Childhood Apraxia of Speech: Neurologic Perspectives on Assessment and Treatment

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Disclosures

Financial

- Receiving an honorarium for this presentation
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Non-Financial

- **ASHA Board of Directors, Vice-President for Finance** (unpaid volunteer)
- **Professor Emeritus**, Auburn University Department of Speech, Language, and Hearing Sciences
- 40 years as University Professor at UU, FAU, UGA, AU
- **Specialties:** Neuroscience, Neuroanatomy/Neurophysiology, Neurogenic Speech & Language Disorders, Neuroaudiology, AAC

Topics Covered

Overview:

- **Signs, Symptoms, and possible etiological features that can underlie childhood apraxia of speech**

Assessment:

- **Classic diagnostic indicators differentiating childhood apraxia of speech from developmental articulation disorders, dysarthria, ataxia, and cluttering**

Treatment:

- **Possible treatment approaches for childhood apraxia of speech and the evidence supporting the use of each**

Many items presented today are drawn from the **ASHA Practice Portal**
https://www.asha.org/practice-portal/

See also the **ASHA Evidence Maps** for efficacy of DX and TX
https://apps.asha.org/EvidenceMaps/

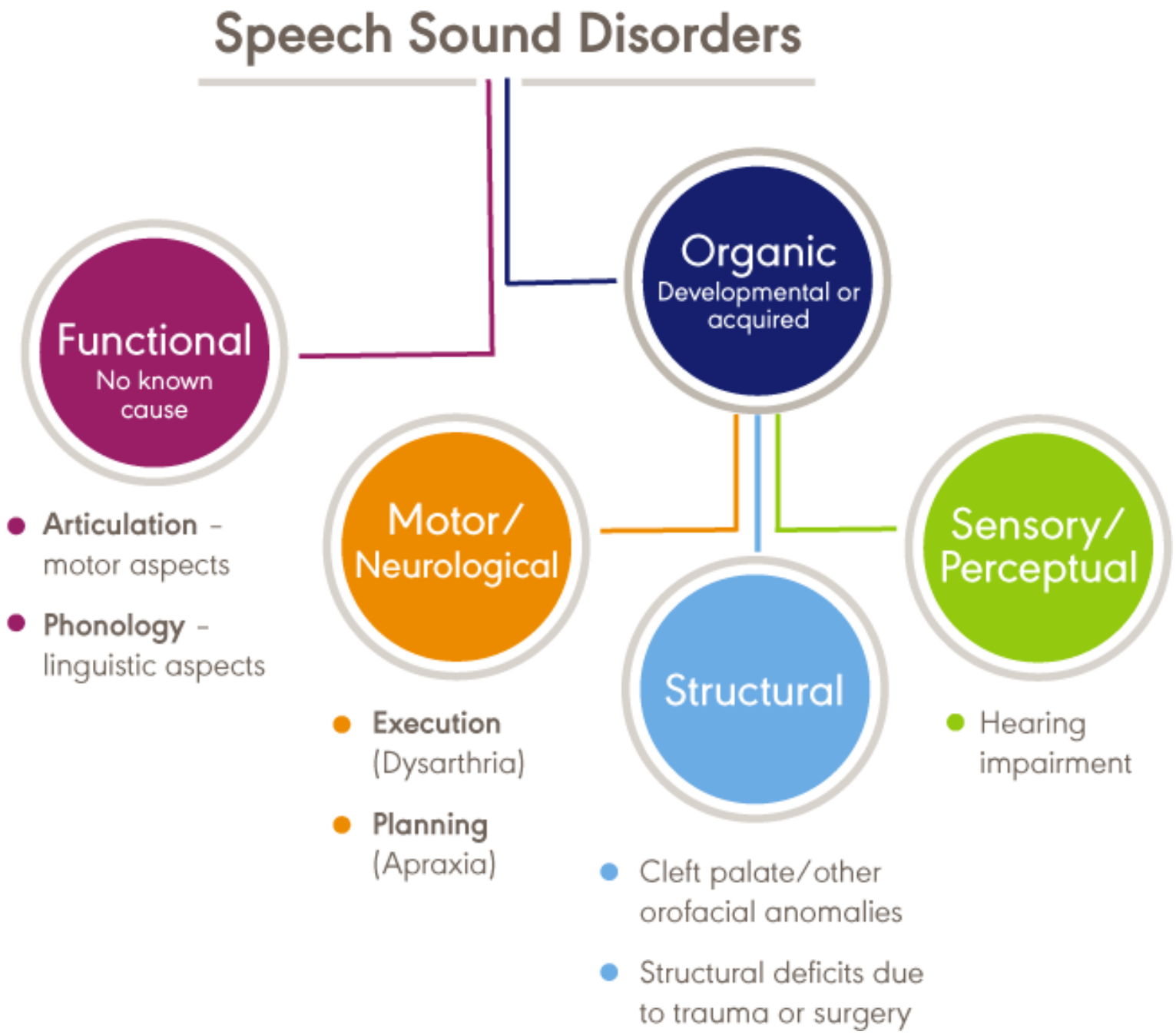
Overview: Definitions

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). The core **impairment in planning and/or programming spatiotemporal parameters of movement sequences** results in errors in speech sound production and prosody – a "motor speech" disorder.

CAS may occur as a result of

- known neurological impairment,
- in association with complex neurobehavioral disorders of known and unknown origin, or
- an idiopathic neurogenic speech sound disorder. (ASHA 2007)

Also referred in research literature as: ***developmental apraxia of speech (DAS)***, ***developmental verbal dyspraxia (DVD)***, and as ***verbal dyspraxia*** in the DSM V



Categorizing Speech Sound Disorders by Underlying Disorders in Function:

1. Functional vs. Organic
   Organic

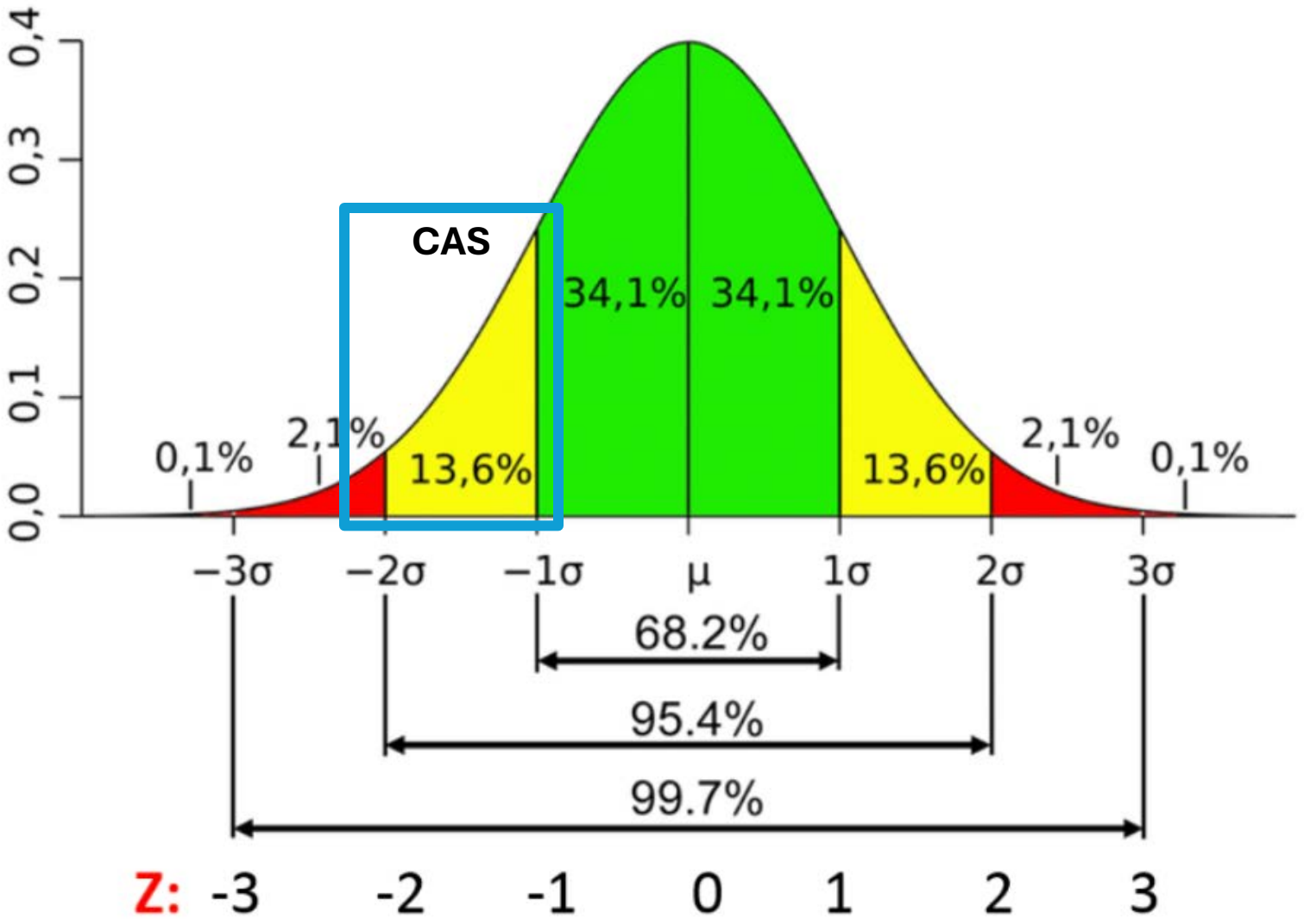
2. Motor/Neurological vs. Structural vs. Sensory/Perceptual

   Motor/Neurological

3. Execution (Dysarthria)
   Planning (Apraxia/CAS)

   Planning (Apraxia/CAS)

Overview: CAS and Normal Distribution relative to Speech Sound Accuracy



Overview: Incidence/Prevalence

- **1-2 children per 1000** (Shriberg et al, 1997)
- **2-3:1 male to female ratio** (Hall, Jordan, & Robin, 1993; Lewis et al., 2004)
- Higher prevalence in **Galactosemia** (genetic sugar metabolic disorder) and various syndromes (**Fragile X**, **Velocardiofacial**, **Prader-Willi**, and **Rhett Syndromes**).
- **Individuals with autism spectrum disorders do not have a higher prevalence of CAS** (Shriberg, Paul, Black, & van Santen, 2011)
- Higher prevalence of **concomitant language, reading, and or spelling disorders in children with CAS** (Lewis et al., 2004; Lewis & Ekelman, 2007)

Overview: Signs and Symptoms

Common, but not necessary or sufficient for diagnosis:

- **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 or phrasal stress (ASHA, 2007)

Overview: Signs and Symptoms

Childhood apraxia of speech	Dysarthria	Phonological disorder
• Initiation, sequencing and prosody distortions • Difficulty moving from syllable to syllable (e.g. robotic, staccato or very slow speech) • Influenced by word length: increasing breakdown with increasing complexity • Inconsistent errors • No paralysis or paresis – normal muscle tone • Normal resonance, respiration and phonation	• Known brain injury, other neurological signs • Sound distortions • Not generally influenced by word length • Usually consistent (except spasticity) • Paralysis, paresis, asymmetry • Abnormal resonance, respiration or phonation	• Normal prosody • Consistent, rule governed, even if not developmentally typical • Influenced by word position not length • Rarely any oral signs • Responsive to phonological feedback

From Cambridge Handbook of Communication Disorders (2015) Ch.21 Developmental Motor Speech Disorders

Overview: Signs and Symptoms

Other symptoms that help differentiate CAS from other SSDs:

- **articulatory groping -** articulatory searching prior to phonating
- **consonant distortions**
- **difficulty with smooth, accurate movement transitions from one sound to the next**
- **increasing difficulty with longer or more complex syllable and word shapes**
- **schwa additions/insertions -** insertion of schwa between consonants or at the end of words;
- **slower than typical rate of speech**
- **syllable segregation -** pauses between sounds, syllables, or words that affect smooth transitions;
- **voicing errors -** voiceless sounds produced as their voiced cognates; and
- **vowel errors -** vowel distortions or substitutions.

(ASHA, 2007; Iuzzini-Seigel (2017); Strand (2017)

Overview: Co-Occurring Communication Disorders

CAS yields increased risk for problems in expressive language and weakness in the phonological foundations for literacy

- delayed language development
- expressive language problems, such as word order confusion and grammatical errors
- problems learning to read, spell, and write
- problems with social language/pragmatics.

(Lewis et al., 2004; McNeill, Gillon, & Dodd; 2009b)

Overview: Co-Occurring Sensory & Motor Problems

Common co-occurring nonspeech sensory and motor problems:

- **gross and fine motor delays**
- **motor clumsiness**
- **oral apraxia**
- **limb apraxia**
- **feeding difficulties**
- **abnormal orosensory perception** (hyper- or hyposensitivity in the oral area).

(Crary & Anderson, 1991; Davis et al., 1998; Dewey, Roy, Square-Storer, & Hayden, 1988; McCabe, Rosenthal, & McLeod, 1998; Shriberg et al., 1997)

Overview: Possible Etiologies

Research typically links possible etiology into 3 patterns

- **idiopathic neurogenic speech sound disorder** (children with no known neurological or neurobehavioral damage/disorders)
- **primary or secondary signs within complex neurobehavioral disorders** (e.g., autism, epilepsy, and syndromes, such as fragile X, Rett syndrome, and Prader–Willi syndrome)

  (Bashina, Simashkova, Grachev, & Gorbachevskaya, 2002; Boyar et al., 2001; Scheffer et al., 1995; Spinelli et al., 1995)

- **in association with known neurological events** (e.g., infection, trauma, intrauterine or early childhood stroke, brain cancer/tumor resection)

  (e.g., Brown et al., 2000)

Overview: Possible Etiologies - Genetics

FOXP2 Gene and the KE family in London, England (2000)

- 1990 Hurst et al: reported on 3 generations of British family (KE) with 50% of members with CAS and oral motor apraxia
- transmission pattern reflected a Mendelian (monogenic) autosomal dominant transmission pattern, a mutation of a single gene on an autosome (non-sex chromosome)
- In 1998, Fisher et al, using a genome-wide scan of affected and unaffected KE family members, reported affected members all carried a mutation in a gene on chromosome 7.
- Work by Fisher, et al (2001) indicated that all affected individuals, both KE family members and CS, carried a mutation in a specific protein-coding gene. The gene coded a novel member of the forkhead-box (FOX) group of transcription factors involved in gene regulation, and was given the name FOXP2.

Overview: Possible Etiologies - Genetics

FOXP2 Gene and the KE family in London, England (2000)

- Interestingly, FOXP2 orthologs have been identified in all mammals for which complete genome sequencing has taken place, as well as in other species, such as songbirds.
- Genetically altered mice with a single copy of FOXP2 have significantly reduced vocalizations as "pups" (Shu, Lu, Zhang, et al, 2005)
- Examination of FOXP2 in zebra finches indicates upregulation of activity in young finches leaning song patterns, and knockdown of the gene's regulation of basal gangliar areas in young finches results in incomplete and inaccurate song imitation (Haesler, Rochefort, Georgi, et al, 2007)

Overview: Possible Etiologies - Genetics

FOXP2 Gene and the KE family in London, England (2000)

- A recent extraction of DNA from Neanderthal bones indicates that Neanderthals had the same version (allele) of the FOXP2 gene as modern humans (Krause, Lalueza-Fox, Orlando, et al, 2007).
- In 2003, Lai, Gerelli, Monaco, Fisher, and Copp reported finding FOXP2 expression in several brain structures including the cortical plate, basal ganglia, thalamus, inferior olives and cerebellum. The authors saw the data as supporting a role for *FOXP2* in the development of corticostriatal and olivocerebellar circuits involved in motor control.
- Vargha-Khadem, Gadian, Copp, and Mishkin (2005) utilized fMRI analysis of individuals with CAS performing silent verb generation and spoken word repetition tasks. fMRI demonstrated underactivation of Broca's area and the putamen (a basal ganglia area involved in motor control).

Overview: Possible Etiologies - Neuroanatomy

Brain Differences in Childhood Apraxia of Speech

- Children with idiopathic CAS were found to have normal structural brain MRI on conventional imaging, suggesting that brain abnormalities that underly idiopathic CAS might be too subtle to be detected by clinical MRI (Liegeois & Morgan, 2012).
- Emerging evidence from studies using more advanced quantitative measures of structural MRI in speech disorders support the presence of structural brain abnormalities on a microscopic level.
- Morphological abnormalities were found in **supramarginal gyrus** and **bilaterally in the planum temporale** and **in Heschl's gyrus** for children with a subtype of speech sound disorder characterized by persistent speech sound errors (Preston et al, 2014).
- In children with idiopathic CAS, a **thicker left supramarginal gyrus was found compared to controls** by (Kadiss et l, 2014), in the absence of appreciable macroscopic lesions.

Overview: Possible Etiologies - Neuroanatomy

Brain Differences in Childhood Apraxia of Speech

- Preston et al, (2014) and Fiori (2014) examining hemispheric interconnectivity found 3 subnetworks had altered (reduced) Fractional Anisotropy in children with CAS, compared to typically developing children.
- These networks included left inferior (opercular part) and superior (dorsolateral, medial and orbital part) frontal gyrus, left superior and middle temporal gyrus and left post-central gyrus (subnetwork 1); right supplementary motor area, left middle and inferior (orbital part) frontal gyrus, left precuneus and cuneus, right superior occipital gyrus and right cerebellum (subnetwork 2); right angular gyrus, right superior temporal gyrus and right inferior occipital gyrus (subnetwork 3).
- Reduced FA of some connections correlated with diadochokinesis, oromotor skills, expressive grammar and poor lexical production in CAS. The authors propose altered connectivity as a possible biological marker for CAS, to be considered in the diagnostic approach and possibly to be applied in the monitoring of changes induced by a specific rehabilitative intervention.

Assessment: Speech Sound Disorders

Comprehensive assessment for speech sound disorders typically includes:

- case history
- oral mechanism examination
- speech sound assessment
- language assessments, if indicated
- auditory screening and/or assessment

In differentiating CAS from other Speech Sound Disorders, more extensive testing in each area above is required

Most toddlers and preschoolers are incapable of performing the more extensive testing, extremely limiting differential diagnosis of CAS in children < 3 years of age

Assessment: Case History

The case history typically includes gathering information about

- family's concerns about the child's speech, language, and literacy skills
- history of middle ear infections and possible hearing loss
- family history of speech and language difficulties (including reading and writing)
- language(s) and dialect(s) used in the home
- primary language(s) and dialect(s) spoken by the child
- family's and other communication partners' perceptions of intelligibility
- teacher's report of the child's intelligibility, the child's participation in the school setting, and how the child's speech compares with that of peers in the classroom

Assessment: Oral Mechanism

Oral mechanism examination evaluates the structure and function of the physical speech mechanism, assessing whether the system is adequate for speech production, and includes assessment of

- **external facies** (facial symmetry, facial clefts/deformities, facial posture)
- **dental occlusion, dentition** (specific tooth deviations or edentulous spaces)
- **size, color, intactness of oral and pharyngeal cavity structures** (tongue, faucial pillars, frenulum, torii)
- **structure of hard and soft palate** (clefts, fistulas, bifid uvula)
- **function** (**range, rate, symmetry, and smoothness of motion** including when crossing the midline) of the **lips, jaw, tongue, and velum**

Assessment: Motor Speech Examination

A MSE should be conducted when CAS is suspected - tasks include

- **nonspeech articulatory postures** (e.g., smile) **and sequences** (e.g., kiss–smile) **versus speech sounds and words (OMA vs. CAS)**
- **well-practiced/automatic speech vs. volitional speech** (for children who are older and/or have some speech)
- **speaking tasks that require single postures vs. sequences of postures** (e.g., single sounds such as [a] vs. words, such as [mama])
- **speech production at the single syllable, bisyllable, multisyllable, phrase, and sentence levels**
- **sequential and alternating movement repetitions of articulatory structures** (e.g., [papapa] and [pataka];)

See McCauley and Strand (2008) for a discussion of nonverbal oral and speech motor performance assessment tools

Assessment: Additional Thoughts

Return to Slides 8, 10, 11 and 12 (Signs and Symptoms) for critical diagnostic features displayed by children with CAS!

- Assessment should include performance across multiple contexts (e.g., spontaneous vs. elicited vs. imitated utterances), as results can vary by context.
- Fluidity (smoothness), rate, consistency, lexical stress, and accuracy should be monitored, as there may be trade-offs among these variables (e.g., the child's productions might be smoother or more accurate when speaking rate is slow vs. rapid)
- Sequencing errors may consist of inaccuracies, inconsistency (i.e., not producing the same sound or syllable in each repetition - whether correct or not), or mis-ordering sounds
- Using dynamic assessment procedures, the clinician can provide cues (e.g., gestural or tactile cues) to better judge the child's speech production and to determine how much cueing is necessary to facilitate performance.

Assessment: Diagnosis of CAS in Children < 3 YOA

Diagnosis of CAS in children under 3 YOA is very challenging

- the potential presence of developmental disabilities and/or comorbid conditions
- the lack of a single, validated list of diagnostic features that differentiates CAS from other types of childhood speech sound disorders
- some primary characteristics of CAS (e.g., word inconsistency, a predominant error pattern of omission, etc.) are characteristic of emerging speech in typically developing children under the age of 3 years
- lack of a sufficient speech sample size for making a more definitive diagnosis
- challenge of sorting out inability versus unwillingness to provide a speech sample or to attempt a speech target
- changes in speech occurring during the first 3 years (e.g., due to developmental maturation, social and linguistic peer exposure, and/or the beneficial effects of treatment) may alter the diagnostic label
- possibly best categorized under a provisional diagnostic classification, such as "CAS cannot be ruled out," "signs are consistent with problems in planning the movements required for speech," or "suspected to have CAS."

Treatment: Basic Decision-Making Tree

A Child < 3 YOA with Indeterminate CAS Diagnosis

- **Trial Therapy** – CAS Approaches, Phonological Approaches, Language Approaches

A Child with Definitive CAS Diagnosis

- **Symptoms:** Number of Symptoms and Severity, Effective Intelligibility
- **Presence of Concomitant Disorders (Weigh the Impact of Each on Intelligibility and Communication Effectiveness)**
  - **Language:** General Language Delay, Expressive Language Disorders, Social/Pragmatic Language Disorders
  - **Phonological Disorders**
  - **Nonspeech Sensory and Motor Problems** (gross and fine motor delays, motor clumsiness, oral and/or limb apraxia, feeding difficulties, abnormal orosensory perception
  - **Other Neurological or Neurobehavioral Problems** (dysarthria, stuttering, cluttering, ASD, Hearing Disorders, etc.)

Treatment selection depends on factors such as the severity of the disorder and the communication needs of the child.

Treatment: CAS Specific Treatment Options

Categories of Treatment Approaches for CAS

- **Motor programming approaches -** use motor learning principles, including the need for many repetitions of speech movements to help the child acquire skills to accurately, consistently, and automatically make sounds and sequences of sounds.
- **Linguistic approaches -** focus on CAS as a language learning disorder; these approaches teach children how to make speech sounds and the rules for when speech sounds and sound sequences are used in a language.
- **Combination approaches -** use both motor programming and linguistic approaches.
- **AAC approaches –** used when concerned that oral communication is not adequate, to provide functional communication while at the same time supporting and enhancing verbal speech production (Yorkston, Beukelman, Strand, & Hakel, 2010)
- **Rhythmic (prosodic) approaches** - such as melodic intonation therapy (MIT; Albert, Sparks, & Helm, 1973; Helfrich-Miller, 1984, 1994)—use intonation patterns (melody, rhythm, and stress) to improve functional speech production.

Treatment: Cueing/Shaping Key to Movement Training

Sensory Cueing Approaches (visual, auditory, proprioceptive, tactile)

- **Visual cueing** methods provide visual "cues" as to the shape, placement, or movement of the articulators. Visual cues can be gestural (e.g., simple hand signs) or computerized speech viewing programs
- **Verbal/auditory cues** provide instruction on how to move the articulators during production attempts
- **Tactile facilitation** methods are those that provide direct tactile input for correct speech production. *PROMPT*© (Prompts for Restructuring Oral Muscular Phonetic Targets) is one tactile method of treatment that is based on touch, pressure, kinesthetic, and proprioceptive cues

Treatment: Motor Programming Approaches

Motor programming approaches are based on motor programming/planning principles:

- provide frequent and intensive practice of speech targets;
- focus on accurate speech movement;
- include external sensory input for speech production (e.g., auditory, visual, tactile, and cognitive cues);
- carefully consider the conditions of practice (e.g., random vs. blocked practice of targets); and
- provide appropriate types and schedules of feedback regarding performance

For a discussion of the principles of motor learning as they apply to CAS and a review of motor-based treatment approaches for CAS, see Maas, Guildersleeve-Neumann, Jakielski, Stoeckel (2014)

Treatment: Motor Programming Approaches

- **Dynamic Temporal and Tactile Cueing (DTTC)** is an integral stimulation ("look, listen, do what I do") method that uses a cueing hierarchy (auditory, visual, and tactile) and systematically decreases supports as the child achieves success at each level of the cueing hierarchy (Strand & Debertine, 2000; Strand et al., 2006). It is suggested for very young children with severe CAS.
- **Nuffield Dyspraxia Program(NDP3®)** is a motor skills learning approach that emphasizes motor programming skills and focuses on speech output. It is described as a "bottom-up" approach in which the aim is to "build" accurate speech from core units of single speech sounds (phonemes) and simple syllables. Phonological skills are incorporated into the treatment approach through the use of minimal word pairs (Williams & Stephens, 2010).
- **Rapid Syllable Transitions (ReST)** is a method that involves repetition of varied sequences of real or nonsense syllables to train motor planning flexibility (Velleman, 2003; Velleman & Strand, 1994). It uses intensive practice in producing multisyllabic, phonotactically permissible pseudo-words. Pseudo-words are used to allow the development and practice of new speech patterns without interference from existing error speech patterns (McCabe et al., 2014; McCabe, Murray, Thomas, & Evans, 2017)

Treatment: Linguistic Approaches

Linguistic approaches for treating CAS emphasize linguistic and phonological components of speech to help the child internalize phonological rules (these are meant to complement to motor approaches, not replace them)**:**

- **Cycles approach** (Hodson, 1989) is a linguistic approach that targets phonological pattern errors. It is designed for children whose speech is highly unintelligible and who have extensive omissions, some substitutions, and a restricted use of consonants. The goal is to increase intelligibility within a short period of time with treatment scheduled in 5-16 week cycles (Hodson, 2010; Prezas & Hodson, 2010). The goal is to approximate the gradual typical phonological development process.
- **Integrated Phonological Awareness (IPA)** is designed to simultaneously facilitate phonological awareness, letter–sound knowledge, and speech production in preschool and young school-age children with speech and language impairment. Specific approaches to facilitate the development of phonological awareness include teaching nursery rhymes and focusing on sound properties of spoken language, and phoneme awareness and letter game activities; McNeill, Gillon, & Dodd, 2009a, 2010; Moriarty & Gillon, 2006).

Treatment: AAC and Prosodic Approaches

- **Augmentative and Alternative Communication (AAC) approaches –** used when concerned that oral communication is not adequate, to provide functional communication while at the same time supporting and enhancing verbal speech production (Yorkston, Beukelman, Strand, & Hakel, 2010). AAC includes gestures, manual signs, voice output devices, and context-specific communication boards.
- **Prosodic facilitation** treatment approaches use intonation patterns (melody, rhythm, and stress) to improve functional speech production. **Melodic intonation therapy** (MIT; Albert et al., 1973) is a prosodic facilitation approach that uses singing, rhythmic speech, and rhythmic hand tapping to train functional phrases and sentences. Using these techniques, the clinician guides the individual through a gradual progression of steps that increase the length of utterances, decrease dependence on the clinician, and decrease reliance on intonation (Martin, Kubitz, & Maher, 2001).

Treatment: Concluding Thoughts

- Motor speech disorders require repetitive planning, programming, and production practice; therefore, intensive and individualized treatment of childhood apraxia is often necessary
- To the extent possible,
  - treatment should take place in naturalistic environments
  - is provided in a culturally appropriate manner
  - involves as many important people in the child's life as possible to facilitate carryover and generalization of skills
  - Involving caregivers in treatment helps them understand and practice goals with the child outside the treatment setting.

Pervasive Speech Sound Disorders: CAS vs Cluttering

Both CAS and Cluttering result in impairments in intelligibility, inconsistency in errors and resistance to treatment

Cluttering

- **Originally was seen as resulting from impaired central language processes and affecting multiple speech/language production aspects (Weiss, 1967)**
- **In 1991 (Daly) described it as a syndrome with multiple communication disorders, one of which commonly is fluency**
- **St. Louis, Myers, Bakker, & Raphael (2007) provided the currently accepted description:** Fluency disorder characterized by a rate that is perceived to be abnormally rapid, irregular, or both, for the speaker. These rate abnormalities are further manifest in one or more of the following symptoms:
  - *Excessive number of disfluencies, the majority of which are not typical of PWS*
  - *Frequent placement of pauses and use of prosodic patterns that do not conform to syntactic & semantic constraints*
  - *Inappropriate (usually excessive) degrees of coarticulation among sounds, especially in multisyllabic words*

Pervasive Speech Sound Disorders: Cluttering

Definition of Cluttering for the Lay Person (St. Louis, Reichel, Scaler-Scott, Van Borsel, Ward, Leahy, Sonsterud, Adams, van Zaalen, Ademola & Arulogon, 2009)

"Cluttering is a speech problem in which a person's speech is either too fast, too jerky, or both. Most people who clutter seem to run their words or sentences together, and they often have many more fillers, hesitations, revisions, or other breaks in their speech than normal speakers do. Their speech sounds 'cluttered' as though they do not have a clear idea of what they want to say, and they are often not aware that they have a speech problem."

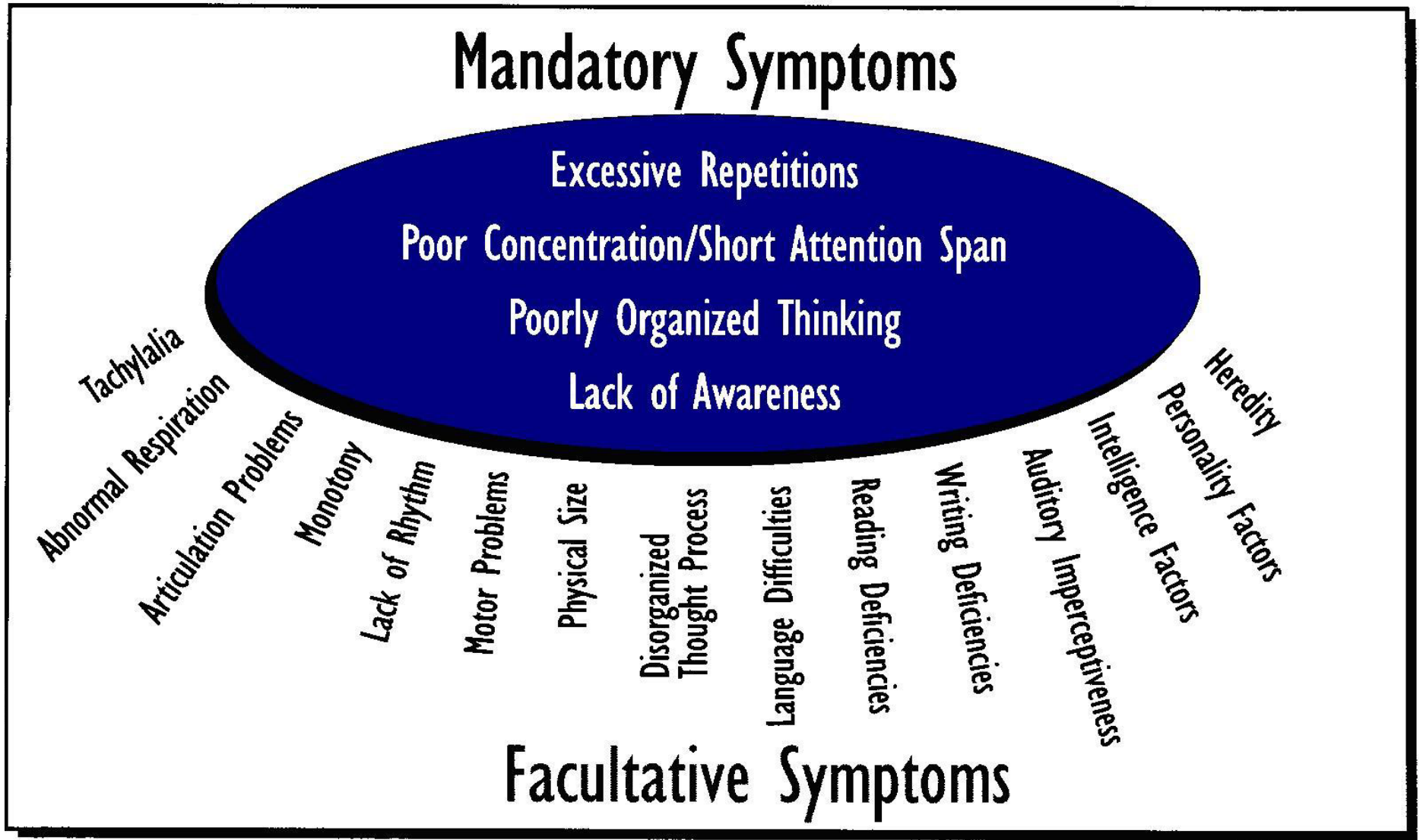
Pervasive Speech Sound Disorders: Cluttering

Prevalence of Cluttering: (similar to CAS it's difficult to determine because definition of disorder is unclear, also many children manifest combined stuttering-cluttering symptoms)

- Becker & Grundmann (1971): 1.5% of 7 & 8 year old German schoolchildren
- Daly (1996): school-aged children with fluency disorders (5% of children), 5% of those were pure clutterers)
- Filatova (2002): tested 55 fluency-disordered children; 7% were pure clutterers
- Preus (1981): 30% of Children Who Stuttered (CWS) were also clutterers; Daly (1996) 40% of CWS are clutterer-stutterers

Cluttering: Signs and Symptoms

Differential Diagnostic Features for Cluttering (Daly 1996)



Cluttering: Signs and Symptoms

Age of Onset:

- While symptoms are present from onset of speech, diagnosis usually is not made until 6 - 8 years of age after lack of RTI. Often worsens during puberty, remains throughout life

Hereditary/Familial Pattern:

- usually present in other immediate family members
- severity may differ across family members; may be only 1-2 impairments in some members, or none at all

Lack of Self-Awareness of Disorder

- appear to unaware of majority of errors, oblivious to listener reactions, and an unconcerned attitude towards disorder

Cluttering: Signs and Symptoms

Impairment in Language Formulation:

- word-finding problems
- metathesis - sound and word sequencing errors
- syntactical and morphological errors
- disassociation between thinking and speaking

Speech Disorders: Phonological problems

- imprecise, indistinct, or slurred articulatory production
- fairly consistent errors on some phonemes (e.g. /l/, /r/, sibilants)
- production (intelligibility) often improves if slows rate and/or over-exaggerates production

Cluttering: Signs and Symptoms

Speech Disorders: problems with Fluency

- easy repetitions of whole words and phrases
- frequent interjections, “filler” words
- frequent silent pauses, hesitations
- often improves if concentrate on production

Speech Disorders: problems with Suprasegmental Aspects

- lack of normal variability in pitch (monotone)
- lack of normal variability in loudness
- poor integration of linguistic phrasing, intonation, and stress

Cluttering: Signs and Symptoms

Speech Disorders: Rate problems

- early descriptions - tachyphemia/tachylalia (excessive rate)
- increased interverbal acceleration (decreased pause time between words) and intraverbal acceleration (contraction of elements within words) leading to coarticulatory errors

Miscellaneous Problems

- Reading/other learning disabilities
- clumsy and/or uncoordinated
- highly distractible
- compulsive talker
- untidy, careless, hasty, impulsive
- poor rhythm, timing, or musical abilities

Cluttering: Treatment

Possible Treatment Approaches: *(from St. Louis et. al., 2007)*

- Increase awareness and self-monitoring skills
- Improve rate (as well as articulation and speech intelligibility)
- Improve linguistic and narrative skills
- Improve fluency skills
- Improve meta-cluttering skills
- Improve phonatory and respiratory behaviors
- Improve family, friend, and employer support
- Improve collaboration with other team members
- Foster transfer and maintenance