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Acoustics of Noise-Adapted & Clear Speech in Individuals with Elevated Depressive Symptoms

References

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Context

It is widely acknowledged that individuals with depression have deficits in communication (Segrin, 1998). A majority of people with dysarthria due to stroke and Parkinson's disease also experience depressive symptoms (Cummings, 1992; Dickson et al., 2008). Based on the hypo- and hyper-articulation (H&H) theory (Lindblom, 1990), talkers spontaneously and reliably enhance their speech production to facilitate speech perception for listeners, especially in challenging communication environments due to the presence of background noise (noise adapted speech, NAS) or a situation to talk to a listener with reduced comprehension (clear speech, CS). A previous research has revealed that people with high depressive (HD) symptoms benefited less from the CS modification compared to talkers with low depressive (LD) symptoms (Yi et al., in press). The current study will further examine acoustics of NAS and CS modification in individuals with elevated depressive symptoms. The findings will provide a better understanding of the nature of communicative deficits in individuals with depressive symptoms and have a potential of aiding speech therapy plan for maximizing intelligibility in talkers with speech sound disorders accompanied with depressive symptoms.

Objective

This project aims to understand how elevated depressive symptoms (non-clinically diagnosed) affect spoken language processing based on different acoustics of NAS and CS, and

provide a resource to establish valid assessment protocols and intervention plans for clinical populations who need speech production enhancement by using CS and NAS enhancement.

Design

Ten participants read 80 meaningful sentences in each of the three following conditions: 1) conversational speech (CO), 2) noise-adapted speech (NAS), and 3) clear speech (CS) (240 sentences in total). Each talker produced all of the sentences in CO first and then CS. Next, they were instructed to read the sentences with no particular speaking style but in the presence of 6-talker babble noise.

Participants

Ten participants were classified into individuals with high depressive (HD) symptoms and low depressive (LD) symptoms based on a self-report scale, Center for Epidemiological Studies Depression Scale (CES-D; Radloff, 1977). The CES-D is a short self-report scale designed to measure depressive symptoms for use with general and clinical populations in order to identify elevated depressive symptoms with high internal consistency (Radloff, 1977). When the participants scored 16 or greater on CES-D, they have a higher likelihood of having major depressive disorder, but they are not medically diagnosed as clinically depressed. Participants were classified as having LD symptoms if they scored 15 or lower on CES-D. We have five individuals with HD symptoms and 5 individuals with LD symptoms. These participants were monolingual speakers of English.

Outcome measures

We examined acoustic-articulatory modifications that CO, NAS, and CS styles produced by 5 talkers with HD symptoms and 5 talkers with LD symptoms. Acoustic parameters include speech rate (syllables per second), mean F0 (Hz), F0 range (Hz), and energy in the 1–3 kHz range (dB).

Results

For each of the four acoustic outcomes were submitted to linear mixed effects regression models. Fixed effects included depressive symptoms (HD vs. LD), speaking style (CO, NAS, & CS) and an interaction between depressive symptoms and speech style. Talkers and sentences were included as random intercepts. Wald test was applied to examine the overall effect of main factors and the interaction.

There are a significant main effect of speaking style and interaction between depressive symptoms with speaking style in all acoustic measures (all p values were smaller than .001). Depressive symptoms were not statistically significant in all acoustics measures. The significant interaction was further investigated using pairwise contrasts evaluated with Bonferroni adjusted significance.

- Speech Rate: Both individuals with LD and HD showed significant differences in each contrast of the three speech styles (all p values < .001).
- Energy in 1-3 kHz: LD group showed significant differences across the speech style while a difference between CO vs. CS was not significant in HD group ($p = .062$).

- F0 mean: LD group showed significant differences across the speech style while HD group did not show any significant difference between CO and CS ($p = 1$).
- F0 range: Both two group showed significant differences between CO vs. NAS (LD: $p < .001$, HD: $p = .048$), & CO vs. CS (LD & HD: $p < .001$), but no difference between NAS & CS (LD: $p = .204$, HD: $p = .395$).

Conclusions

Talkers with HD symptoms showed NAS alteration in all acoustic measures and CS modification in speech rate and f0 range, but different to LD talkers, talkers with HD did not show significant CS enhancement in energy in 1-3 kHz and f0 mean. Findings have implications for the potential to aid speech therapy plan for maximizing intelligibility in individuals with speech sound disorders accompanied with depressive symptoms. While not meant for formal diagnosis, this work highlights reduced communication behaviors as observable signals which could augment existing clinical protocols for individuals with speech disorders accompanied with depressive symptoms.