The use of biofeedback in speech therapy for individuals with Down syndrome: a comparison of ultrasound and electropalatography

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Many individuals with Down syndrome (DS) have trouble with articulation of speech, which often causes difficulties with their intelligibility. The speech errors of individuals with DS are often difficult to treat with conventional speech therapy interventions, demonstrating the need to establish successful interventions for treating this population. Ultrasound and electropalatography (EPG) are two methods of biofeedback, that provide visual feedback information about the articulation of speech as it is occurring. Individuals with DS hold a relative strength in the area of visual learning, making biofeedback treatment methods a great option. This paper reviews and compares ultrasound technology and EPG and examines studies investigating the success of these methods on the speech production and intelligibility of individuals with DS. It argues that while both types of technology offer promising results for the treatment of this population, ultrasound should be the preferred technology because of its versatility, non-invasive nature, and relative cost effectiveness.

Key words: Down syndrome, biofeedback, ultrasound, electropalatography, pronunciation

Introduction

Speech errors in individuals with DS are often viewed as difficult to improve in therapy, as they can be resistant to the standard interventions used by SLPs (Wood, Wishart, Hardcastle, & Cleland, 2019), which demonstrates the need to explore new and different intervention options. Individuals with DS are visual learners, which makes members of this population great candidates for biofeedback.

This paper reviews the existing literature on ultrasound and electropalatography and reports on studies that have used the technologies with individuals with DS, comparing the strengths and weaknesses of the two technologies in pronunciation training with this specific population. The technologies are looked at in terms of effectiveness, versatility, invasiveness, cost, as well as other categories relevant to therapy settings. It is hypothesized that while electropalatography provides feedback at a higher level of detail, ultrasound strikes a balance of giving useful feedback while being relatively un-invasive and should be the preferred technology to be used in speech therapy with individuals with DS. The findings of this paper will inform clinicians about the most effective method to help individuals with DS with their speech production in order to improve their intelligibility in their everyday lives.

Ultrasound

When using ultrasound, a transducer is placed just below the chin and above the larynx (Bernhardt, Gick, Bacsfalvi, & Adler-Bock, 2005). The transducer sends out ultra-high frequency sound waves, which are reflected back towards the transducer when they hit the air in the oral cavity

could combine each movement they practised producing the full /ɹ/ vocalization in isolation. The last step was the production of /ɹ/ within words in varying positions.

All three participants made significant improvements in their /ɹ/ production over the course of the study. Prior to therapy, participants had minimal or no /ɹ/ production within words. After receiving ultrasound therapy, two participants had 100% accuracy for /

assessments interventions for speech disorders with a range of different populations. It is particularly useful for speech errors that involve lingual consonants, especially when the difficulties are motor based as in DS (Wood et al., 2019). A target articulation is shown on one side of the screen which an individual attempts to copy and learn from, and their own articulation is shown on the other side (Wood et al., 2009).

Wood et al.'s (2019) study aimed to evaluate the effectiveness of EPG therapy in improving the speech production of school aged children with DS. They compared the use of EPG to EPG informed therapy, as well as usual methods of speech therapy for children with DS. The researchers hypothesized that EPG-based therapy would see the greatest improvement because of the visual learning strength of people with DS. Participants were 27 children with DS aged 8–18 who completed 24 one-hour therapy sessions over a period of 12 weeks. Therapy targeted lingual speech errors that were considered the most disruptive to each participant's intelligibility. EPG therapy began with a target phoneme in a consonant-vowel or vowel-consonant construction, and then moved to phrase and sentence levels as the participant improved. When the participant had mastered the articulation and generalized it in different contexts, visual feedback was gradually reduced. EPG informed therapy consisted of techniques focusing on expressive and comprehensive language, informed by an initial EPG assessment

contacts the palate, meaning that it cannot be used for many articulations. Ultrasound is more cost-effective, as there are no individual customizations required, more flexible, as treatment can begin immediately and be stopped with little money wasted if the client does not like the technology or it is not working, and it is significantly less invasive than EPG, as there is nothing being placed inside the mouth. It is also more interactive, as the probe can be passed back and forth between the SLP and client, as they work together to improve on a target speech sound, capitalizing on the social strength in DS.

Conclusion

Ultrasound and EPG are both visual biofeedback tools that the literature shows have been successful in helping children and young adults with DS improve their speech production. Ultrasound should be the preferred technology because of its versatility, non-invasive nature, and relative cost-effectiveness. Further research should be done directly comparing the effectiveness of ultrasound and EPG, with the same stimuli, teaching methods, and participant groups, in order to confirm the preliminary findings of this paper. More research has been done on EPG with this particular population, but because of the strengths of ultrasound, future research should be done on the effectiveness of ultrasound on individuals with DS. Research should be done with larger sample sizes and control groups, as well as on individuals with DS of a variety of different age groups in order to determine when in development this tool is most successful. Longitudinal studies should also be done to investigate how the learning from ultrasound fares over time: does production of the target sounds improve, stay the same, or decline over time? The findings of this paper demonstrate the promising progress of research and speech therapy for children and young adults with DS.

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