

EFFECTS OF MULTI-TALKER BACKGROUND NOISE ON THE INTENSITY OF SPOKEN SENTENCES IN PARKINSON'S DISEASE

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1. INTRODUCTION

Hypophonia or low speech intensity is one of the most frequent and commonly treated speech symptoms in Parkinson's disease (PD) (Adams, 1997). The moment-to-moment impact of hypophonia on communication is often observed to be dramatically influenced by the intensity of the surrounding background noise. In general, the louder the background noise the more difficult it is for the person with hypophonia to communicate. Unfortunately, the relationship between speech intensity and background noise level has rarely been systematically examined in previous studies of hypophonia. A preliminary report, by Adams and Lang (1992), found that 90 dB SPL of white noise produced a marked increase in speech intensity in 10 PD subjects. In contrast, Ho, Bradshaw, Iansek and Alfredson (1999), found that pink noise, presented at 10-30 dB above threshold, produced minimal or no increase in speech intensity in a group of 12 PDs. These inconsistencies may be related to a number of factors such as, the severity of hypophonia, the type background noise, the noise levels, the speech tasks, the intensity measures, and the methods of stimulus presentation. Defining the relationship between speech intensity and background noise has important implications for the understanding, assessment and treatment of hypophonia in PD. The purpose of the present study was to attempt to define the relationship between speech intensity and background noise in individuals with hypophonia and Parkinson's disease.

2. METHOD

This study included 10 idiopathic PD subjects (8 male, 2 female), (64-78 years, $M=69$, $SD=5.3$) with hypophonia and 10 age-equivalent controls (9 male, 1 female), (55-80 years, $M=73$, $SD=4.4$). All subjects with PD were reported by a Neurologist (MJ) to demonstrate reduced speech intensity or hypophonia. All subjects with PD were stabilized on their anti-parkinsonian medication and were tested at approximately 1 hour after taking their regularly scheduled anti-parkinsonian medication. Normal and PD subjects passed a 40 dB hearing screening.

All subjects were tested in an audiometric booth. During all conditions, subjects sat in a chair facing a wall of the audiometric booth. A loudspeaker was placed 72 inches in

front of the subjects. Subjects wore a headset microphone (AKG-C420) positioned a constant 6 cm distance from the mouth. The experimenter presented a standard tape-recording of multi-talker noise (Audiotech – 4 talker noise) through the loudspeaker, adjusting the dB level of the noise via a diagnostic audiometer (GSI 61). The speech of each subject was recorded using a digital audio tape recorder (Tascam DA-01). Subjects were required to repeat the sentences "I owe you a yo-yo. I owe you a yo-yo" (Goldinger, Pisoni, & Luce, 1996) in each noise condition. The sentence "I owe you a yo-yo" was selected because all segments within this sentence are voiced and therefore the sentence is fairly easy to segment and it has a fairly constant intensity contour.

The multi-talker noise was presented randomly to each subject in five dB increments ranging from 50-70 dB. Each dB level was presented twice in the following order: 50, 65, 60, 70, 55 dB then 55, 70, 60, 65, 50 dB. The subjects' recorded test sentences were digitized using Kay Elemetrics' Visipitch program. The average intensity (dB) for each test sentence was determined using the Visipitch intensity analysis routine. A two-factor repeated measures ANOVA was used in the statistical analysis.

3. RESULTS

The results for the PD and control groups are shown in Figure 1. Both PDs and controls showed a significant increase in speech intensity across increases in the level of background noise ($p=.0001$). PD subjects were approximately 2-3 dB lower than controls across all noise levels. This PD versus control group difference approached significance ($p=.065$). Hypophonic PD subjects appeared to show a speech intensity versus background noise relationship that was parallel to the controls but at a consistently lower speech intensity (see regression lines in Figure 1). The speech intensity versus background noise regression lines for each of the PD subjects are shown in Figure 2. These regression lines all show a positive slope. Interestingly, the most severe hypophonic PD can be seen (Figure 2) to have a fairly strong positive slope. Figure 2 suggests that there is no relationship between the severity of the subject's hypophonia and the slope of the regression line.

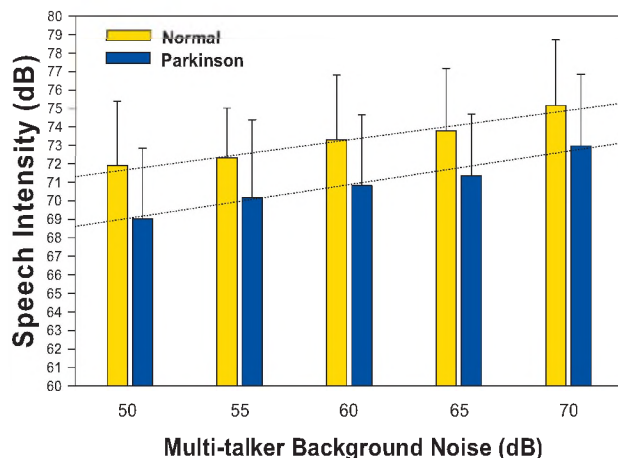


Fig. 1. Average speech intensity obtained from Parkinson disease and control subjects during 5 levels of multi-talker noise (50, 55, 60, 65, 70 dB). Corresponding regression lines are shown for each group.

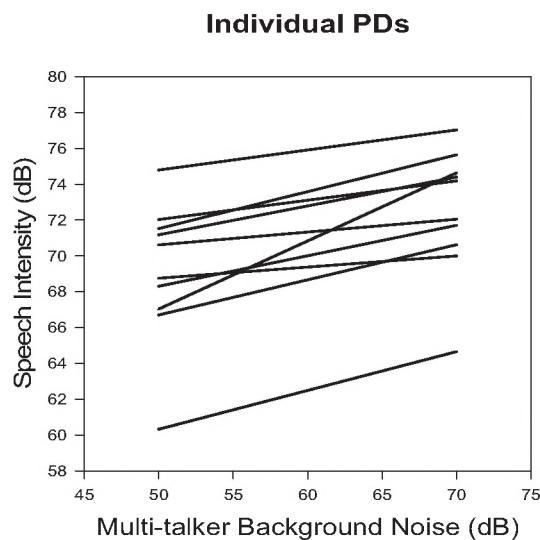


Fig. 2. Individual speech intensity versus background noise regression lines for the subjects with Parkinson's disease (PD).

4. DISCUSSION

The results of this study suggest that subjects with PD show a systematic increase in speech intensity across increases in background noise. These findings agree with the first published demonstration of the "Lombard effect" in PD (Adams & Lang, 1992). The present study also showed that the positive relationship between speech intensity and background noise is approximately parallel to that of controls. Interestingly, despite this positive Lombard relationship, the PD subjects' speech intensity was consistently below that of the controls for each of the noise levels examined. Thus, relative to controls, the PD subjects

showed a parallel but reduced speech versus noise intensity relationship.

The results of the present study are in contrast to one previous study by Ho et al. (1999) that failed to observe a strong positive Lombard relationship in their PD subjects. When comparing the methods of the Ho et al. (1999) study to those of Adams and Lang (1992) and to the present study, the main inconsistency appears to be related to the level of the background noise that was used. The Ho et al. (1999) study appears to have used noise levels that were below 50 dB while the present study and the Adams & Lang (1992) study used noise levels that were above 50 dB SPL. In an earlier, study of the Lombard effect in normals, Lane and Tranel (1971) warned that it may be difficult to demonstrate a strong and consistent Lombard effect at very low levels of background noise. It is suggested that this difficulty may be even more pronounced in hypophonic subjects. Future studies involving a wider range of background levels may be required to resolve this issue.

The present study highlights the potentially powerful and positive effects of background noise on speech intensity production in hypophonia. Future studies are required to determine if the Lombard effect can be incorporated into novel methods of treatment for individuals with PD and hypophonia.

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ACKNOWLEDGEMENTS

This research was funded by a grant from the University of Western Ontario's Academic Development Fund that was awarded to the first author.

AUTHOR NOTES

This work was conducted while Olga Haralabous was completing her M.Sc. Degree in Communication Sciences and Disorders (Speech-Language Pathology) at the University of Western Ontario.