

Public Abstract

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Title:A Multiple Subsystem Approach to Predicting Speech Intelligibility Decline in Older Adults

Introduction: Given the significant impact of progressive dysarthrias on individuals' communication abilities and the increasing prevalence of progressive dysarthrias in the United States, it is becoming imperative to develop prediction models of speech intelligibility decline. As a first step, the present study focused on healthy older adults and specifically, on determining age-related effects on the respiratory, phonatory, and articulatory subsystems and their impact on speech intelligibility. For this purpose, we used a multiple subsystem approach similar to that used in the extant literature on cerebral palsy (Lee, Hustad, & Weismer, 2013) and amyotrophic lateral sclerosis (ALS; Rong et al., 2016). The aims of the present study were to (1) determine age-related changes to the respiratory, phonatory, and articulatory subsystems and (2) investigate whether speech intelligibility decline is observed in healthy older adults and if so, to determine which variables from each subsystem are predictive of intelligibility decline.

Method: Fifteen healthy, older adults and fifteen younger adults participated in instrument-based assessments of the phonatory, respiratory, and articulatory subsystems. Respiratory, acoustic, aerodynamic, and kinematic measures were obtained during syllable, sentence, word, and nonspeech tasks. Speech intelligibility for each speaker was determined by naïve listeners during multi-talker babble. Contributions of selected subsystem variables on speech intelligibility were determined using a multiple linear regression analysis.

Results: Age-related differences were detected across phonatory and articulatory subsystem measures including maximum phonation time and cepstral peak prominence (phonatory subsystem) and spatiotemporal variability index and maximum speed of tongue movements (articulatory subsystem). Selected variables in the phonatory and articulatory subsystem were significant predictors of speech intelligibility in older adults including laryngeal airway resistance (39%), airflow during voicing (35%), maximum phonation time (9%; phonatory subsystem) and duration (10%) and maximum speed (5%) of tongue movements (articulatory subsystem). Collectively, 89% of speech intelligibility variance in older adults could be explained by the phonatory (74%) and articulatory (15%) subsystem models.

Discussion: Significant subsystem differences between older and younger adults were found indicating age-related speech decline. Measures representing phonatory and articulatory subsystems predicted speech intelligibility differences in older adults suggesting that age-related speech declines such as breathy voice quality and age-related articulatory slowing contributed to intelligibility decline. Subsystem measures were more sensitive to age-related speech differences in older adults than intelligibility, which is a finding consistent in ALS literature (Ball, Willis, Beukelman, & Pattee, 2001; Green et al., 2013).