

**A critical review of the effect of singing on intelligibility and other speech characteristics in adults with dysarthria**

dysarthric speech secondary to (18 years post-onset), across five speech tasks (spontaneous speech, repetition, reading, repeated singing and spontaneous singing). He was stage 2 on the Hoehn and Yahr (1976) rating scale. Speech impairment was one of his primary symptoms. The Assessment of Intelligibility of Dysarthric Speech was used to measure his intelligibility, and this revealed that he was 46% intelligible for single words, 68% intelligible for sentences and had a speaking rate of 137.5 words per minutes, resulting in an efficiency ratio of 0.49. The researchers obtained vocal production samples (ie. one researcher had a conversation with the participant regarding his early life, while the other researcher transcribed 30 consecutive utterances) from the participant for later comparison of intelligibility to the five different production tasks. These 30 utterances were transcribed legibly in large print on to three sheets of paper, each sheet containing 10 utterances, numbered 1-10. These were presented to the participant to elicit production in three other speech tasks: reading, repetition and repeated singing (the order of these tasks was counterbalanced for each sheet of utterances). In a separate session, several weeks after the first session, spontaneous singing was elicited. From the original 30 utterances (each elicited in four speech tasks) and an additional 8 utterances from the spontaneous singing condition, a set of 136 stimuli (semantically coherent phrases) was selected to make four listening tapes. Each tape included a different speech task version of each of the utterances. Sixty-four subjects listened to 4 practice items (with immediate feedback given) and 40 test items, and transcribed portions of each stimulus onto blank lines on an answer sheet.

To determine intelligibility of utterances in the five conditions, correctly transcribed words were counted. Singular/plural listening errors were counted as correct

the five speech tasks and the number of correct words on the four tapes. No difference in overall level of difficulty was revealed ( $F(3,156) < 1$ ), and therefore the data from the four tapes was combined for the subsequent analyses. Overall, listeners correctly transcribed 29% of the spontaneous speech, 78% of the reading utterances, 79% of the repeated speech, 80% of the repeated singing, and 88% of the spontaneously sung utterances. A within-subjects design, one-way Analysis of Variance (ANOVA) examining speech task with intelligibility was highly significant ( $F(4,155) = 33.62$ ,  $p = .0001$ ). Post hoc t-test comparisons revealed spontaneous speech was significantly different from each other task ( $p < .05$ ), and the other four tasks were not significantly different from one another. Four analyses explored the relationship between intelligibility and the acoustic characteristics of the stimuli: relative

intensity, word duration, dysfluency, and acoustic qualities as seen in spectrograms. For loudness, a significant effect of task was found ( $F(4,131) = 2.99$ ,  $p = .02$ ). Post hoc comparisons revealed that spontaneous singing was louder than the other tasks ( $p < .05$ ). Loudness was not correlated with intelligibility across all items ( $r = -.14$ ,  $p > .05$ ), or across items within any of the speech tasks individually, suggesting other variables were also affecting intelligibility. Word duration was not significant ( $F(3,124) = 2.58$ ;  $p = .057$ ), nor did it correlate with intelligibility ( $r = .035$ ,  $p = .66$ ). There was a significantly higher number (68%) of

the Sentence Intelligibility Test (SIT) and a Picture Description Task (PDT). In addition, speech naturalness was rated (by 15 speech pathologists and 15 non speech pathologists, using six naturalness categories), and waveform analysis was conducted.

The results for each outcome variable on the SIT and PDT were pooled together. ANOVAs with subject and stage of intervention as factors showed a statistically significant improvement of 6.75% in speech intelligibility on the PDT task between pre and post assessments and pre and mid assessments ( $P < 0.05 \sim 0.023$ ). Trends towards improvements were found for all other assessment measures, however, these results did not reach statistical significance. With regards to speech naturalness, 85% of the time, post-treatment sentences were rated more natural than pre-

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difficult to generalize the results to other adults with

### *Discussion*

Based on the studies gathered and reviewed above, it is evident that more evidence-based research is required on the topic of using singing to improve speech characteristics and intelligibility in adults with dysarthria. Of the four articles reviewed in this paper, all were found to have relatively weak levels of evidence, due to the