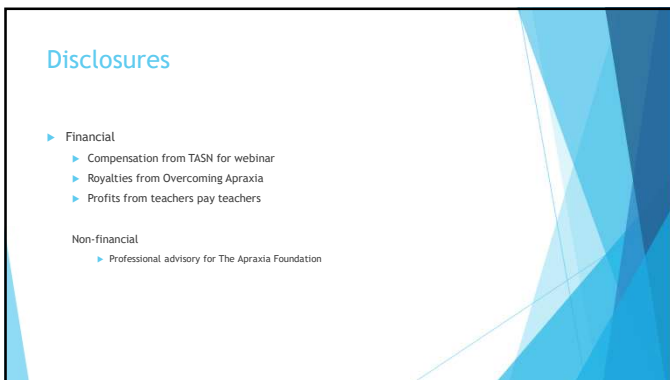
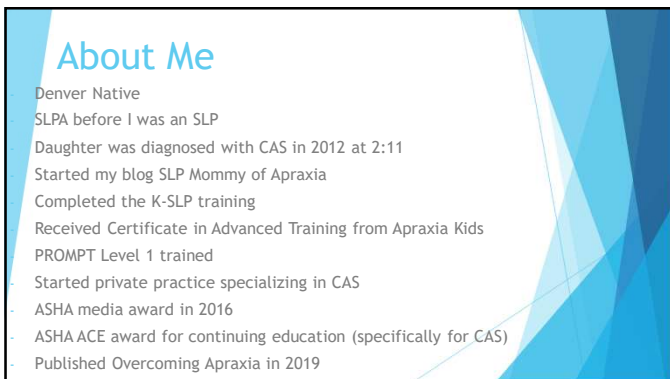


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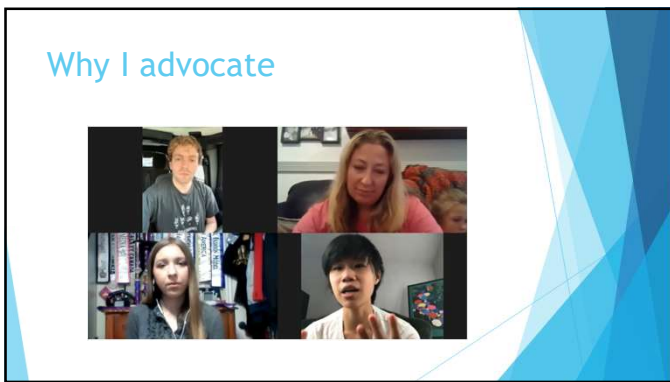
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Apraxia is a problem with programming/planning: NOT execution.

(E. Maas, C. E. Gilderleeve-Neumann, K. J. Jakietski R. Stoeckel, 2014)

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What is Childhood Apraxia of Speech (CAS)?

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 may occur 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 technical report, 2007)

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Definition Continued

(ASHA, 2007)

Three generally agreed upon diagnostic markers (ASHA 3)

- inconsistent errors on consonants and vowels in repeated productions of syllables or words
- lengthened and disrupted co-articulatory transitions between sounds and syllables (difficulty moving from one sound to the next, or one syllable to the next)
- inappropriate prosody, especially in the realization of lexical or phrasal stress. (may sound monotone, robotic, equal syllabic stress etc)

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Other Diagnostic indicators

- Vowel Distortions
- Distorted substitutions
- Difficulty with initial artic configurations or transitional movement gestures
- Equal stress, lexical, or phrasal stress errors
- Syllable segregation or word segregation
- Groping
- Intrusive schwa
- Voicing errors
- Slow speech rate and/or slow DDK
- Increased difficulty with multi-syllabic words
- Inconsistency on repeated trials of words/utterances

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Characteristics becoming more discriminative of a CAS dx

- ▶ * Difficulty moving from one articulatory configuration to another
- ▶ Groping, or trial/error behavior
- ▶ Vowel distortions
- ▶ * Prosodic errors
- ▶ Inconsistent voicing errors

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Other non-speech “soft signs” that may be present

- general awkwardness or clumsiness
- impaired volitional oral movements
- delays in motor development
- mildly low muscle tone
- abnormal oro-sensory perception (hyper- or hyposensitivity in the oral area), and oral apraxia (e.g., [Davis et al., 1998](#); [McCabe et al., 1998](#); [Shriberg et al., 1997a](#)). The non-speech motor features typically listed for oral apraxia are impaired volitional oral movements (imitated or elicited postures or sequences such as “smile-kiss”) and groping (e.g., [Davis et al., 1998](#); [McCabe et al., 1998](#); [Shriberg et al., 1997a](#)).

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Who Dx CAS?

“As indicated in the [Code of Ethics](#) (ASHA, 2010), SLPs who serve this population should be specifically educated and appropriately trained to do so. SLPs who diagnose and treat CAS must possess skills in differential diagnosis of childhood motor speech disorders, specialized knowledge in motor learning theory, and experience with appropriate intervention techniques that may include augmentative and alternative communication and assistive technology.” (ASHA Practice Portal Childhood Apraxia of Speech)

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Important to remember that over time, labels may change.

► Over time, due to continued neural maturation and treatment, a child may progress to exhibiting only a few residual articulation errors, with no vowel distortions, groping, or prosodic errors. At that point, the label CAS is not appropriate - although it may be appropriate to note the history of CAS, which may be important to later difficulties with literacy or learning and pronouncing difficult, novel, multisyllabic words (Strand, 2017).”

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A controversial diagnosis

- Diagnostic indicators vary in the research from study to study.
- There is currently no gold standard, that when identified, leaves little doubt that CAS is present
- CAS characteristics can overlap with phonological processing characteristics
- Clinicians in the field have devised their own diagnostic schemas
 - ASHA 3 versus Mayo 10
 - Leads to potential misdiagnosis/over diagnosis, inconsistent dx

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Causes

No known cause to date for all cases

- Genetic
- Neurological Impairment
- Idiopathic

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Genetic

- Chromosomal and/or genetic disorders
- Vargha-Khadem et al. (1998) discovered a mutation on a gene that causes CAS called FOXP2. However, only a small percentage of children with CAS had FOXP2 abnormalities.
- Morgan & Webster (2018)
 - "Evidence is increasingly suggesting that CAS is a genetic disorder...Mutations of FOXP2 only have been associated with a relatively homogeneous phenotype of CAS and language disorder in the absence of ID, but this has been the only candidate gene to date to show a selectivity of this kind. Other genotypes associated with CAS, to date, generally lead to broader ID syndromes (e.g. *BCL11A*, *KANS11*) and/or significant medical comorbidities such as epilepsy (e.g. *GRIN2A*) or autism (16p11.2 deletion), where CAS may occur as part of the broader spectrum of the condition."

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Neurological Impairment

- Can be the result of a neurological impairment caused by infection, illness, or injury before or after birth, which may, or may not show up as positive findings on MRI scans. May be caused by a stroke or other TBI occurring in childhood.
- A study in 2014 examined MRI data, specifically cortical thickness in areas of interest for children with and without CAS and found, "children with idiopathic apraxia had significantly thicker left posterior supramarginal gyri than controls" (Kadis et al., 2014)
- Participants received PROMPT and post scans showed a significant decrease of the cortical thickening in the area.

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Idiopathic

- CAS can run in families (heritable).
- Can also be diagnosed in children where there is no family history of CAS (de novo).

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How early to diagnose?

- ASHA warns a diagnosis of CAS before 3 years is challenging for a variety of reasons.
- HOWEVER, if motor planning is suspected, it is best to treat it accordingly "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."

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Early signs of apraxia

- ▶ Lack of babbling or rich babbling as an infant
- ▶ Limited vocalizations in the first two years of life
- ▶ Lack of a consonant by age 12 months
- ▶ Use of fewer than three consonants by 16 months of age
- ▶ Use of fewer than five consonants by 24 months of age
- ▶ Limited to no velar productions (/k/, /g/)
- ▶ Preference of stops and nasals over other consonants
- ▶ Productions are largely vowels, with little use of other syllable shapes

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Early signs continued

- ▶ Inconsistent errors
- ▶ Increased errors or difficulty with longer or more complex syllable and word shapes
- ▶ Omissions, particularly in the word initial position
- ▶ Vowel errors/distortions
- ▶ Loss of previously produced words (pop out words)
- ▶ Higher receptive than expressive language

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Differential DX

It is possible to have CAS and phonological disorder or dysarthria or developmental language disorder

Symptoms of Apraxia and Autism have numerous symptoms that overlap.
 • Especially true in cases of "global" apraxia

Other disorders:
 Down Syndrome,
 Cleft Palate, Fragile X

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CAS and Autism

ASD

- ▶ Difficulties communicating verbally and/or non-verbally
- ▶ May demonstrate little inherent desire to communicate and interact with others
- ▶ Exhibits unusual playtime interests and/or lacks purposeful play skills
- ▶ Limited eye contact due to weak joint attention skills

CAS

- ▶ Usually can communicate effectively, but often non-verbally
- ▶ Usually demonstrates a strong desire to communicate and interact with others
- ▶ Usually demonstrates similar play time interests as peers
- ▶ Good joint attention skills but may avert gaze when pressured to speak

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Prevalence of ASD and CAS

- Conflicting representation in the research
- Tierney and colleagues (2015) found that 63.6% of children diagnosed with ASD also had CAS and 36.8% of children initially diagnosed with CAS also had autism.
 - Study has limitations because it pulled children already enrolled in an autism program.
- Shriberg and colleagues (2019) found among a sample of 46 children no statistical support for the hypothesis of ASD and concomitant CAS.
 - This study has been criticized because the criteria used to diagnose CAS inherently would have excluded some children with ASD resulting in lower incidence rates.

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Importance of differential dx

- In a word: TREATMENT!!!
- Important to address any missing foundational skills such as joint attention, imitation, and self regulation in therapy **before** addressing the speech motor planning targets
- Children diagnosed with CAS need a motor-based speech approach to therapy
- Traditional articulation and phonological therapies are not successful for children with CAS (Cycles, minimal pairs, maximum opposition, etc)

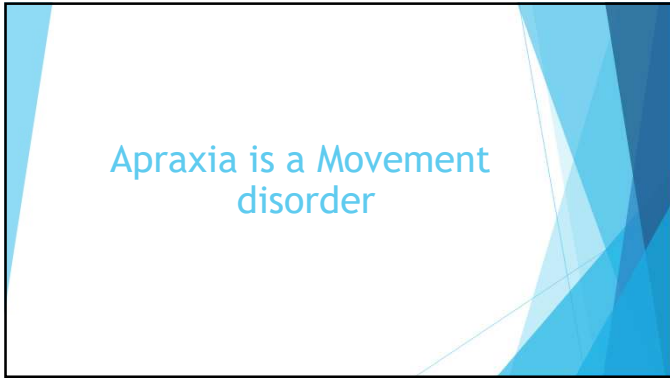
These approaches are designed to remediate a sound, or sound error patterns.

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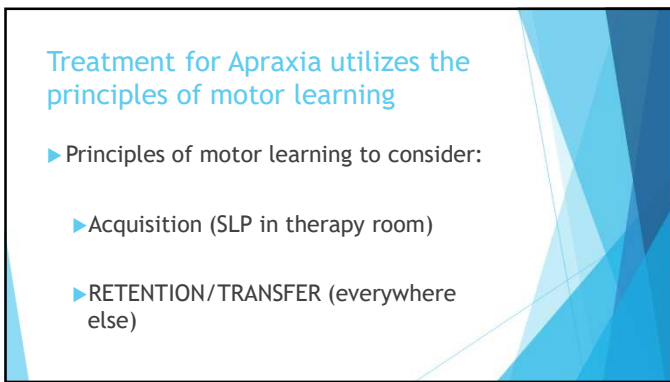
How Apraxia Therapy differs from Traditional Therapy

- > **MOVEMENT** - Therapy for apraxia should be focusing on the **MOVEMENT**. *Coarticulation* (movement between sounds) is the focus as opposed to *articulation*(sound production).
- > Target Selection - Targets for apraxia do not necessarily follow developmental norms. They *should* take into account 1. sound repertoire 2. stimulability 3. functionality (don't forget prosody!)

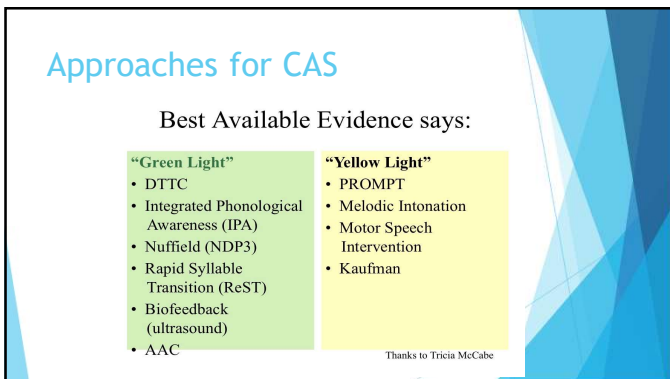
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Intensity of Treatment

- ▶ What does the research say?
 - ▶ Approaches for CAS typically involve 60-120 trials per session.
 - ▶ In contrast, approaches for phonological disorders average 10-30 trials per session (Murray, McCabe & Ballard, 2014).
 - ▶ Distributing practice over a longer period facilitates both immediate performance and retention. (Maas et al., 2008).
 - ▶ Current recommendations range from one article saying twice weekly is sufficient to others recommending 3-5 times a week of INDIVIDUAL therapy

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Mass vs Distributed Practice

- | | |
|---|---|
| <p>Mass Practice</p> <ul style="list-style-type: none"> ▪ Minimal time between trials or sessions ▪ Facilitates acquisition ▪ May refer to a large number of repetitions of a single target | <p>Distributed Practice</p> <ul style="list-style-type: none"> ▪ Greater time between trials or sessions ▪ Important for stabilization and generalization ▪ Fewer repetitions |
|---|---|

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Constant vs Variable Practice

- | | |
|---|--|
| <p>Constant</p> <ul style="list-style-type: none"> ▪ Working on one exemplar of target ▪ Facilitates Acquisition | <p>Variable</p> <ul style="list-style-type: none"> ▪ Practice incorporates variations of the target ▪ Facilitates motor memory and transfer of skills |
|---|--|

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Blocked vs Random Practice

<p>Blocked</p> <p>Presentation of stimuli are chosen and practiced in a predictable manner throughout the session</p>	<p>Random</p> <p>Order of the presentation of the stimuli are randomly mixed up throughout the session</p>
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Cues and feedback

Feedback
(Sullivan, Kantak, & Burtner, 2008)
(Maas et. al. 2008)

Preliminary studies show children need more feedback for a longer amount of time

<p>*Knowledge of Performance</p> <p>*Knowledge of Results</p> <p>*avoid the "good job" *be mindful of fading</p>	<p>Visual</p> <p>Auditory</p> <p>Tactile</p> <p>*fade cues as quickly as possible</p>
--	---

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Feedback

- ▶ Knowledge of Results
 - Information provided after completion of the target that compares outcome to target
- ▶ Knowledge of Performance
 - Relates to the nature or quality of the movement gesture specific to what the child did (close your lips, round your lips etc.)

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Target selection

What kinds of words?

- ▶ Functional Functional Functional!!!
- ▶ Targets should incorporate all the sounds in the child's repertoire attempting varying syllable shapes and word positions.
- ▶ Should try to incorporate different communicative functions: commenting, requesting, rejecting, greetings etc.

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School Implications for retention/transfer of speech skills

- ▶ Children may meet their goals and targets in the therapy setting, but true motor learning has not occurred until they can demonstrate in numerous settings and situations in their spontaneous speech.
- ▶ True motor learning of the target occurs when the child demonstrates retention and transfer.
- ▶ Staff in the school are some of the best facilitators for this.

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Cueing

- ▶ Cueing is essential in the treatment for CAS as it provides a way to help the brain plan and program the movements for speech.
- ▶ Various types of cueing including: verbal, visual, tactile, etc.

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Verbal Cue Examples

- ▶ /M/ humming sound
- ▶ /D/ drumming sound
- ▶ /P/ popping sound
- ▶ /S/ hissing sound
- ▶ /H/ breathy sound

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Example of visual cues

- ▶ Watching clinician's face
- ▶ Finger cues
- ▶ Picture cues (Bjorem, Lindamood-Bell and others)



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Example of visual finger cues



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A note on cueing

- ▶ Though cues are essential for helping the child with the planning and programming component, for true motor learning or retention to occur, cues need to be faded.



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Distributed practice

- ▶ For carryover to occur, distributed practice is essential.
- ▶ Within a session, *mass practice* can refer to a large number of repetitions of a single target. *Distributed practice* is fewer repetitions spread throughout the session.
- ▶ Outside the session, distributed practice can mean the practice trials a child gets throughout their day. *School staff can be some of the BEST facilitators for this!*

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School staff can be among some of the BEST facilitators for distributed practice and can play a critical role in retention and carryover (true motor learning).

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Important though that school staff cue correctly and follow through with fidelity the plan set forth by the SLP. This may include some staff training on cues that work for the particular student's individualized needs

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Ideas for school carryover

- ▶ Utilizing school staff (lunch ladies, paras, office staff, recess supervisors)
- ▶ Provide visual reminders of target words in strategic areas around the school
- ▶ Teacher *code* word or gesture as a reminder to self correct a speech target

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School Implications

- ▶ On demand speech more difficult than spontaneous
- ▶ Testing
- ▶ Behavioral Implications
- ▶ Effect on grammar/syntax
- ▶ Comorbidities
- ▶ Prosody
- ▶ Social Implications
- ▶ Anxiety
- ▶ Residual errors

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Invisible symptoms

- ▶ On demand speech is more difficult than spontaneous speech
 - ▶ Children with CAS may be able to say something when it's spontaneous in a low-pressure situation but may "freeze" when put on the spot.
 - ▶ Requiring eye contact can significantly increase anxiety further exacerbating the situation

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Invisible symptoms

- ▶ School implications
 - ▶ Child may demonstrate expressive knowledge inconsistently as a result of CAS
 - ▶ May say "no" when they mean "yes" or vice versa
 - ▶ May say "no" as an avoidance tactic to not have to elaborate
 - ▶ May experience word finding related issues either do to CAS or a co-morbid language disorder

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Coping mechanisms

- ▶ May say the wrong answer to buy time
- ▶ May say a more easily accessible word to allow for processing time
- ▶ May come up with a phrase to "buy time" ie "can I tell you something?" or "what did you say?"
- ▶ Can exhibit "secondary characteristics" in an attempt to get the word out.

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Testing kids with CAS

- ▶ During naming tasks (numbers, colors, letters), may mislabel expressively despite knowing the answer receptively
- ▶ 1:1 testing
- ▶ May consider low and high tech AAC
- ▶ Extended time
- ▶ Want to look for ways to receptively test the child wherever and whenever possible
 - ▶ DIBELS says in the manual not for kids with apraxia
 - ▶ iReady was a good assessment that relied on receptive measures

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Behaviors

- ▶ Behaviors like hitting or biting may be the result of difficulties with on demand speech. May not be able to say the words “stop” or “no” in the moment and use behaviors as a way to communicate.
- ▶ Children with CAS may be mistaken as being defiant or purposefully disobedient for not answering a question or following through with a direction

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Effect on grammar/syntax

- ▶ Grammar and syntax errors may be particularly stubborn to remediate with CAS in the history and can negatively affect reading and writing.
- ▶ When reading, particularly with a co-morbidity of dyslexia, the child with CAS may get “stuck” in a motor plan when reading out loud, reading the wrong word aloud despite knowing the word.
 - ▶ Strategies to help include offering the child a drink or a break and then coming back and trying again

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Comorbidities

- ▶ Developmental Coordination Disorder (limb apraxia)
 - ▶ Can affect writing, running, cycling, throwing, and catching a ball.

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Social implications

- ▶ Children and adolescents with a history of CAS are at an increased risk for social problems and hyperactivity
- ▶ Consider services to address social/pragmatic/prosody skills and possible mental health services if needed
- ▶ May need more scaffolded support to make friends or work with others in a group.
- ▶ Physical implications, could have difficulty with PE

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Anxiety

- ▶ Have notes that may help in high anxiety situations
- ▶ Service dogs
- ▶ Santa Clause encounter
- ▶ Teach self advocacy
- ▶ Consider medication
- ▶ Sensory items

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Residual Errors

- ▶ Children with CAS may never full resolve the speech difficulties and traditional residual errors such as /r/ may continue to be difficult into adulthood
- ▶ In individuals with ASD, residual errors with prosody are common
- ▶ Some individuals with CAS in the history report difficulty later learning new multi-syllabic vocabulary words in science and/or social studies or may have difficulty with a foreign language.

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Questions?

- ▶ Find me on social media under the handle SLP Mommy of Apraxia
- ▶ Email me at lauraslpmommy@gmail.com

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