THE IMPACT OF DIALECT ON THE ABILITY TO UNDERSTAND SPEECH-IN-NOISE

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1 Introduction

Difficulty understanding speech-in-noise (SIN) is one of the most commonly reported hearing issues for older adults. Thus, being able to accurately assess an individuals' ability to understand SIN is of utmost importance. A number of standardized assessments have been developed to quantify this ability, such as the QuickSIN [1]. In general, these tests use pre-recorded speech as the target stimulus, and thus the language and dialect of each test cannot be easily modified. One issue that has received scant attention is how dialect impacts performance on a standardized SIN test.

Previous work has demonstrated that dialect can impact the ability to understand speech-in-noise. When target speech was a non-native dialect (e.g. Japanese speaker, speaking in English), the ability to understand the speech was impacted by how dissimilar the dialect was from the native dialect of the listener [2]. Bilingual participants were worse at understanding SIN in their second language compared to their native language, and the difference in performance was reduced as second language proficiency increased [3]. In the USA, regional dialects were harder to understand in background noise, compared to a 'general American' dialect, suggesting that understanding mismatched speaker-listener native English dialects is more difficult compared to when there is no mismatch [4]. Interestingly, the effect of speaker dialect did not interact with listener dialect, suggesting that in geographically connected regions, the dominant dialect is equally understandable in noise, even for speakers of a different dialect [4]. It is therefore possible that speakers of dialects from a geographically isolated region might perform worse on SIN tasks in the more common dialect.

This putative impact is critically important for speakers of dialects that do not have standardized SIN assessments in their native dialect. The potential negative impact of speaker-listener dialect mismatch could lead to inaccurate audiological assessment, and increased variability in research. One region that has a distinct English dialect and is geographically isolated is the island of Newfoundland; within Newfoundland, areas outside St. John's (i.e., main population centre) are further isolated from speakers of non-Newfoundland dialects of English. Accordingly, the goal of this study was to examine if people with normal hearing from Newfoundland perform outside of the norms for the QuickSIN test.

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2 Method

2.1 Participants

A total of 56 participants between 18 and 39 years old (41 women, and 15 men; M_{age} = 22.16, SD = 5.33) were recruited from Memorial University, Grenfell Campus and from the community. Grenfell Campus is located in Western Newfoundland. All participants were native English speakers born in Newfoundland to parents who were also born and raised in Newfoundland. All participants described their English dialect as being Newfoundland English.

2.2 Procedure, stimuli and task

All stimuli were presented through Sennheiser HD200 headphones, while participants were seated in a double walled sound-attenuating booth. A demographics questionnaire was administered orally by the researcher. Pure-tone thresholds were collected for each octave from 250-8000 Hz. The impact of dialect on speech-in-noise was assessed using lists 1-5 from the QuickSIN (Etymotic research) at 75 dB SPL. All participants also did a practice list before the experimental lists were presented. The results from QuickSIN are presented in decibels signal-to-noise ratio loss (dB SNR), with 0 dB SNR representing the expected performance of a listener with normal hearing [1]. Killion et al. [1] also calculated confidence intervals (CI) around 0 dB SNR. The CIs around 0 dB SNR are smaller as more lists are used. These CIs were used to compare the current sample of speakers of Newfoundland English.

3 Results

All participants had normal audiometric thresholds (i.e., below 25 dB HL from 250-8000 Hz). The dB SNR loss from lists 1-5, and the mean dB SNR loss from those 5 lists are presented in Figure 1. As a first step, performance on each individual list was compared to the expected performance of 0 dB SNR loss. Performance on each list was significantly above 0 dB SNR ($t(55) = 3.5\text{-}12.9$, $p \leq .001$ for all), Next, performance was compared to the single list 95% CI (2.7 dB SNR loss) from Killion et al., [1]. Performance on lists 1, 2 and 4 was significantly below the 95% CI boundary (i.e., performance was within the normal range; $t(55) = -1.89$, $p = .06$; -7.69, $p < .001$ & -4.74, $p < .001$). Performance on lists 3 & 5 was not significantly different than the boundary of the 95% CI ($p > .45$ for both). Averaging performance across the five lists increases reliability, thus decreasing the CI [1]. When comparing average performance across the five lists to the CI for five

lists, dB SNR loss was above (i.e. worse) the 95% CI boundary (1.2 dB SNR loss; $t(55)= 5.02$, $p \leq .001$).

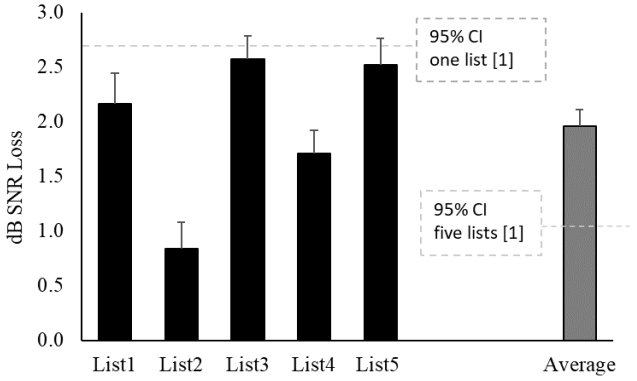

Figure 1: Performance on lists 1-5 of the QuickSIN test, and their average. 95% confidence intervals from [1] are shown to highlight how participants from Newfoundland compared to the norms.

4 Discussion

The present study found that Newfoundlanders performance on the QuickSIN was outside the norms when considering five lists. Performance on each individual list was higher than normal, but did not fall outside the 95% CI [1]. All participants had normal hearing as assessed by pure-tone audiometry. This finding provides support for the hypothesis that it is more difficult to understand SIN in a non-native dialect. Most critical, the findings suggest that speaker-talker dialect mismatch can negatively impact audiological assessment and may impact research that uses standardized SIN assessments.

Previous research has found that that speaker-listener dialect mismatch results in increased difficulty understanding SIN [2]–[4]). However, this effect seems to be mitigated when the speaker is using a 'dominant' regional dialect [4]. Although the QuickSIN test was recorded in the dominant North American English dialect, people from Newfoundland performed outside the norms. This suggests that geography may play a role. The isolation of Western Newfoundland from the rest of the continent means that people in this region are less exposed to that dominant dialect. The current findings, taken in concert with previous work showing little impact of dialect-speaker mismatch on SIN perception when using continental American dialects [4], suggest it is likely that 'in-person' experience and exposure to a native English dialect can mitigate the impact of dialect difference on the ability to understand SIN. One possible mechanism for Newfoundlander's difficulty understanding SIN in a non-Newfoundland dialect is based on the *framework for understanding effortful listening* described by Pichora-Fuller et al. [5]. In general, this model highlights that there is a limited amount of cognitive resources available to process and understand speech. When listening to a less familiar dialect, differences in speech prosody, vocabulary, vowel sounds, and other dialectical differences increase the cognitive resources required to understand the speech. In quiet situations, cognitive resources are available to process dialectical differences, so the speech can be understood. When there is background noise, additional cognitive resources are needed to perceptually segregate the speech from noise. Accordingly, when the noise level reaches a certain threshold, there are not enough cognitive resources available to simultaneously segregate the speech from noise and process the dialectical differences. In this situation, the speech can no longer be understood. Limited cognitive resources are the likely source of the impact of dialect on SIN understanding as the participants in this study were young healthy adults, with normal audiometric thresholds. It is therefore unlikely that the increased difficulty understanding SIN in a different dialect in the current study was due to abnormal peripheral encoding or central auditory processing deficits.

5 Conclusion

Native Newfoundland English speakers performed significantly worse on a QuickSIN test compared to the standardized norms [1]. This could lead to potential for misdiagnosis of hearing problems because the QuickSIN test is used clinically. It is therefore necessary to develop a "newfound" norm for Newfoundlanders on the QuickSIN, or to develop a new standardized assessment that uses speech stimuli recorded by a native Newfoundlander. The results of this study highlight the need to accomplish both of these goals.

Acknowledgments

Funding for this project was provided by the Canada Research Chair program, and the University Summer Student Internship Program at Memorial University of Newfoundland.

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