

The effect of cognition and motor control on voice quality across the lifespan

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Previous research demonstrates that increasing chronological age can lead to distinct changes in the voice (Hejrná & Jespersen, 2021; Reubold et al., 2010). This includes changes in voice quality measures such as f_0 , shimmer, jitter and harmonic to noise ratio (HNR) (Deqan et al., 2012; Rojas et al., 2020). However, results show considerable variability, due to presumed social factors, methodological differences between studies (Spazzapan et al., 2024), and importantly biological factors. I hypothesise therefore that changes in biological functioning, such as cognitive and motor control differences, might lead to differing rates and patterns of change in the voice as people age.

Despite the current increased momentum of age-related research, few studies discuss age-related phonetic changes in combination with cognition and motor control. Given this, how does age interact with cognitive and motor control across the lifespan, in relation to voice quality?

For this study, 140 participants were recruited from Lancaster and Morecambe, North-West of England and were split into two age-groups: 1) 84 speakers aged 16-37 years ($M=18.51$, $SD=4.44$); and 2), 56 speakers aged 65-95 years ($M=74.52$, $SD=7.39$). Participants completed several representative cognitive and motor control tasks including a digit span, diadochokinetic (DDK), and trail making task (Chan & Elliott, 2011; Dawson, 2020; Lu & Bigler, 2002). Participants also completed an interview, questionnaire, and the reading passage 'The Boy Who Cried Wolf' from which measures of f_0 , shimmer, jitter and HNR were extracted from the vowels, producing 10,541 tokens for analysis.

Results indicate significant age-related changes in older females for f_0 . However measures of shimmer, jitter and HNR demonstrated very few age-related changes. For the cognitive/motor control data, we observe decreases in motor control with increased age, and a slight increase in cognitive control with increased age. However, results show considerable overlap between age groups. To reduce the dimensionality of the data, principal component analysis was used to compare the speech data to that of the cognitive/motor control data. Linear-mixed effect models were then fitted to look at the interactions between these results in order to understand the impact of cognition/motor control on voice quality across the lifespan more clearly. Significant effects were found for cognitive control on jitter, supporting observations that differences in executive functionality are associated with changes in speech production in adult speakers (Heaton et al., 2020). However, limited effects were found for all measures for motor control, despite evidence from previous studies to the contrary (Dawson, 2020). This could be due to differences in methodology or could further highlight ageing as an individual phenomenon. We further this analysis by considering health and social factors, such as education, exercise and smoking habits which could explain these results.

This study highlights the importance of continued ageing research in phonetic spaces to ensure we understand the multi-dimensional ageing process in relation to biological changes (Pichler, 2023).

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