12-15-2023

Psychometric Functions on Word Recognition Test Exploring the difference in performance between Mandarin-English bilinguals and English monolinguals on the NU-6 word recognition test

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Exploring the difference in performance between Mandarin-English bilinguals and English monolinguals

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communication sciences and disorders, 2024
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Abstract

As the U.S. becomes increasingly more diverse, audiologists will have greater numbers of clients on their caseloads who are not native speakers of the English language. Bilinguals, even those who are proficient in English, have been shown to perform differently than English monolinguals on various speech recognition tests (Desjardins, Barraza, Orozco, 2019). Despite this, audiologists are still interpreting the speech recognition performance scores of their bilingual clients relative to the existing normative data base (which was normed with native English language speakers). This is primarily because normative data on common clinical speech recognition test measures for non-native English speakers has not been established. Thus, audiologists may not be accurately diagnosing and providing the most effective treatments to their non-native English-speaking clients.

Introduction and Motivation

Speech recognition testing is a critical component in the standard audiological test battery. Audiologists use clients' speech recognition scores to diagnose pathology and measure the effectiveness of treatments and interventions (Jerger & Jerger, 1981). This is done by comparing a client's speech recognition performance score to a respective normative database. The long-established normative database used in clinical audiological practice was obtained through studies that measured the psychometric properties of the most commonly used speech recognition test materials (e.g. Beattie et al. 1985).

These studies, without exception, collected data from participants who were native English language speakers.

As the U.S. becomes increasingly more diverse, audiologists will have greater numbers of clients on their caseloads who are not native speakers of the English language. Bilinguals, even those who are proficient in English, have been shown to perform differently than English monolinguals on various speech recognition tests (Desjardins, Barraza, Orozco, 2019). Despite this, audiologists are still interpreting the speech recognition performance scores of their bilingual clients relative to the existing normative data base (which was normed with native English language speakers). This is primarily because normative data on common clinical speech recognition test measures for non-native English speakers has not been established. Thus, audiologists may not be accurately diagnosing and providing the most effective treatments to their non-native English-speaking clients. The purpose of this study was to: 1) Obtain the psychometric function for the most commonly used clinical audiometric speech test in individuals whose first language is not English, and 2) Compare the psychometric functions for the most commonly used clinical audiometric speech test in individuals whose first language is not English to English monolingual speakers. We hypothesize that bilinguals will yield Performance-Intensity functions that are significantly different from their English monolingual counterparts.

Case Study and Results

Twenty English monolingual and Twenty Mandarin-English bilingual adults participated in this study. All participants were 18-25 years of age and had normal hearing thresholds from 250 Hz to 8000 Hz, bilaterally. All testing took place in the Hearing Aid Laboratory and the Gebbie Clinic audiology suite and each session took approximately 2.5 hours to complete. First, participants were given an informed consent document. After reading the informed consent document, the participant had the option to choose to participate in the study, decline to participate, and/or ask the examiner for additional information about the study before making a decision. Participants who chose to participate in the study were then given the Language Experience and Proficiency Questionnaire on a PC computer (LEAP-Q; Marian, Blumenfeld, & Kaushanskaya, 2007). Participants hearing thresholds were then screened at 500 Hz, 1000 Hz, 2000 Hz and 4000 Hz, bilaterally (ASHA, 2007). Psychometric functions for the NU-6 word recognition test were obtained using the procedure established (Beattie et al. 1985). Participants were seated in a sound-attenuated booth. Participants then listened to words presented to their right ear via TDH headphones in quiet. Speech recognition materials were presented from a Sony CD player routed through a Grayson Stadler Audiostar Audiometer (Eden Praire, MN) presented at -4, 0, 8, 16, 24, 32 dB. The participant must repeat back the word and write their response on a response sheet. The task was scored as the percentage of key words correctly repeated. Breaks for each participant were provided every 15-20 minutes or as needed.

Figure 1. Performance Intensity function for English Monolingual and Mandarin-English bilingual adults.
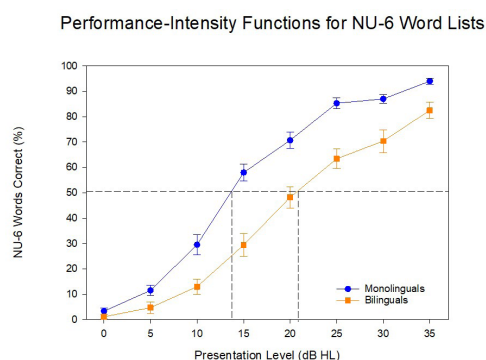

Performance-Intensity Functions for NU-6 Word Lists

Figure 1[1] shows presentation levels of the NU-6 test in dBHL and percent correct speech recognition performance. The PI function for English Monolinguals is consistent with previously published norms for the NU-6 (Beattie, 1985). There was a significant difference in slope between the two groups (t (30) = 4.762, p < 0.001). The shallower slope for bilinguals (orange line) indicates increased test difficulty. The mean 50% correct performance thresholds was 14 dB (SD = 3) for English Monolinguals and 21 dBHL (SD = .9) for Mandarin-English bilinguals. There was a significant difference in 50% performance thresholds between the two participant groups (t (30) = -5.741, p < 0.001): The percent correct performance at 35 dBHL was 100% for English Monolinguals and 80% for Mandarin-English Bilinguals.

The NU-6 Word Recognition Test, also known as the Northwestern University-6 Test, is a standardized and validated speech audiometry test used to assess an individual's ability to recognize monosyllabic words presented at different decibel intensity (dB) levels (Tillman & Carhart, 1966). This test is commonly used by audiologists during a diagnostic hearing evaluation to determine a patient's ability to understand spoken words at a conversational listening level in a quiet environment. To obtain reliable results, the test must be administered in a soundproof booth. There are six lists of the NU-6, each of which contains 50 monosyllabic words which together contain all of the phonemes in the English language. For clinical purposes, a patient would be presented two lists during their hearing evaluation, one to the left ear and one to their right ear at a conversational listening level. For our experimental testing, each participant was presented all 6 lists in a randomized order and at dB levels from very soft to normal conversational levels. Participants were instructed to listen to a word, repeat it verbally and write it down on an answer sheet. Each list of words is scored as thepercentage of words the participants repeated correctly.

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[1] Preliminary results from this project were disseminated through a poster presentation at the American Speech Language and Hearing Convention in Fall 2022. I also presented the findings from this project at the College of Arts and Sciences Undergraduate Research Festival in spring 2023 as well as the SOURCE spring symposium in spring 2023.

Conclusion and Future Work

In conclusion, The NU-6 speech recognition test was more difficult for Mandarin-English bilinguals compared to the English monolinguals , even though the bilingual participants had good English proficiency and normal hearing thresholds. The NU-6 speech recognition test results from clients who are dominant in a language other than English should not be compared with current English monolingual norms. Normative data from the current study can be used by audiologists who are providing services to Mandarin-English bilingual adults to determine speech recognition performance in Mandarin-English bilinguals.

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