The impact of stimulated vocal loudness on nasalance in dysarthria

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by Monica A. McHenry, Julie M. Liss

This study was designed to determine the effect of stimulated vocal loudness on nasalance in individuals with various dysarthria subtypes. Thirty participants produced three stimulated levels of vocal loudness while reading a nonnasal passage. Data included dysarthria classification, vocal sound pressure level, nasalance, and listener perception of nasality. There was not a predictable relationship between a change in vocal sound pressure level (SPL) and a change in nasalance, nor did these changes result in consistent perceptual results. There were, however, dysarthria-specific effects of stimulated vocal loudness on nasality. Further, the study highlighted the importance of corroborating objective data with perceptual findings.

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A key component of dysarthria management is the behavioral manipulation of variables that may improve intelligibility. Because patients may have difficulty remembering and carrying out multiple cues to improve intelligibility (Yorkston, Beukelman, Strand, & Bell, 1999), it is ideal to find one feature that will dramatically impact all physiological systems. An example of this approach is the use of loud speech by individuals with hypokinetic dysarthria (Ramig, Countryman, Hoehn, & Thompson, 1996; Ramig, Sapir, Fox, & Countryman, 2001). Increasing vocal loudness has been shown to impact both segmental and suprasegmental aspects of speech production, as well as intelligibility, in some speakers with dysarthria (Ramig et al., 1996; Ramig et al., 2001). However, it remains to be determined whether such strategies differentially affect the various physiological subsystems of speech production.
This question is of certain clinical import because occasionally specific problems may account for a large proportion of the intelligibility deficit in a given speaker (Duffy, 1995; McHenry & Wilson, 1994).

Hypernasality is common in various types of dysarthria, secondary to weakness and/or incoordination of the muscles responsible for velopharyngeal port modulation. Behavioral treatments for improving hypernasality have been shown to produce small or modest improvements, while more dramatic improvements can be obtained through surgical or prosthetic management (Duffy, 1995; Karnell, Hansen, Hardy, Lavelle, & Markt, 2004; Yorkston et al., 1999). Unfortunately, invasive procedures are appropriate in only a small proportion of patients; therefore, behavioral intervention is often the only option (Duffy, 1995; Kuehn et al., 2002).

An earlier study (McHenry, 1997) revealed that a stimulated increase in vocal loudness (e.g., verbally encouraging the production of louder-than-normal speech) resulted in reduced velopharyngeal orifice area in many individuals with motor speech disorders. In that work, 89% of 28 participants with traumatic brain injury decreased velopharyngeal orifice area when increased vocal loudness was stimulated. This finding has intuitive appeal with regard to dysarthria, wherein underlying muscular weakness contributes to inadequate velopharyngeal function. However, there were limitations to the earlier study that prevented a generalized interpretation of the results. First, participants were not classified according to dysarthria type. Because the hypernasality occurs in the setting of other dysarthria-specific speech symptoms, it is likely that increased vocal loudness is not uniformly beneficial across all dysarthria subtypes. Second, data in the original study did not include vocal sound pressure level, thus the precise relationship between loudness and velopharyngeal orifice area could not be determined. Although increasing vocal loudness is believed to be an essential feature for obtaining generalized physiologic changes that improve speech production, there is likely a nonlinear relationship between loudness level and speech production measures. Finally, while there is a good relationship between nasalance scores and perceptual judgments of nasality in both individuals with cleft palate (Hardin, Van Demark, Morris, & Payne, 1992) and those with neurogenic etiologies (McHenry, 1999), the relationship between perception of nasality and velopharyngeal orifice area is less clear (McHenry, 1999; Thompson & Murdoch, 1995).

This study was designed to determine the effect of varying vocal loudness on nasalance. Based on the previous investigation, it was predicted that, in general, increased vocal loudness would be associated with lower nasalance values, and the perceptual impression of less hypernasality, as compared with the normal loudness condition. However, it was anticipated that dysarthria-specific patterns might emerge, in which speaking softer than normal would result in lower nasalance values, and the perceptual impression of less hypernasality than in the normal or increased loudness conditions. If found, these results would highlight the need for judicious application of vocal loudness interventions and hint at their contraindications for the treatment of hypernasality in certain clinical scenarios.