Developmental stuttering: a speech-motor impairment with sensory aspects

BY MAX GATTIE

In treating patients who stutter, understanding the effects of sensory input (i.e. auditory input) can help to direct therapeutic approaches.

Sensory processing has been identified as a contributory factor in several diagnoses, notably autism and ADHD [1], however it has not standardly been considered a factor in developmental stuttering. This might be surprising. Auditory prosthetics designed to reduce the amount of stuttering have been available for many years, suggesting that at least some aspects of stuttering are due to speech perception rather than speech production. Despite this, auditory prosthetics are not standardly used in stuttering therapy, and stuttering research has a primary focus on speech production.

The apparent oversight of stuttering's sensory aspects could be due to its status as a classic speech-motor control disorder. Stuttered speech is characterised by involuntary prolongations to syllables, or repetitions of syllables. Sometimes prolongations are silent, because the associated muscular tension has prevented airflow. These are referred to as blocks. They might happen, for example, due to closure between the tongue and velum or alveolar ridge, or within the larynx. The reader can emulate a stuttered block by attempting to say the word 'bang' whilst holding the lips together.

The muscular spasms that occur during blocks are a hallmark of stuttering. Experience of blocks can be highly unpleasant, especially when they occur unexpectedly and involuntarily. As a result, many who stutter create workarounds, which usually appear soon after the onset of their stuttering. Developmental stuttering has a typical onset around three to five years old, shortly after speech is formulated into phrases or sentences. The workarounds

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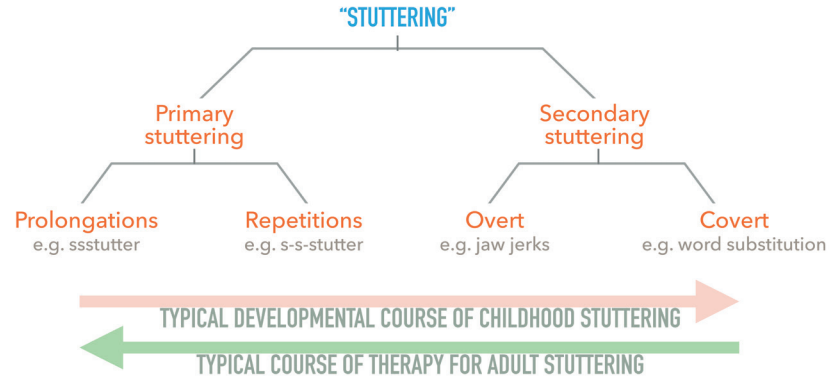

Figure 1: Some different types of stuttering. Developmental stuttering usually starts as simple prolongations and repetitions. Attempts by the speaker to modify the behaviour can often lead to secondary stuttering, which frequently becomes intractable.

that children who stutter develop, referred to as secondary stuttering, can be overt or covert. Some examples of overt secondary stuttering include additional muscular effort in an attempt to complete an utterance, and timing behaviours such as foot tapping or hand movements. Some examples of covert secondary stuttering include substituting a word that is being stuttered for a different word and avoiding a speaking situation altogether when stuttering is anticipated.

Although such strategies can at first resolve some of the difficulties associated with stuttering, secondary stuttering will often become far more troublesome than primary stuttering ever was. As a result, much childhood therapy is designed to prevent secondary stuttering from developing, whereas adult therapy is designed so that secondary stuttering that has become ingrained can be unlearned. The approach used is often a combination of psychological therapy and speech work. Such therapies can greatly reduce or even eliminate secondary stuttering, leaving just the prolongations and repetitions of primary stuttering. If desired, primary stuttering itself can then be reduced. The strategy for doing so typically involves a consistent choice of prolongations over repetitions whenever stuttering occurs or is anticipated. With practice, prolongations can be whittled down by reducing tension, such that they become unnoticeable to speaker and listener. Progression of and therapy strategies for developmental stuttering are summarised in Figure 1.

So, what should we think of auditory prosthetics capable of reducing the amount of stuttering? Such devices do not fit straightforwardly with the explanation of stuttering just outlined and, moreover, do not seem as if they would even be necessary if stuttering has an effective therapy that does not require prosthetics. There are at least three points to make in response. Firstly, there is no guarantee that speech therapy for stuttering will reduce the amount of stuttering, with the therapy often being highly taxing on both the therapist and the client. Secondly, when auditory prosthetics are the only component of stuttering therapy, effects can be short-lived and may not manifest at all for some. Lastly, the mechanism through which auditory prosthetics gain effectiveness is not well understood.

To make sense of this, we might for a moment set aside secondary stuttering as a learned behaviour that can be modified using psychological therapies. This leaves primary stuttering – i.e. the prolonged or repeated syllables – as the remaining therapy target. Speech therapy modifying production has already been described, consisting of a deliberate choice of

prolongations which can then be shortened. There are also therapies designed to alter brain function. All of these are experimental at present, comprising neurological therapies such as transcranial direct current stimulation and drug therapies altering neurotransmitter function. It is notable that although the experimental therapies were intended for areas of the brain thought to be important for speech production, such brain areas can also be important for speech perception [2]. Having described therapies for conscious alteration of articulatory technique and for brain function, the final possible therapy type for primary stuttering is sensory feedback.

Almost any alteration to audition during vocalisation can have the effect of reducing stuttering. One of the earliest to be established was choral speech, in which a second speaker reads the same passage of text as the person who stutters. In the 1950s, delay to auditory feedback was found to have a similar effect. By the late 1970s, a commercial prosthetic, the Edinburgh Masker, with a laryngeal microphone and white noise masking over headphones, enabled people who stutter to benefit from the effect of altered auditory feedback in public settings. Walkman-style devices followed in the 1980s, using delayed auditory feedback. By the late 1980s, frequency shifted feedback had also been found to reduce the amount of stuttering. This would lead to a hearing-aid style device which combined a delay and a frequency shift. The device received heavy promotion in the early 2000s, including an appearance on *The Oprah Winfrey Show*. Similar functionality is now available using apps on iOS or Android with wireless earphones.

A common feature in all of these devices is the exclusive use of air conduction. However, own voice is heard through an approximately even mixture of air and body conduction, including a vestibular component [3], and these afferent streams are combined with somatosensory feedback and modified by corticofugal motor activity. My own research has established that vestibular function is atypical in people who stutter [4] and similar results have been found using vibrotactile stimulation. This sets the scene for continued investigation of multisensory feedback during vocalisation in those who stutter, with experimental possibilities increased by the availability of a mouse model engineered to contain homologues of human stuttering mutations [5]. Stuttering may be a condition in which alterations to sensory integration help us to understand speech-motor function.

References

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AUTHOR

Max Gattie, BSc, MRes, MA,

Postdoctoral Research, Northwestern University, Chicago, USA / University of Manchester, UK.

Declaration of competing interest: None declared.