Phonetic Mistakes Made During Speech-In-Noise Test by Tinnitus Patients

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Introduction

This study was conducted in order to research the effects of tinnitus in speech in noise recognition, specifically in the context of phonemes. Tinnitus is a common hearing disorder in today's world, and can be described by patients as ringing or noises in the ears in the absence of physical sound. It ranges from a condition that can be barely noticeable, to one that can be completely disturbing. It is estimated that tinnitus affects about 10-15% of the general population, making it a prevalent disorder in today's society (Hoffman & Reed, 2004; Henry et al., 2005). In previous studies, it was concluded that cognition, attention, and speech in noise performance can be affected greatly by severe tinnitus (Tyler et al., 2014). Another study researched tinnitus patients with normal hearing sensitivity, where the patients reported difficulty in speech comprehension. The absence of a hearing impairment in these individuals with tinnitus proves that speech comprehension is not just speech inquired, and is not solely affected by hearing loss (Tai & Husain, 2018). Tai and Husain's study also looked at the patients' results of the speech-in-noise recognition test. Between all of the signal-to-noise ratio (SNR) conditions tested, the researchers found a substantial difference between the performance of the control group and the group with tinnitus patients at 5 dB SNR (Tai & Husain, 2018). This study aims to expand on these findings, by examining the mistakes made at the phoneme level, which was recommended by a recent review study on speech comprehension in tinnitus patients (Ivansic et al., 2017).

Method

Participants
Total: 22 participants

Control: 7 participants
Average age: 48
Ages 21-59
3 Females
4 Males

Tinnitus: 15 participants
Average age: 46
Ages 22-62
5 Females
10 Males

All participants had relatively normal hearing sensitivity, defined as pure-tone thresholds less than 35 dB HL from 500 to 4000 Hz in each ear.

Method
This study evaluated the participants' speech-in-noise performance through the use of the Quick Speech-in-Noise (QuickSIN) test (Tai & Husain, 2018). The QuickSIN test measured both ears of each participant by presenting 2 lists of sentences at 70 dB HL in each ear. The responses of each participant for each list were recorded, and then transcribed phonetically using the International Phonetic Alphabet (IPA). Within each transcription, the incorrect phonemes spoken by the participants were identified and highlighted in red, and lists 1 through 4 at the 5 dB SNR condition were specifically analyzed. Each consonant within those 4 lists were placed into their specific frequency category, ranging from frequencies at 250 Hz to 4000 Hz or greater. By placing the consonants in these frequency categories, the overall prevalence of each frequency can be determined. The frequency distribution among the 4 lists was calculated into percentages (see pie chart).
Later, the responses given by the participants were analyzed and split into a control group and a tinnitus group (see line graph).

Results

QuickSIN 5 dB SNR condition sentences, transcribed using IPA. Highlighted consonants were analyzed.

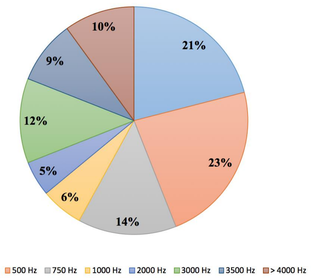
List #	5 dB SNR Sentences	Phonemes
1	It is a band of steel three inches wide.	ɪt ɪz ə bænd ʌv stil θri ˈɪnʧəz waɪd.
2	Crouch before you jump or miss the mark.	kraʊʧ bɪˈfɔr ju ʤʌmp ɔr mɪs ðə mɑrk.
3	Pick a card and slip it under the pack.	pɪk ə kɑrd ænd slɪp ɪt ˈʌndər ðə pæk.
4	The stems of the tall glasses cracked and broke.	ðə stɛmz ʌv ðə tɔl ˈglæsəz krækt ænd broʊk.

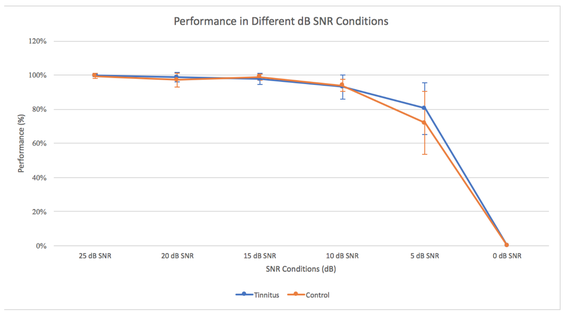
Phoneme Prevalence

SNR 5	Phoneme Prevalence	Total
250 Hz	/j/: 1 /z/: 4 /m/: 4 /n/: 5	14
500 Hz	/v/: 2 /d/: 6 /b/: 3 /l/: 4	15
750 Hz	/r/: 9	9
1000 Hz	/p/: 4	4
2000 Hz	/g/: 1 /ʧ/: 2	3
3000 Hz	/k/: 8	8
3500 Hz	/t/: 6	6
>4000 Hz	/f/: 1 /s/: 5 /θ/: 1	7
	Total:	**66**

Each consonant belongs to one of the frequency groups. The prevalence of these consonants in the QuickSIN 5 dB SNR condition (see table above), created a specific frequency distribution within this condition.

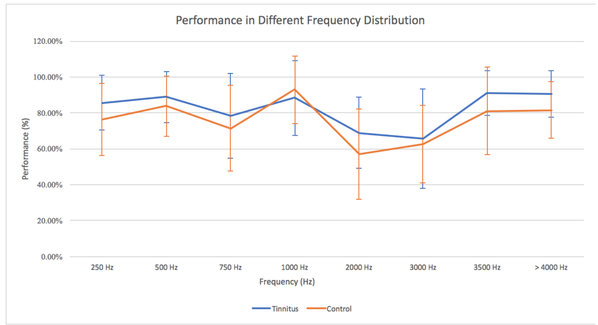
Frequency Distribution





Between the two groups, the control group was found to have a lower overall performance than the tinnitus group in the 5 dB SNR condition.

In general, it is evident that the control group has an overall lower performance than the tinnitus group within the frequency distribution of the 5 dB SNR condition. The control group missed more phonemes at the 5 dB SNR condition than the tinnitus group.



Discussion

After analyzing the performance of the tinnitus group and the control group at the 5 dB SNR condition of the QuickSIN test, the control group missed more phonemes overall and was found to have a lower performance than the tinnitus group in this specific condition.

- The results were expected to be in line with the findings of Tai and Husain (2018), where the tinnitus group was found to have a significantly lower performance than the control group in the 5 dB SNR condition.
- Out of the 22 participants in this study, 7 were part of the control group while the other 15 were part of the tinnitus group. The poorer performance observed in the control group is possibly due to greater variation in individual performance with the small sample size.
- Future studies may find different and more expected results with a larger control group, allowing the researchers to expand on the study. It is recommended that future studies pinpoint the specific phonemes that are missed at the 5 dB SNR condition, and translate those into their corresponding frequencies, to examine the relation between these frequencies and the pitch of tinnitus.

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