

Childhood Apraxia of Speech and Related Therapies

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Childhood apraxia of speech (CAS) is a motor planning speech disorder that directly affects a child's ability to produce speech sounds and words (ASHA, 2007). Since it is a motor planning disorder, it is not the muscles affected by the disorder, but rather the message that the brain sends to the muscles. The breakdown between the brain and the muscles creates impaired movements. Apraxia has direct impacts on the child's speech, which can also affect the child's language development (American Speech-Language-Hearing Association [ASHA], 2007). However, different types of intervention can improve CAS. This paper aims to outline the effects of each approach to therapy and make a recommendation for integrated therapy.

About 1 to 2 in every 1,000 children have CAS (ASHA, 2007). The disorder can be detected during the prelinguistic stage of language development. If the child is not babbling in the usual patterned form (CVCV), then this could indicate a deficit in oral motor skills. Once the child is able to speak, there are common characteristics that can be generalized across all patients with CAS. These include inconsistent sound errors, difficulty with coarticulation, and dysprosody, or disordered prosody. An example of inconsistent sound errors would be when a child produces the /t/ phoneme, but when it is in the initial word position, the child exhibits prevocalic voicing. Another aspect of inconsistency would be if a child is able to produce a phoneme in unstructured speech, but is not able to produce it in a repeated word. In addition, syllables can be unnaturally extended due to the interrupted motor planning of CAS (Case & Grigos, 2016).

These deficits in speech production can secondarily affect the child's language abilities. Speech delays directly correlate with language delays. Children with CAS struggle most with expressive morphology and phonological awareness (ASHA, 2007). Related to language, CAS can also affect a child's literacy, especially if there is a familial history of speech and language delays, as well as previously exhibited CAS.

Speech language pathologists can use direct and indirect therapies as well as compensatory strategies to treat children with CAS (ASHA, 2007). Direct therapies include approaches that incorporate activities during therapy that are actively working on speech and language, indirect therapies include treatments that train the brain to help speech such as biofeedback, and compensatory strategies are a way for clients to work around problems instead of trying to fix them. All of these approaches can have a positive impact on a child with CAS's speech and/or language.

Intervention for Speech

Effects on Speech Sounds

Because CAS greatly affects speech sounds, it is important for intervention to be able to primarily treat a client's speech sound production deficiencies. One of the most common approaches to speech sound therapy for children with CAS is Rapid Syllable Transitions (ReST). Murray et al. (2015) conducted a study that analyzed 26 children ages 4-12 with mild to severe CAS. The participants received ReST treatment for four days a week for 3 weeks, and there was a significant change in the participant's speech abilities. It can be difficult for some children to have access to intervention, but ReST does not always have to be performed face-to-face. Five participants participated in ReST intervention that was administered through Telehealth video conferencing in a 3-week study (Thomas et al., 2016). The participants had similar improvements to those who received the treatment in a traditional setting. Further research is needed to make definitive conclusions, but the participants' improvement indicates a future in video-conferenced intervention.

However, CAS can be so severe that the child is not able to produce any intelligible sounds. These clients are the ones that would benefit most from augmentative and alternative communication (AAC), but AAC can be beneficial for any client with CAS. Oommen and McCarthy (2015) created an intervention that integrated natural speech with AAC. The natural speech encouraged natural speech of the child, while the AAC provided a crutch for when the

child could not articulate their thought with their words. AAC includes a technological aspect, but it also includes enhancing gestures, facial expressions, and other nonverbal means of communication. Both low tech and high tech AAC communication boards increased the participants' intelligible speech (Oommen & McCarthy, 2015). While some clients with CAS may not need to depend on AAC, it is suggested that it be incorporated in intervention at any severity level.

Ultrasound biofeedback is a therapy approach that has been explored as a tactic in intervention for children with CAS in which children can watch the movement that their mouths make on a live-feed ultrasound as a visual guide. After intervention that involves the client being asked to perform different movements with their tongues, the children improve their word-level speech sounds (Preston et al., 2013). This is due to the increased proprioception that ultrasound feedback provides. In addition, it can also be used to target specific speech sounds that the client struggles with (Preston et al., 2016). The child can watch how the sound is supposed to be produced, and then mirror it themselves. This practice encourages the brain to consciously rewire itself, which helps improve motor-planning disorders such as CAS.

Another technological intervention tool for CAS is Tabby Talks. Tabby Talks is an automated system that can listen to a child's speech and recognize errors (Shahin et al., 2015). This tool is primarily used for assessment, but can be used in intervention sessions as well. Tabby Talks can recognize errors down to the phoneme level and record what speech production deficits the child exhibits the most. The data is sent to the clinician who can use it to adjust the child's intervention accordingly. Though this may not be entirely focused on intervention, it can be implemented as another way children can become more consciously aware of their speech errors.

Effects on Prosody

Another hallmark symptom of CAS is inappropriate prosody, or dysprosody, which impacts the meaning and intonation of words. Compared to normally developing children,

children with CAS take almost twice as long to learn and use a new word with the correct lexical stress and vowel duration (Case & Grigos, 2016). To combat this deficit, clinicians can create a treatment plan that focuses on making motor planning less effortful. Just as ReST improved speech sounds, it can also improve dysprosody (McCabe et al., 2014). Participants attended treatment for the recommended four times a week and were able to improve their lexical stress. The fast-paced and high-frequency nature of ReST helps the client speed up their motor planning and improve his/her prosody.

Some treatments are made specifically for dysprosody according to the principles of motor learning, which encourages frequent, high repetition activities to elicit as many responses as possible. These elements can help clients control their syllable duration and the pitch of their voices (Ballard et al., 2010). The clients are stimulated in a random manner to create a more organic speaking environment. This approach could be compared to ReST because they both focus on high-frequency repetition.

The Tabby Talks system can also be used for prosody. An interface in the device is able to detect the length of syllables (Shahin et al., 2015). When the child speaks and the vowel duration is not normative, the system can record how often and how long the child inappropriately stresses his/her vowels. The dysprosody data is also sent directly to the clinician, who will be able to look for patterns in the child's lexical stress to work on in therapy. The specificity of this form of data keeping can help clinicians indicate target phonemes that the client struggles most with.

Intervention for Language

Effects on Phonological Awareness

Children with CAS have lower phonological awareness than normally developing children (McNeill et al., 2009). CAS is not a language disorder, but a deficit in speech can manifest and create a language deficit. Intervention for phonological awareness does not look like intervention for speech sound production. Auditory bombardment has not been proven

useful for phonological awareness, so phonological awareness intervention has a focus on manipulating the subunits of speech into syllables, words, and sentences (Moriarty & Gillon, 2006). Sample activities for phonological awareness intervention could include identifying isolated phonemes, identifying initial and final phonemes, phoneme segmentation and blending, and phoneme manipulation (Moriarty & Gillon, 2006). The intention of working with phonological awareness is to connect the graphemes with sounds, which encourages speech production.

Not only can speech-generated devices help a child with CAS communicate, but it can also improve their language. In a case study done in the United Kingdom, a boy with severe CAS used a speech-generated device, and after weeks of intervention, it improved his linguistic development (Lüké, 2016). Phonological awareness is an important aspect of language. Because he learned how to use the device, he was able to connect the symbols to sounds. This approach has the same goal for any intervention for phonological awareness.

Effects on Literacy

Phonological awareness directly correlates to literacy. When the phonemes are linked to graphemes, then the child can learn to read. Integrated Phonological Awareness Intervention can be used not just for phonological awareness, but literacy as well. This intervention can improve all aspects of literacy except for real-word decoding (McNeill et al., 2010). The authors of the study hypothesized that the reason real-word decoding did not strengthen during therapy is because the assessment had many words that are difficult to sound out, and therefore, the child had a difficult time learning them (McNeill et al., 2010).

However, phonological awareness intervention is not the only therapy a child with CAS needs for literacy. In a single-case study of a girl with CAS, she received a multitude of therapies over a period of 5 years. She participated in sessions that focused on sound production, phonological awareness, speech-print connections, and word decoding (Zaretsky et al., 2010). She achieved adequate literacy skills as a result of the combination of therapies.

Integrated phonological awareness could help, but alone, it would not work to improve all aspects of literacy.

Intervention Efficacy

Intervention Schedule

Having the appropriate activities creates a successful intervention plan, but the order in which these activities are performed is also important. Each time you see a client, you have the option to keep a set schedule or create a new schedule every session. It may seem trivial but having a set schedule can be beneficial for children with CAS (Maas & Farinella, 2012). The motor memory of knowing what comes next in therapy can help create connections in the brain to allow it to acquire the new skills being taught.

However, the intervention schedule does not need to be rigidly set. Jones and Kroot (2016) studied the effects of a randomized, set, and set-randomized schedule on unimpaired speakers' ability to learn tongue twisters. Compared to randomized schedules, both set schedules and schedules that were set for half of the sessions and then random for the second half were superior (Jones & Kroot, 2016). These results indicate that, as long as the intervention begins with a set schedule, there is a possibility that it could be randomized in the future and still have the same outcomes.

Maintenance

A systematic review of CAS treatments was done at the University of Wales, Sydney, to look objectively at the outcomes of each approach (Murray et al., 2014). They were able to narrow down the three best approaches to therapy, although more than half of the approaches elicited the same results. The authors discussed that the best way to differentiate the different approaches was by analyzing the generalization and maintenance as opposed to the initial results (Murray et al., 2014). A clinician choosing a therapy plan should consider the maintenance of the approach as the goal of therapy is to have lifelong improvements.

When compared to a similar motor planning speech treatment, researchers observed ReST not only improved the participants' syllable production, but the results also lasted longer than the other approach (Murray et al., 2015). In another study analyzing ReST, Thomas et al., 2014 used frequency as the independent variable. The usual ReST program lasts for 24 sessions, 4 sessions for 6 weeks, but the four children in this study only went twice a week. The participants had the same amount of gains as the norm data; however, they were not able to retain the skill as long as those who attend therapy four times a week (Thomas et al., 2014). The more the child attends therapy, the longer the results will be maintained.

Limitations

Childhood apraxia of speech is not a topic that is heavily researched in the field of speech language pathology. The limited amount of research made it difficult to find information that was also relevant and useful. Many of the studies contained less than six participants, and there were many case studies. Although the information could be useful for future researchers, it hindered the development of this paper. Because the results relied on only a few people, generalization to a larger population is guarded.

Not only was the research limited, but there was limited access to the research, too. The time constraint only allowed for a few days' worth of research. Also, the databases that University students are allowed to access do not include all of the research available. Journals that were useful would appear in the results list, but they were only available on library loan or at a different university. Having more time and resources would have allowed for a more thorough review.

Clinical Implications

Recommendations

Therapy. Treating CAS can be done in a variety of ways. Because it affects so many aspects of speech and language, there are different types of therapy to target each of them. However, certain therapies are superior to others. To achieve the best results, the intervention

plan should be considered in sections. CAS has more than one symptom, so there should be more than one type of intervention.

For the speech symptoms of a child with CAS, it is recommended to use Rapid Syllable Transitions (ReST) because of its benefits in both speech sound production and prosody, as well as its long-term maintenance. For the language component of CAS, it is recommended to use Integrated Phonological Awareness Intervention because of its success helping children with phonological awareness and literacy, but other supplemental therapies focusing on literacy should be added. Therapy should have a set schedule at first, but can be eventually randomized.

Additional Strategies. Not all children with CAS will respond to intervention the same. Some may respond less than their peers with CAS, and some will not respond to therapy at all. In these cases, there are other strategies that can be used during therapy that will facilitate therapy (DeThorne et al., 2009).

Provide other means of communication. This could include AAC or something as simple as a list of words or pictures that the child can refer back to when they are struggling with communicating.

Remove the stress from the child. When the child feels like there is pressure on them to elicit the correct speech sounds, it could frustrate them even more, causing more errors.

Imitate the child. Imitating the child will give him/her an idea of what the listener is hearing when they produce an utterance, and it also works as a model. If the clinician imitates the child, then the child may learn to imitate the clinician.

Use exaggerated intonation. When the child can link a certain melody to a phrase, they will be able to learn it easier (Beathard & Krout, 2008). Give certain key phrases a specific intonation that will help the child be able to produce those words.

Use other senses. Visual and tactile cues can help the child because the cues activate different parts of the brain. Tap out words on the child's hand or over-enunciate words.

Be intentional with oro-motor activities. If oro-motor activities are used in therapy, use ones that also co-occur in speech production. Activities such as sticking the tongue out as far as it can go is impractical as there is no sound in the American English language that requires that movement.

Conclusion

An integrated approach to therapy is recommended for children with childhood apraxia of speech. Creating a program with different goals will provide children with CAS therapy for their different symptoms. CAS affects both speech and language, so it is necessary to make an intervention plan that treats both of these deficits. The symptoms of CAS are specific to each individual, and their therapy should be as well.

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