signs"

- 1. Inconsistency – a few options
  - Conversational speech
    - Record sample and look for consistency in attempts at words produced multiple times.
  - Single word Artic tests
    - Administer whole test once
    - Repeat later in the session (twice; 3X total)
    - Record productions and look at consistency

Assessing Inconsistency

- Assess using the consistency subtest of the *Diagnostic Evaluation of Articulation and Phonology (DEAP)*
  - 25 words attempted once (do some other activity), say 25 words again (do some other activity), say 25 words again.
  - If >40% of the words are produced inconsistently = criterion for "inconsistent".

Assessing "Key Features"

- 2. Problems with transitions
- DDK procedures
  - Focus on consistency and accuracy (not speed)
  - May not have difficulty with AMR tasks (same place of artic; puh,puh, puh; tuh, tuh, tuh)
  - More likely to see problems with SMR tasks (place of artic changes; puh, tuh,tuh; puh, tuh, kuh)
  - Problems with both may signal co-existing dysarthria

A word about DDKs

- Suggest testing at normal rate (no need for a stopwatch)
  - 1. Children with CAS have sequencing problems at normal rate.
  - 2. Several studies suggest motor planning is different at fast rate vs. normal rate.

Assessing "Key fFeatures"

- 2. More on transitions?
- Problems with multisyllabic words and/or as words get progressively longer?
  - Probably only useful for children over 6 years
    - ham – hammer – hammering
    - hope – hopeful – hopefully
    - hand – handle – handily
    - wide – widen – widening

Assessing "Key Features"

- 3. Prosody
- Evaluate conversational speech
  - Listen for inappropriate use of stress on multisyllabic words
  - Listen for inappropriate use of pitch and intonation
  - Listen for inconsistent rate or loudness
    - Overall slower rate may indicate co-existing dysarthria
  - Inconsistent nasality?
  - Need to evaluate at least 25-30 utterances to get a valid sample

Additional Analyses

- Case history
  - Look for "neurological events" that might suggest neurological damage – not always there.
  - Look for family history of any speech or language impairments – not always there.
  - Look for (past and current) problems with feeding, chewing, swallowing, and/or drooling.
    - Would suggest possible co-existing oral apraxia

Additional Analyses

- Use conversational speech to establish good baseline:
  - 1. Overall intelligibility (% words understood)
    - Need to measure it directly
  - 2. Syllable shape inventory
    - Ignore accuracy here
    - Any consonant counts as C, any vowel counts as V
  - 3. Phonetic inventory
    - Any sound that shows up counts, regardless of whether it matches the target

Implications for CAS Treatment?

- Many children with CAS spend longs periods in therapy.
  - One interpretation is we're doing something wrong.
- Not really a language-based (phonological) problem
- Not really a motor performance (articulation) problem
- Core problem is 'programming and planning'
  - Perhaps that's what we should be treating?

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