Data Write Up: Listening Comprehension in Accents and Noise Experiment (LANE)
By Jordan Richardson
Background

This study was formulated in order to investigate whether or not the combination of accents and noise affected listening comprehension performance. Prior to this study, research studies had been conducted to conclude that listening comprehension requires more effort in the presence of two-speaker babble and accented speech. This effect has been seen even when the speaker is a highly proficient second language learner. Listeners often quickly adapt to speech, even though more effort is exerted when overlapping babble is the same as one's native language (van engine et al). Previous research on energetic and informational masking (Cooke et al) found that "if both target and masker might contain important information, it is reasonable to suppose that processing resources are allocated to both "(Cooke et al). This would detail that a higher cognitive load would be used in order for a person to attend to some target speech event, like a lecture, as well as some masker, like two-speaker babble. In this study, we did not attend to cognitive load, but in making a hypothesis, acknowledged that it could affect our results. Along with that, Chan et al in 2019 found that "the current results showed that foreign accents impaired memory." So, it is logical to also hypothesize that a foreign accent (to the participant) in two-talker babble would impair the participant's ability to encode a target speech event. Yet, McLaughlin et al concluded in their study that "working memory positively predicts performance for conditions with nonnative accented speech…in four adverse listening conditions." Despite these conclusions, no study to date has examined the effects of accents and noise on listening comprehension for discourse length material. Given an interest in working memory, and the decline it commonly has for people over the age of 65 , along with previous research studies, the question arose inquiring about the manners in which nonnative speech and noise impacted listening comprehension for older adults. This study aimed to seek information about that inquiry, with an initial hypothesis detailing that participants would have an easier time listening and answering questions about lectures if no noise were in the background in comparison to three other adverse conditions.

Methodology

22 older adults (65+) took part in this research study. Only 17, however, were included in data analysis due to technological errors. The data in this paper will refer to those 17 participants. Each participant underwent a hearing test (audiogram), a QuickSin task, and a working memory task (OSpan). Then, finally the participants performed the listening comprehension task in qualtrics and received monetary compensation.

Hearing Task (Pure Tone Audiometry)

Participants sat in alone in sound proof booth, and listened to pure tone *sounds,* in order to assess and identify hearing thresholds for each participant. The researcher sat in another sound proof booth to administer the test. For data analyses purposes, the better pure tone average was reported.

QuickSIN

Because speech and the ability to understand speech is not tested in the hearing task, we administered the QuickSIN to assess SNR (signal-to-noise ratio) loss. Participants listened to and were asked to vocally recall 6 sentences with 6 different levels of background babble. For example, 25 SNR details very minimal background babble, where the speech event does not sound as loud, and therefore impact a listener's ability to comprehend the target sentence, and 0 SNR would detail that both the target sentence and the background babble are being presented at the same level of loudness, and therefore the babble extremely impairs a participant's ability to attend to the target speech event. The SNR's that were observed in this portion of the experiment were 25dB, 20dB, 15dB, 5db, and 0dB (easiest to hardest).

Working Memory Task

Participants sat in a room, with the door closed, and were asked to take the OSpan working memory task. Participants were to read a math problem aloud, and judge it for correctness. After this judgement task, participants were then presented with a word to recall. This task was presented as a series, that increased as the working memory task went along, in which then after judging multiple math problems, separated by words to recall, the participants were then tasked with typing in the words they had previously seen when the program depicted three question marks on the computer screen.

Listening Comprehension Task

Participants sat in a room with headphones, with the door closed, and were asked to listen to 8 lectures in 4 different conditions. The conditions were as follows: Lectures from a Native English Speaker without any background noise (Native Quiet), lectures from Native English Speaker with two speaker babble at an SNR of 8dB (Native Babble), lectures from Nonnative English Speakers (speaker's first language was Korean) without any background noise (Nonnative Quiet), and lectures from a nonnative english speaker (first language was Korean) with two speaker babble in the background at an SNR of 8dB. These lectures were counter-balanced and randomly distributed to the participants. Between the 8 lectures, each participant was tasked with answering 6 questions based on the lectures' content. Each lecture ranged between 3-8 minutes. The lectures and questions came from LISN.

Results (graphs)

Figure 1.1

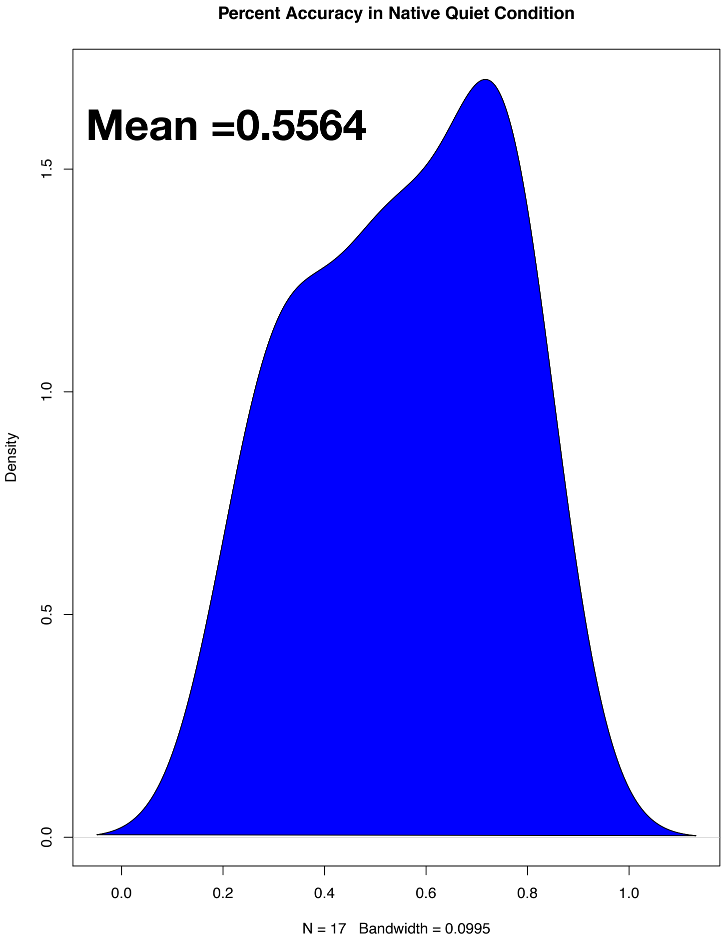


Figure 1.3 depicts a density plot, detailing a mean of 0.5564 on listening comprehension tasks in quiet conditions given lectures from a Native English speaker

Figure 1.2

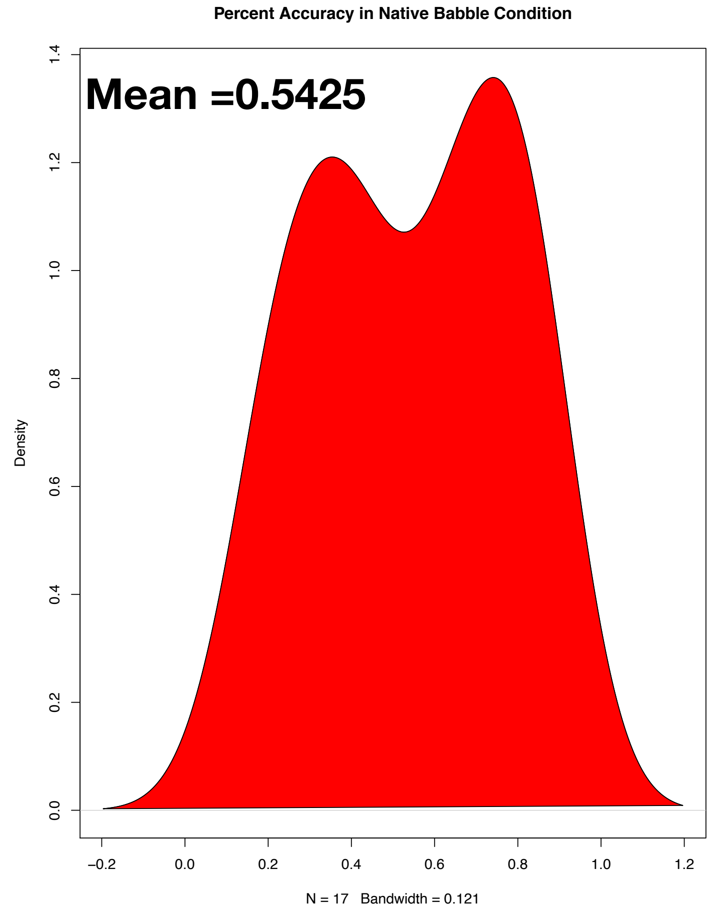


Figure 1.2 depicts a density plot, detailing a mean of 0.5425 on listening comprehension tasks in conditions with two speaker babble given lectures from a Native English speaker

Figure 1.3

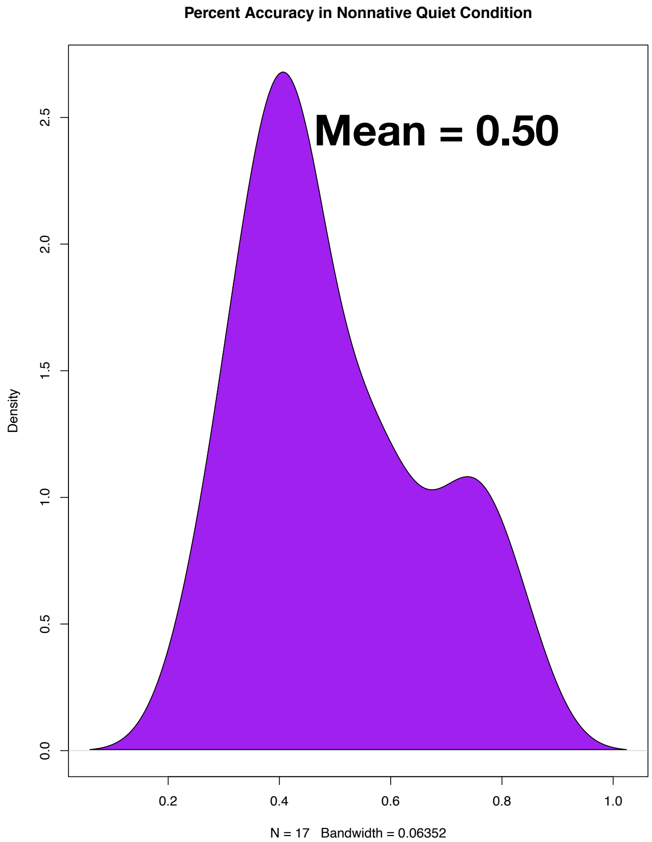


Figure 1.3 depicts a density plot, detailing a mean of 0.50 on listening comprehension tasks in quiet conditions given lectures from a Nonnative English speaker (accented).

Figure 1.4

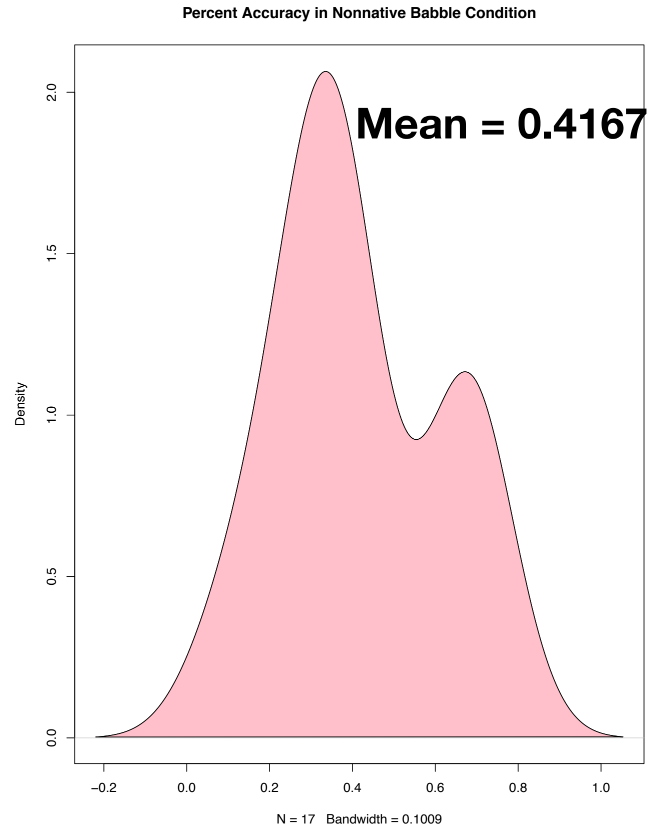


Figure 1.4 depicts a density plot, detailing a mean of 0.4167 on listening comprehension tasks in conditions with two speaker babble given lectures from a Nonnative English speaker (accented).

Figure 2.1

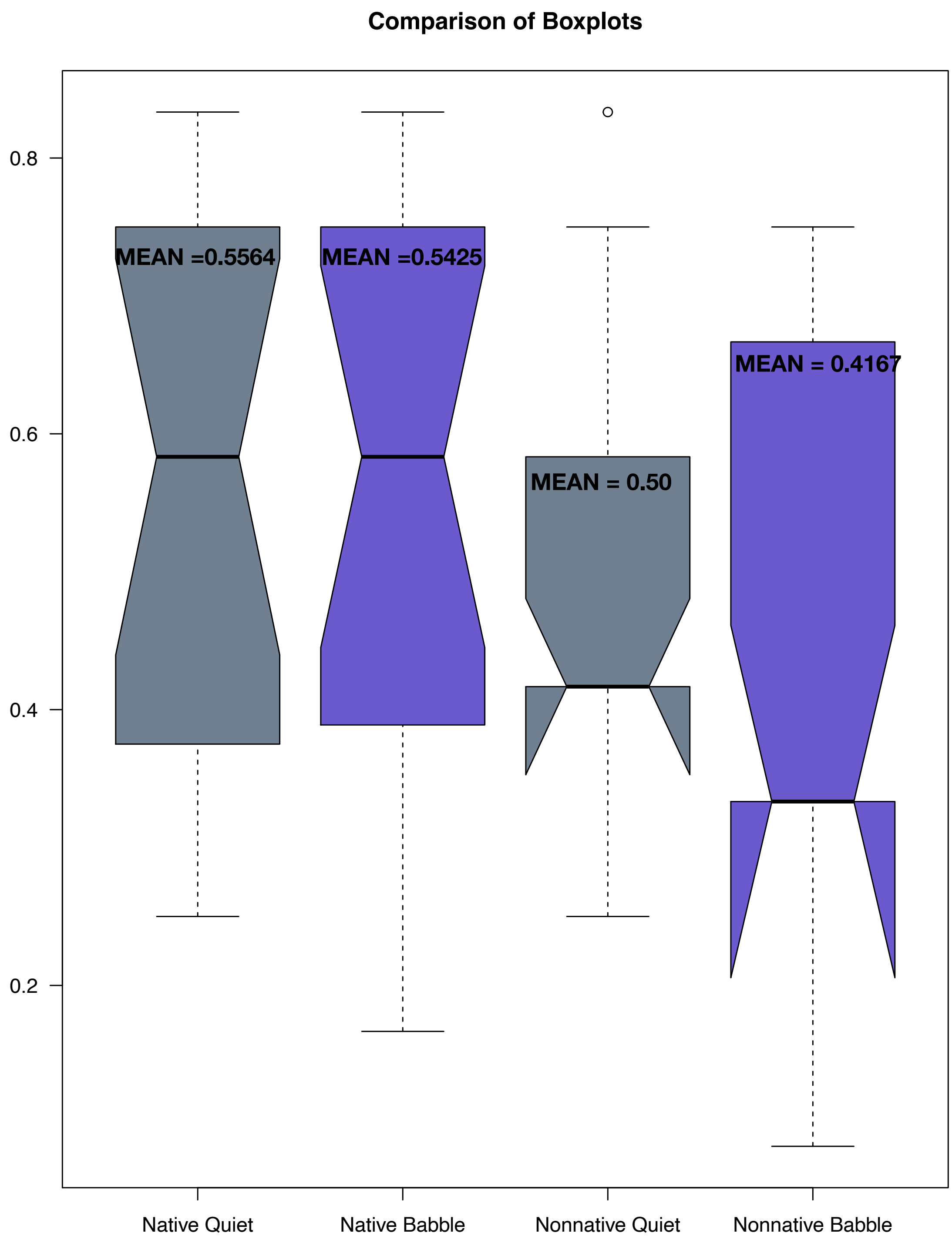
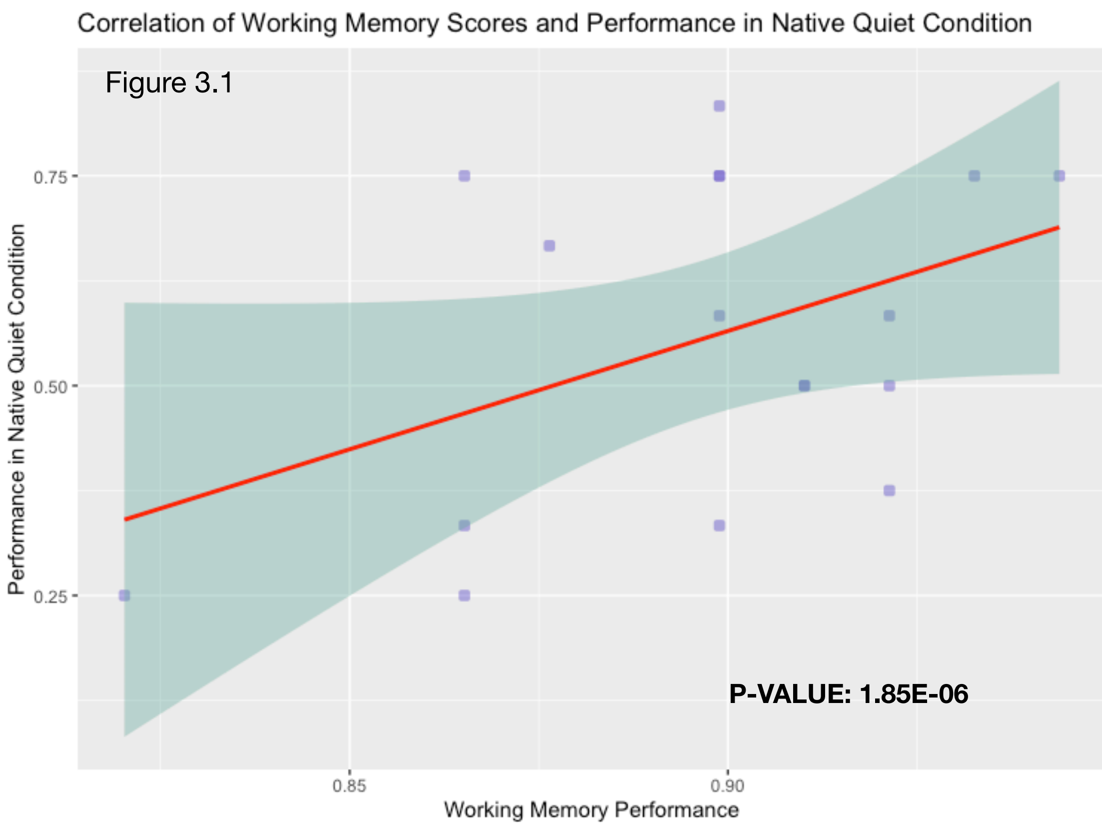
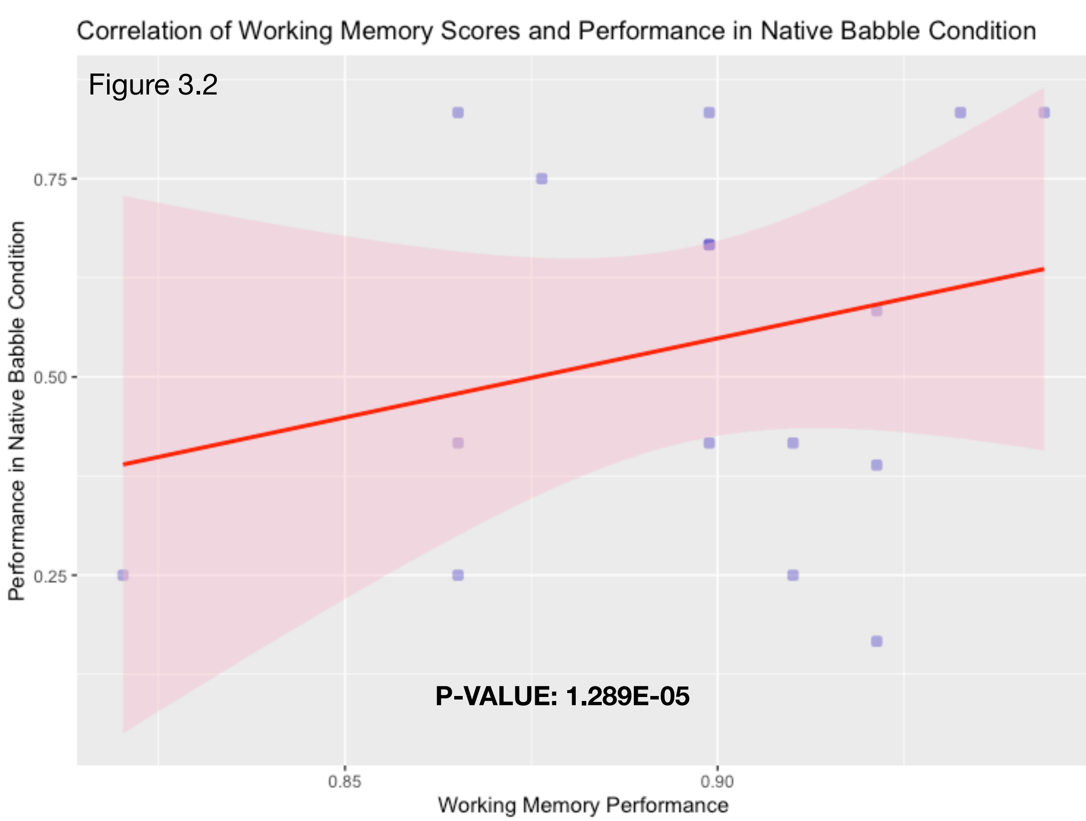
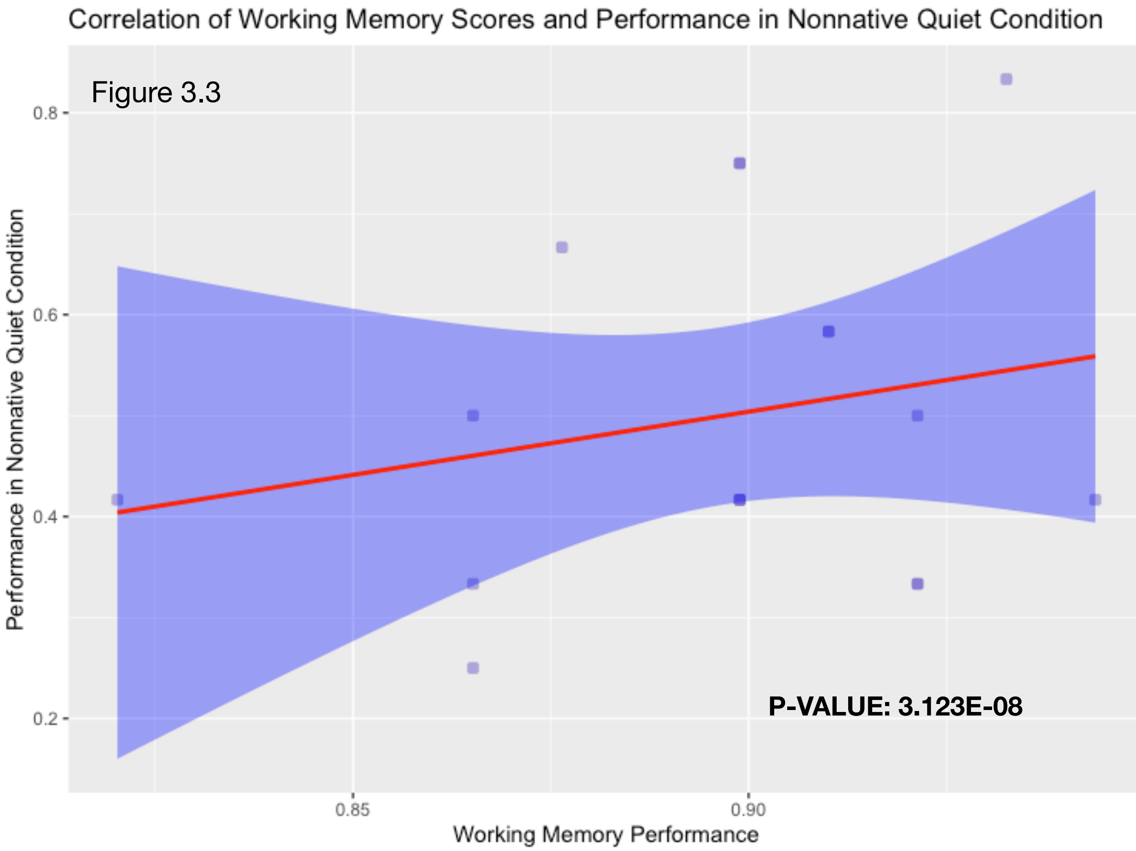


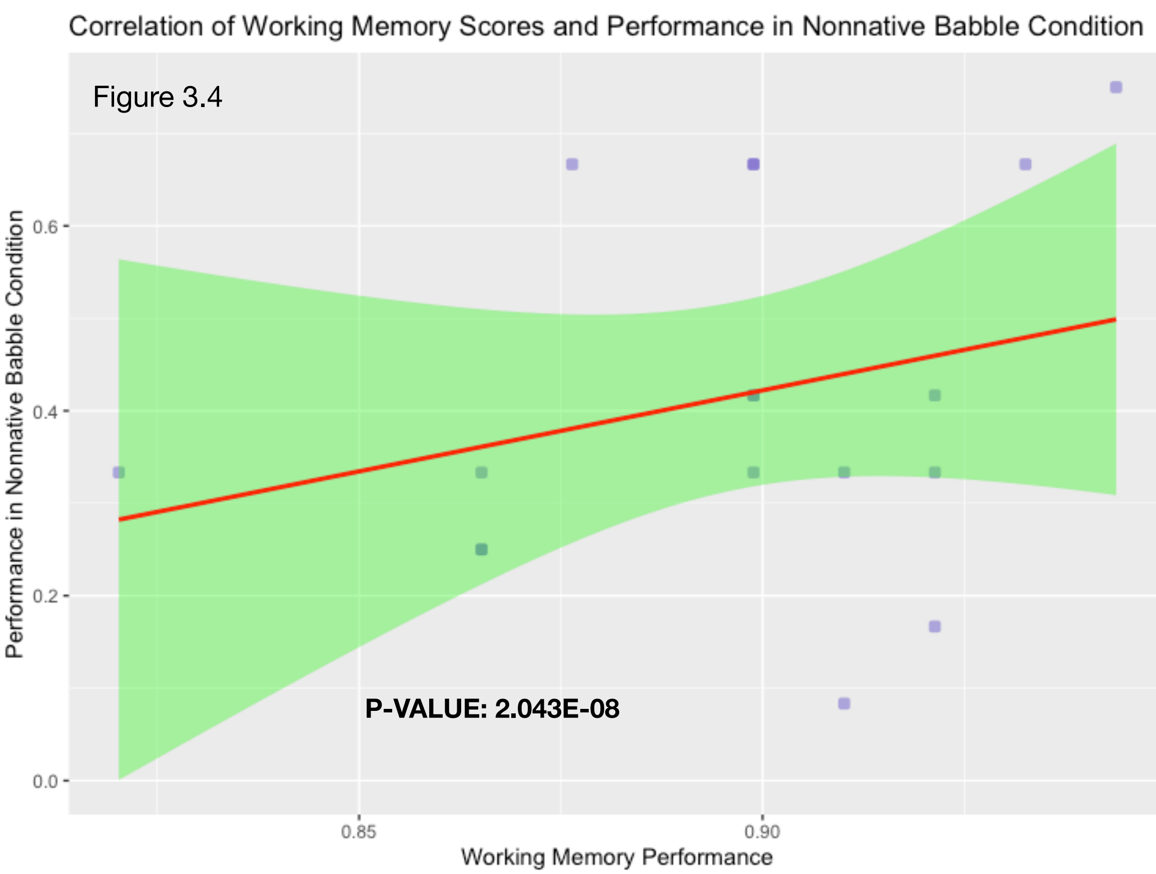
Figure 2.1 shows a comparison of participants' performance in the four speech conditions: Native Quiet, Native Babble, Nonnative Quiet, and Nonnative Babble.

Figures 4.1-4.4 respectively: —depict the correlations between participant performance in each condition in the Listening Comprehension Task and the participant's performance on the working memory task.

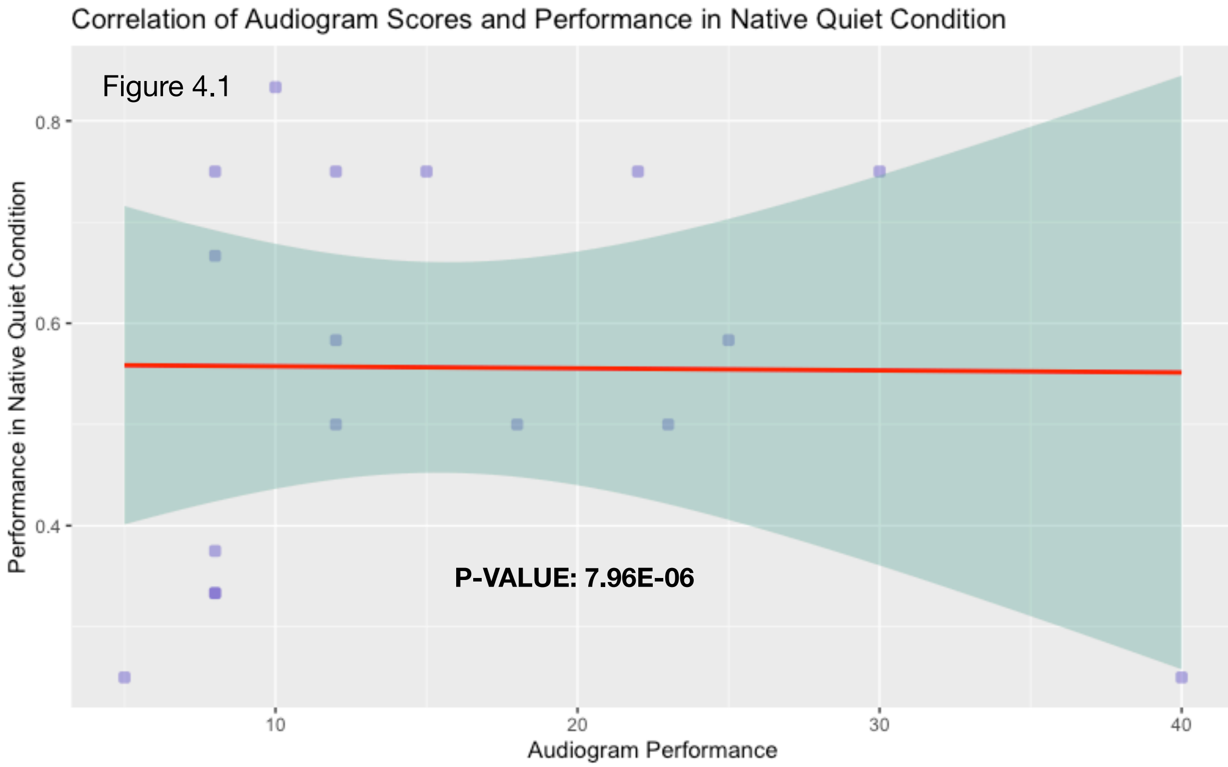


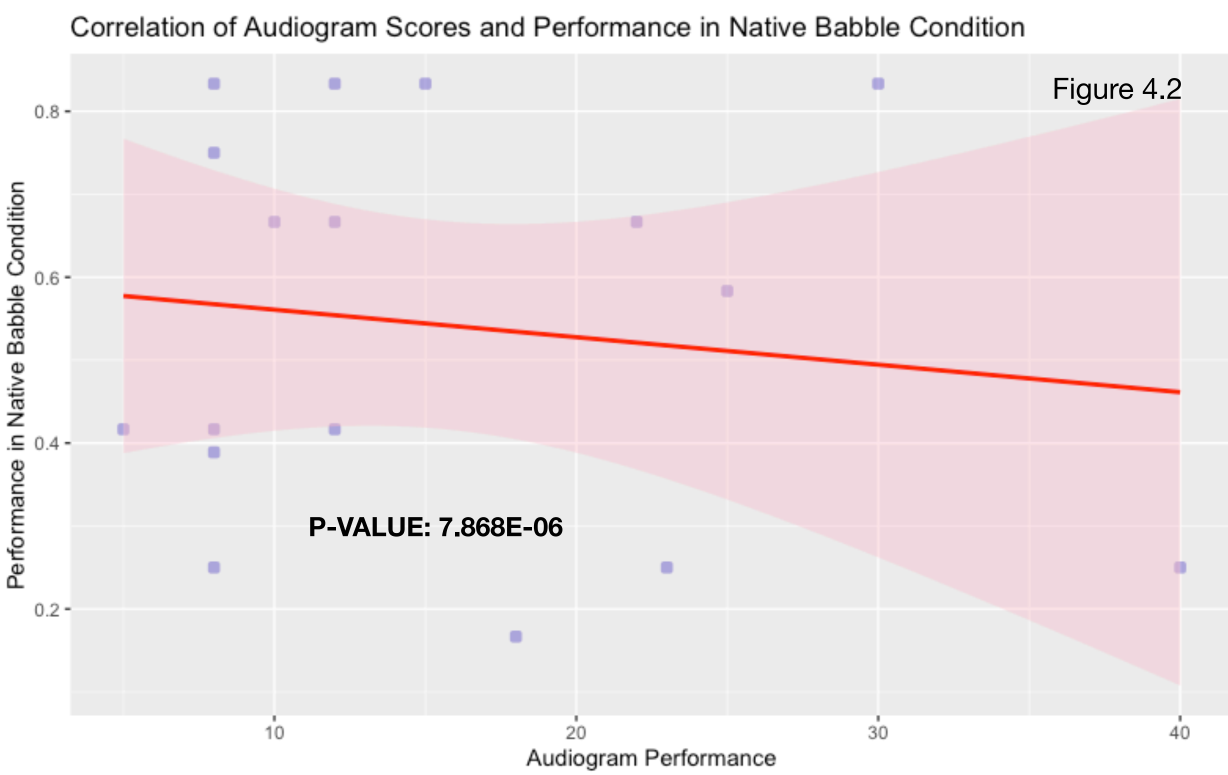


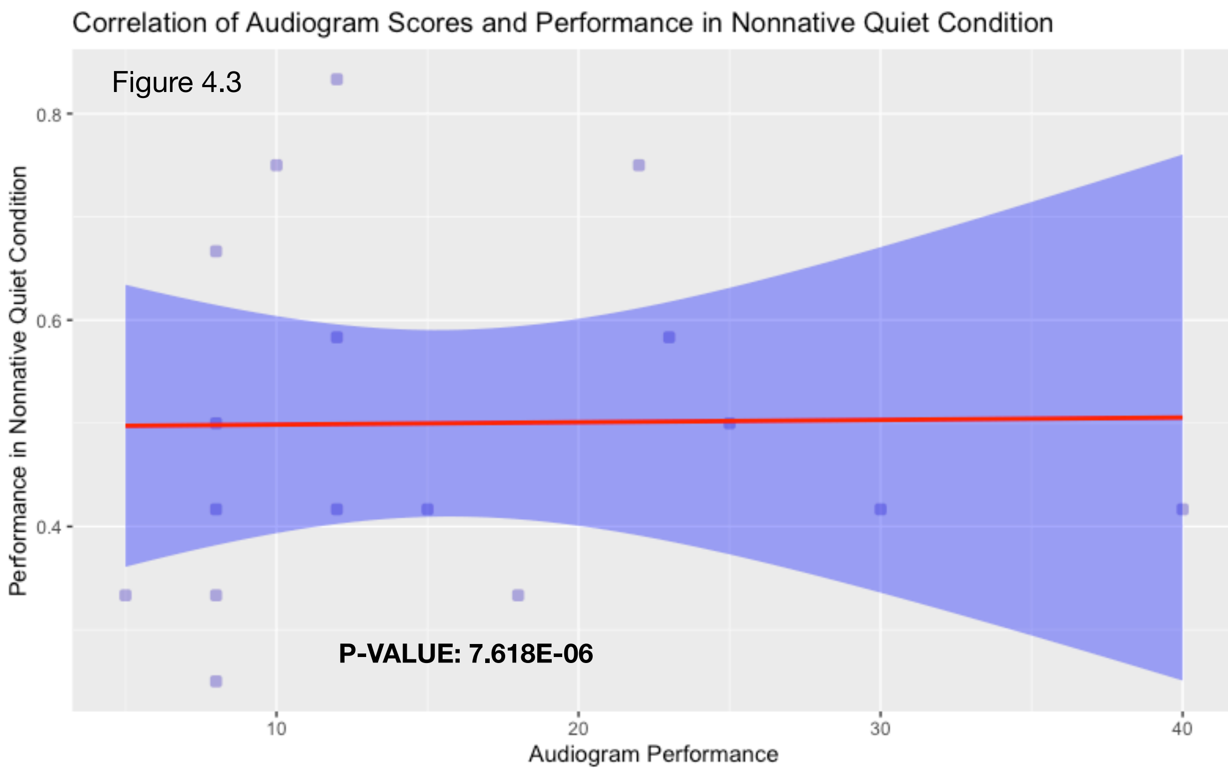

Correlation of Working Memory Scores and Performance in Nonnative Quiet Condition
Figure 3.3
P-VALUE: 3.123E-08
Performance in Nonnative Quiet Condition
Working Memory Performance
0.8
0.6
0.4
0.2
0.85
0.90

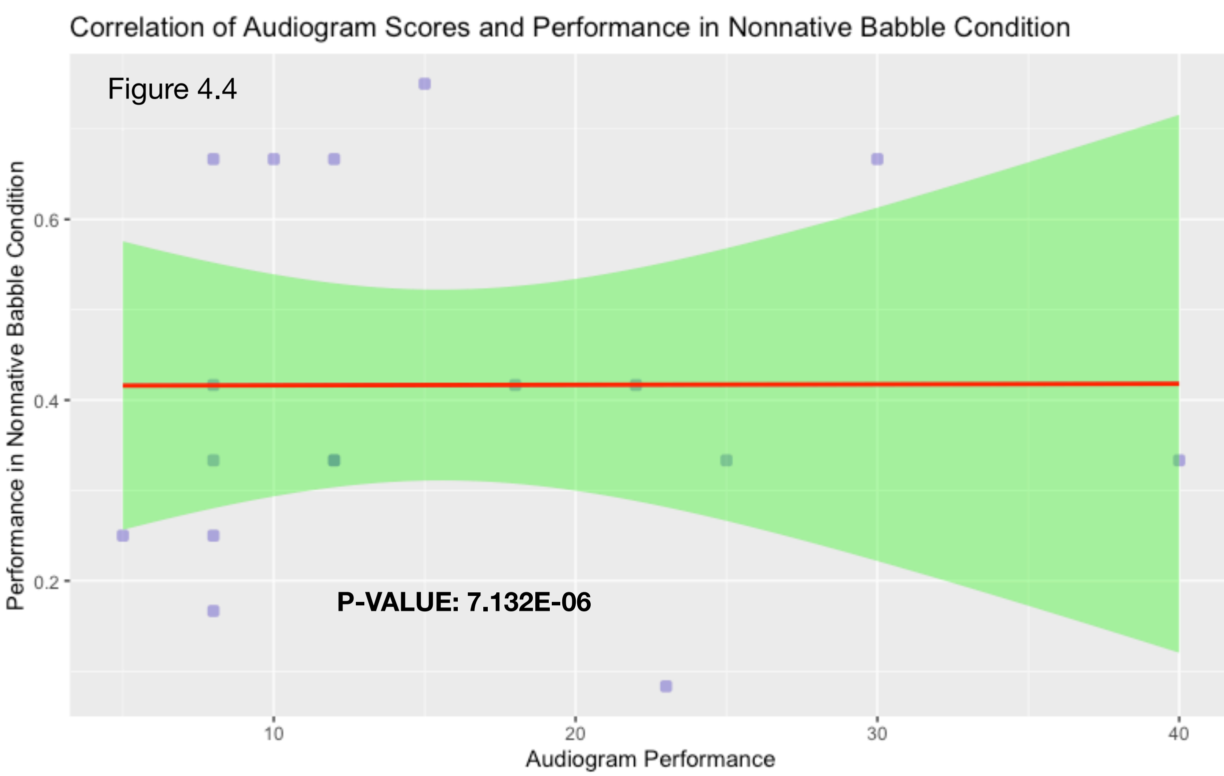

Correlation of Working Memory Scores and Performance in Nonnative Babble Condition
Figure 3.4
P-VALUE: 2.043E-08
Performance in Nonnative Babble Condition
Working Memory Performance
0.6
0.4
0.2
0.0
0.85
0.90

Figures 4.1-4.4 respectively: depict correlations between audiogram scores and performance on listening comprehension task per speech and noise condition.






Correlation of Audiogram Scores and Performance in Nonnative Quiet Condition
Figure 4.3
0.8
0.6
0.4
Performance in Nonnative Quiet Condition
P-VALUE: 7.618E-06
10
20
30
40
Audiogram Performance


Correlation of Audiogram Scores and Performance in Nonnative Babble Condition
Figure 4.4
0.6
0.4
0.2
Performance in Nonnative Babble Condition
P-VALUE: 7.132E-06
10
20
30
40
Audiogram Performance

Figures 5.1-5.4 respectively: depict correlations between QuickSIN scores and performance on listening comprehension task per speech and noise condition.

Figure 5.1

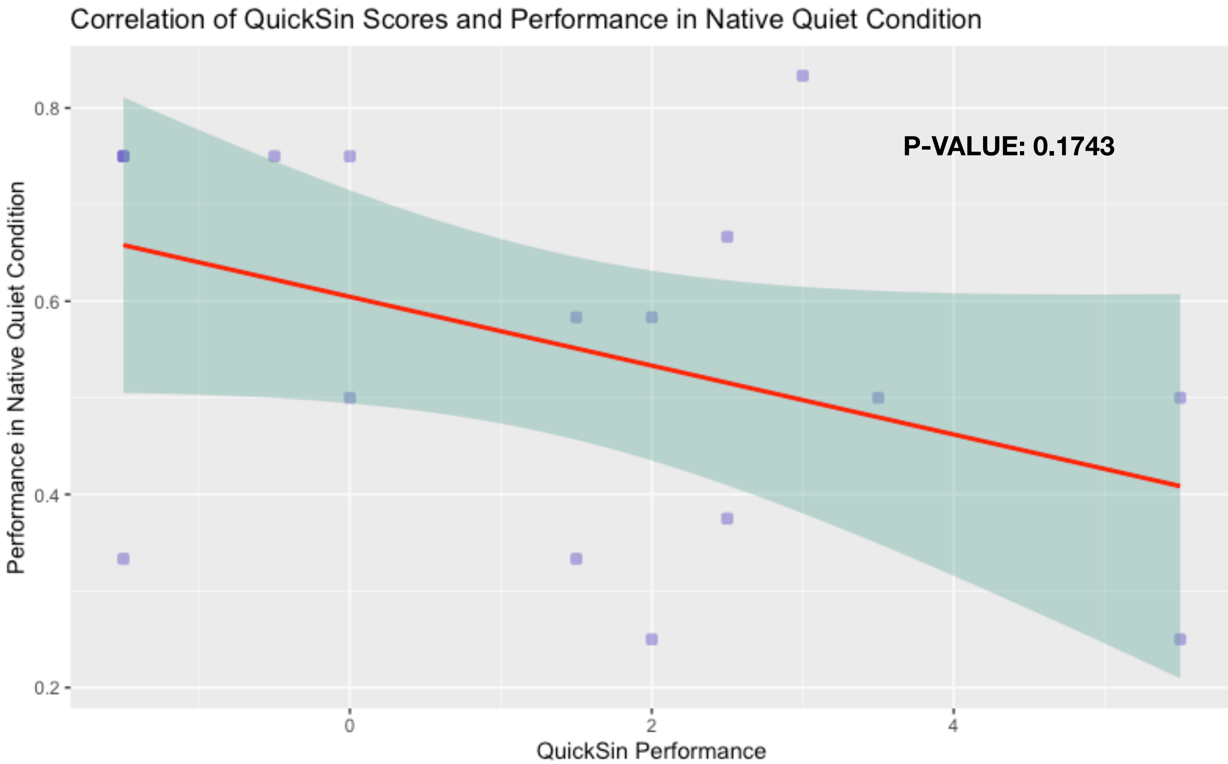


Figure 5.2

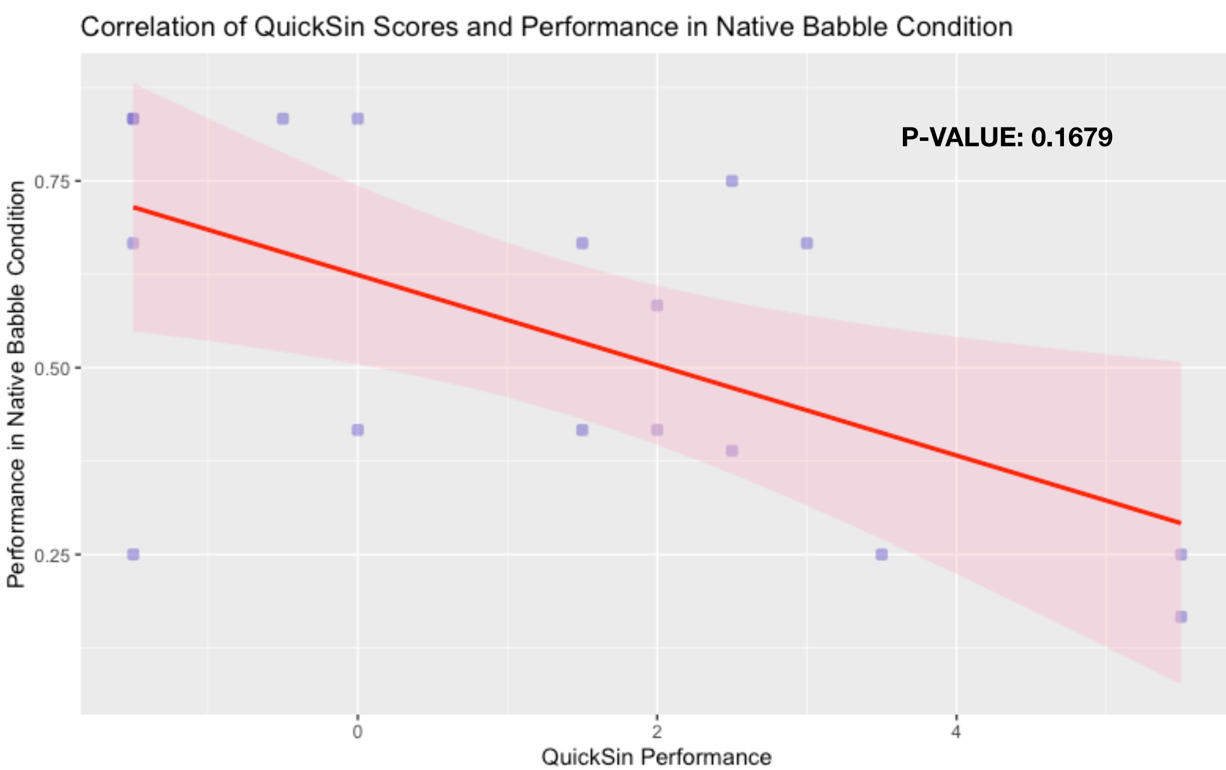


Figure 5.3

Correlation of QuickSin Scores and Performance in Nonnative Quiet Condition

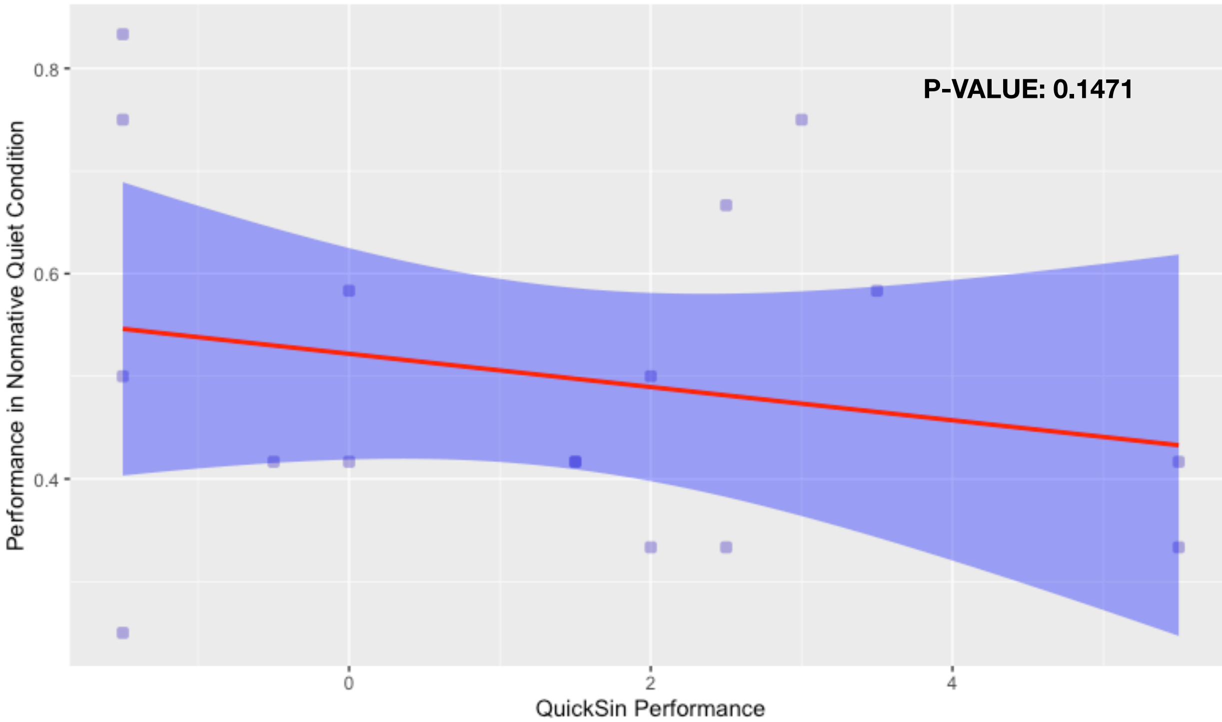


Figure 5.4

Correlation of QuickSin Scores and Performance in Nonnative Babble Condition

Discussion

My initial hypotheses were that participants would perform better on the listening comprehension task when the lectures were being administered by the native English speaker in the quiet condition. My concurrent predictions were then that the nonnative quiet condition would be next easiest, then native babble would be a bit harder than the two aforementioned conditions, with the nonnative babble condition being the hardest.

When referring to Figures 1.1-1.4, we can see that the means of each condition definitely differ. Yet, not to what I initially expected. Participants are performing a lot worst than what I initially anticipated in the nonnative quiet condition with a mean of .50 in comparison with native quiet's mean of .5564. I expected for the performances to be near the same, as is depicted by the mean in the native babble condition (.54). Though not a major difference, these findings were definitely not anticipated.

When referring to Figure 2.1, we observed that, summarily, native quiet does seem to be the easiest, with the nonnative babble condition being a tad bit different, but not significantly—with a p-value of 0.04 in a test of significance between nonnative babble and native quiet. So, it seems that though babble didn't impact participant performance much in the nonnative quiet condition, it definitely played a role in the nonnative babble condition, at least in its deviation from native quiet's mean. These results seem to indicate that the combination of a foreign accent along with two speaker babble might impede one's ability to comprehend speech, as I initially predicted. Yet due to the p-value being greater than .05, the data fails to reject the null hypothesis.

When referring to figures 3.1-3.4, 4.1-4.4, and 5.1-5.4, correlation does not equate to causation. Yet, it seems to be a negative relation between QuickSIN performance and performance on the listening comprehension task. The linear regression line for the relation between audiograms and listening comprehension seems to depict that performance on the hearing tasks does not aid in predicting performance on the listening comprehension task. Yet, it does seem that working memory, at least slightly, positively shows a relationship to performance on the listening comprehension task.

My initial hypotheses dictated that working memory would show a positive relationship with listening comprehension, as prior research stated, and it did the same in this study. Though, the relationship was not the strongest, the data could be strengthened if there were more participants included in the data and the study.

Articles Read (references—not all included in write up)

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