TOWSON UNIVERSITY
COLLEGE OF GRADUATE STUDIES AND RESEARCH

THE WORD RECOGNITION SCORES OF NATIVE-ENGLISH

LISTENERS USING WORD LISTS RECORDED IN ENGLISH

FROM NATIVE-SPANISH SPEAKERS WITH VARIED DIALECT

By

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AUDIOLOGY DOCTORAL THESIS APPROVAL PAGE

This is to certify that the Audiology Doctoral Thesis prepared by <u>Monica Labbe</u> entitled <u>THE WORD RECOGNITION SCORES OF NATIVE-ENGLISH LISTENERS USING WORD LISTS RECORDED IN ENGLISH FROM NATIVE-SPANISH SPEAKERS WITH VARIED DIALECT </u> has been approved by his or her committee as satisfactory completion of the Audiology Doctoral Project requirement for the degree <u>Doctor of Audiology (Au.D.)</u>

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ABSTRACT

THE WORD RECOGNITION SCORES OF NATIVE-ENGLISH
LISTENERS USING WORD LISTS RECORDED IN ENGLISH
FROM NATIVE-SPANISH SPEAKERS WITH VARIED DIALECT

Monica Labbe

The profession of audiology is working to recruit professionals from different ethnic backgrounds, particularly Hispanic, into the field to accommodate the increasingly diverse population of the United States.   Speech audiometry, a routine part of the audiological test battery, would be most affected by this multicultural push because test scores could be affected by linguistic variations. The purpose of this study was to determine if the word recognition score of 21 native-English listeners would differ significantly if obtained using word lists recorded in English from two male native-Spanish speakers with varied degrees of dialect compared to one male native-English speaker. The results revealed that the participants scored significantly lower on words were recorded by native-Spanish speakers compared to the native-English speaker. This significant difference could lead to a misdiagnosis if the score were interpreted as true word recognition ability rather than a reflection of the audiologist's dialect.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

Introduction

Speech audiometry is a routine part of the audiological test battery. Over 90% of audiologists conduct word recognition score (WRS) testing (Martin, Champlin, & Chambers, 1998; Wilson, 2004). Although standardized recorded materials are commercially available and research supports the benefits of using standardized recorded material, the majority of audiologists still use monitored live voice (MLV) for speech audiometry (Martin et al., 1998; Wiley, Stoppenbach, Feldhake, Moss, & Thordardottir, 1995). The use of MLV has some significant disadvantages, compared with the use of standardized recorded speech, most notably, the large amount of variability within a speaker or among different speakers. Even among native speakers of English without a non-General American English dialect, speech is affected by the speaker's gender, pitch, voice quality, and speaking rate (Mullenix, Pisoni, & Martin, 1988; Wiley, 1997). As the population of the United States has become more culturally diverse, the effects of linguistic background on WRS will become more of an issue. According to the 2000-2002 United States Census, 75% of the population is white and the second largest ethnic group is Hispanic. The American Speech-Language-Hearing Association, the accrediting body of speech language pathologists and audiologists, has recognized this increase in the multicultural

population and has taken an active role in the recruitment of professionals of different ethnic backgrounds into the field of audiology.

The majority of the literature examining the association between speech recognition and linguistic background has focused on the effect a native-English speaker has on a non-native English listener's WRS. A review of literature indicated only one study (Cakiroglu & Danhauer, 1992) which investigated the effect of both speakers' and listeners' linguistic background on WRS. This study investigated Turkish, East Indian and American speakers and listeners and found the Turkish listeners performed best with the Turkish speaker, while the East Indian and American listeners' scores were not significantly affected by the speakers' linguistic background. To date, there have been no studies examining the effects of native-Spanish speakers on the WRS of native-English listeners; therefore, the purpose of this study was to determine the effect native-Spanish speakers have on the WRS of native-English listeners.

CHAPTER 2

Literature Review

Speech Audiometry

"Historically, the first speech tests were spoken or whispered messages presented at measured distances between the talker and the listener" (ASHA, 1988, p. 85). In the early 1920's, clinical speech audiometry emerged because there was an interest in quantifying how hearing loss affected speech. Today, speech audiometry continues to be an important part of the audiological test battery because the majority of the patients with hearing loss who are seen in the clinic report having difficulty understanding speech (Brandy, 2002; Wilson, 2004).

Speech audiometry has several purposes. It is used to provide information concerning sensitivity to speech materials and the understanding of speech at suprathreshold levels (ASHA, 1988). It can be used diagnostically to examine speech-processing abilities throughout the auditory system, and also to crosscheck the validity of pure-tone thresholds. In addition, speech audiometry is used to diagnose or monitor the progression of a pathology, determine hearing aid candidacy and benefit, and to assess auditory processing (Mackersie, 2002; Stach, 1998).

Speech Audiometric Tests

There are many different areas of interest in speech audiometry and different tests are required to assess each of them. Examples of speech audiometric tests include: speech detection threshold/speech awareness threshold (SDT/SAT), speech-in-noise tests, speech recognition threshold (SRT) and word recognition score (WRS). The following is a brief discussion of each of these categories of speech audiometric tests.

Speech detection threshold/speech awareness threshold tests. Speech detection threshold (SDT) or speech awareness threshold (SAT) tests measure the minimum intensity level (in dB HL) at which the presence of a speech signal can be detected 50% of the time (ASHA, 1988). For these tests, the patient is not required to recognize (understand) the stimulus, but rather indicate if the stimulus is present. Although SDT/SAT tests are often used with children, they are occasionally used with adults. For example, if the SRT is significantly higher than the pure-tone average, the SDT/SAT tests may more accurately measure the true hearing sensitivity (Brandy, 2002).

Speech-in-noise testing. Speech-in-noise testing is used to measure the ability of a patient to understand speech in the presence of background noise, to aid in the selection of amplification as a test of functional gain to show hearing aid benefit (Wilson, 2004) and as one part of an auditory processing assessment. The recommended stimuli for amplification purposes, according to Wilson, are words or sentences in multitalker babble which simulates listening to speech in a background of noise similar to a cafeteria or other crowded place.

Speech recognition threshold.   The speech recognition threshold is the

minimum level at which a patient can repeat a speech signal correctly 50% of the

time. This test is commonly conducted using spondaic words (spondees), which

are two-syllable words (e.g. baseball, cowboy) which have equal emphasis on

both syllables. Unlike the SDT/SAT, the SRT requires a patient to "recognize"

presented words and either repeat, point to, or write down the word. The first

step of the test is to familiarize the patient with the spondee words that will be

used during testing. The purpose of this step is to ensure that the test

vocabulary is familiar to the patient, the patient can auditorily recognize each

word, and that the patient's responses can be accurately interpreted by the tester

(ASHA, 1988).   From here, there are several methods of obtaining the SRT.

The next step in the ASHA (1988) method is to determine the starting level.

According to ASHA, one word is presented at 30 or 40 dB HL. If this level is too

low and the patient does not respond, the intensity is increased in 20 dB steps

until a word is correctly repeated. Once a word has been correctly repeated, the

intensity is decreased in 10 dB steps, with one word presented at each level, until

the patient misses a word. If the patient misses a word, a second word is

presented. The starting level of the test is determined as the intensity at which

the patient misses two consecutive words plus 10 dB.   From the starting level,

five words are presented. If all five are repeated correctly, the intensity is

decreased in 5 dB steps, with five words presented at each level, until the

listener misses all five words at the same level. The SRT is equal to the starting

level minus the number of words repeated correctly, plus 2 dB (correction factor).

The SRT is obtained to ensure the validity of the pure-tone results. The SRT also serves as a baseline for determining the presentation levels for word recognition tests (ASHA, 1988).

Word recognition score. The word recognition score (WRS) is the percentage of words repeated correctly at a suprathreshold level. In theory, the WRS is the best score that can be obtained from a particular patient; however, the optimal WRS is only obtained by performing a time-consuming performance intensity function. Therefore, the WRS is often assumed to be at its optimal level when tested at a level deemed comfortable by the patient or a level at some predetermined sensation level relative to the SRT.

The most commonly used materials for WRS testing are monosyllabic words that are presented in an open-set format. An open-set format means that the patient must respond without any prior knowledge of what the possible alternatives might be (Gelfand, 2001). The words are presented at a sensation level above the SRT via earphones or speakers. The examiner keeps a tally of correct and incorrect responses and a percent correct score is derived. WRS can be used to describe how a hearing impairment affects speech understanding, to diagnosis auditory disorders, to determine hearing aid candidacy and to verify hearing aid benefit (Gelfand, 2001; Wilson, 2004).

The SRT and WRS are the two most routinely administered speech audiometric tests (Wiley, Stoppenbach, Feldhake, Moss, & Thordardottir, 1995; Martin, Champlin, & Chambers, 1998). The primary focus of this project is

WRS. The following section will review the factors that can affect an individual's

performance on word recognition testing.

Word Recognition Testing

Over the past 25 years, Martin has periodically surveyed and reported the

audiometric tests and test procedures used by audiologists for diagnosis. The

surveys request information regarding the number and percentage of respondent

audiologists who used specified tests and procedures. According to the most

recent survey by Martin et al. (1998), 91% of the audiologists who responded to

the survey reported they routinely administer word recognition testing. In a

similar survey by Wilson (2004), a similarly high number of audiologists reported

they conducted word recognition testing, with WRS conducted on almost all

patients seen for an audiological evaluation. Because of the pervasiveness of

this test procedure in audiology clinics, it is important that any factors that could

affect the test accuracy are understood by clinicians and explored by

researchers.

There are many factors that may affect the WRS, including: the word list,

lexical factors (e.g. frequency of word use), the number of words presented, the

use of a carrier phrase, the intensity level of presentation, the gender of the

speaker, the voice quality of the speaker, and the delivery method of the stimulus

(e.g. monitored live voice (MLV) or standardized recording) (Bell & Wilson, 2001;

Brandy, 2002; Dirks, Takayanagi, & Mosfegh, 2001; Martin et al., 1998; Posner &

Ventry, 1977; Thorton & Raffin, 1978; Ullrich & Grimm, 1976; Wiley et al., 1995;

Wilson, Zizz, Shanks, & Causey, 1990). The following is a discussion of each of

these factors.

Word list. Historically, the first recorded speech test was the Western

Electric 4A (Fletcher & Steinberg, 1929). This test consisted of spoken digits

presented via a phonographic recording. Twenty years later, in the 1940's, word

lists were developed for clinical testing, and that is the model still being used

today. The types of stimuli generally used for word recognition tests include

nonsense syllables, monosyllabic words and sentences (Nicolosi, Harryman, &

Kresheck, 1996; Brandy, 2002). The most widely used word recognition tests for

adults are the Central Institute for the Deaf (CID) W-22 word list and the

Northwestern University Test No. 6 (NU-6) word list (Martin et al., 1998; Wiley et

al., 1995).

The W-22 word list was developed by Hirsh et al. (1952). The W-22

consists of 200 phonetically balanced monosyllabic words arranged in four lists

of 50 words. Phonetic balance means that the relative frequencies of the

phonemes on the test list are as close as possible to the distribution of speech

sounds used in English (Gelfand, 2001). The other commonly used word list, the

NU-6, was developed by Tillman and Carhart (1966). The NU-6 consists of 200

phonemically balanced words arranged in four lists each containing 50 words. In

the Martin et al. (1998) study, 48% of the respondents reported they use the W-

22 word list compared to 44% reportedly using the NU-6 word list.

A disagreement exists in the literature regarding differences in WRS

scores based on the word list chosen. An early study comparing the

performance of normal hearing listeners on the W-22 and NU-6 word lists was

done by Beattie, Edgerton and Svihovec (1977). WRS scores were obtained at 8

sensation levels (4, 8, 12, 16, 20, 24, 28 and 32 dB re: SRT). The results

indicated that as the sensation level increased, the W-22 scores increased at a

greater slope (4.6%/dB) when compared to the NU-6 scores (4.2%/dB), however

these differences did not reach statistical significance. The only significant

difference found was at 20 dB SL. These investigators concluded that the NU-6

word list may be slightly more difficult than the W-22. A more recent study

conducted by Wilson and Oyler (1997) looked at the psychometric functions for

the W-22 and NU-6 materials spoken by the same speaker with participants who

had normal hearing. A psychometric function describes the relation between the

physical intensity of a stimulus and a listener's ability to detect or respond

correctly to it. The results suggested that recognition scores were 4-8% better on

NU-6 materials compared to W-22 materials. Although this difference is

statistically significant, it is not clinically significant. For clinical purposes, the two

to four dB differences are within the five dB measurement steps typically used.

Lexical Factors. WRS can also be affected by several lexical factors such

as the position of the word in the sentence as well as the frequency of word use.

In 1998, Luce and Pisoni proposed a model known as the Neighborhood

Activation Model (NAM), which states that words that occur frequently and have

few phonemically similar neighbors (lexically easy words) are recognized more

easily than words that occur less frequently and have a large number of

phonemically similar neighbors (lexically hard words) (Luce, 1986; Luce &

The WRS of native-English listeners from native-Spanish speakers 10

Pisoni). More recently, Dirks, Takayanagi and Moshfegh (2001) looked at the

effects of lexical factors on word recognition for both hearing impaired and

normal hearing listeners. Their results support the NAM model; individuals with

normal hearing and those with hearing impairments performed better with

lexically easy words when compared to lexically hard words.

Bell and Wilson (2001) studied how recognition of sentence materials was

influenced by frequency of word use and lexical confusability. Lexical

confusability was defined as the number of other words in the language that are

phonetically similar to a given target word. The results of this study indicated that

high use words were more intelligible than low use words in both noise and quiet.

These results are similar to those found by Dirks et al. (2001).

Number of items. The number of words presented in a word recognition

list is an important clinical consideration because the use of fewer items

increases the variability and decreases the reliability of the scores (Penrod, 1994;

Wiley et al., 1995).   Thornton and Raffin (1978) investigated the variability of

speech recognition scores as a function of the number of items on the word list.

A binomial model was developed, and some of its characteristics were tested

against data from 4120 scores obtained on the W-22 test. A table for determining

significant deviations between scores was generated and compared to observed

differences in half-list scores for the W-22 tests. Their findings showed that the

shorter the word list, the greater the standard deviation. For example, for a W-22

WRS of 80%, the standard deviation for a 50-item list is plus or minus six

percent, while a 25-item list has a standard deviation of plus or minus eight

The WRS of native-English listeners from native-Spanish speakers 11 percent. Beatie, Svihovec and Edgeton (1977) compared WRS's of normal hearing listeners on half versus full word lists. They found 96% of the half-list scores were within six percent of the full-list scores. However, four percent had a half-list/full-list difference which ranged from 8-14%. Therefore, the researchers suggested using half-lists as a screening tool to determine if a full-list is required. Even though there is a possibility that the reliability is jeopardized by using a 25 item word list, 56% of audiologists reported they administer 25 words per ear routinely, although 30% reported they continue past 25 words if the patient misses any words (Martin et al., 1998).

Carrier Phrase. The variability of word recognition scores due to the presence or absence of a carrier phrase has been carefully researched. Studies have shown that statistically significant improvements in WRS occur with the use of a carrier phrase (Gelfand, 1975; Gladstone & Siegenthaler, 1971). According to Brandy (2002) one possible reason for this improvement is that the use of a carrier phrase may serve as an alerting tool for the patient. In contrast, other studies have shown no statistically significant difference in WRS when a carrier phrase is used (Martin, Hawkins, & Bailey, 1962).

Level of Presentation. The level of presentation of speech stimuli can have a significant impact on an individual's WRS. Sixty-seven percent of audiologists reported they administer word recognition tests at a specific sensation level referenced to the SRT (Martin et al, 1998). Forty percent use 40 dB SL (re: SRT) and 30% use 30 dB SL (re: SRT) (Wiley et al., 1995). The use of 30 or 40 dB SL re: the SRT is often better than using the most comfortable

The WRS of native-English listeners from native-Spanish speakers 12

loudness level (MCL), because the highest word recognition score is often

obtained at levels significantly above the MCL (Ullrich & Grimm, 1976; Posner &

Ventry, 1977). However, none of these methods assures that the optimal WRS

is obtained.

Gender of speaker. In 1990, Wilson, Zizz, Shanks, and Causey obtained

normative data for the NU-6 word list recorded by a female speaker. These data

were then compared to the data obtained with the original male recorded version

(Tillman & Carhart, 1966). Results revealed that even though the male and

female speakers were recorded at 0 VU, the intensity of the female speaker was

11-15 dB higher in comparison to the male. The differences could be due to the

spectral differences between the two sets of materials that produced a calibration

anomaly. However, this information should be taken into consideration when

comparing WRS results presented via male/female MLV.

Monitored Live Voice versus Recorded Material.

The two clinical methods of presenting speech materials are MLV and

recorded speech stimuli. There are several advantages and disadvantages to

each method. The advantages to using MLV include quickness and flexibility

(Carhart, 1946; Mackersie, 2002). The speed at which the words are presented

can be adjusted to accommodate the patient. For example, an elderly patient

may require a longer interstimulus interval in order to process the word and

respond. The disadvantages to using MLV include variability between speakers

and within the same speaker for multiple presentations (Mullennix, Pisoni, &

Martin, 1988; Wiley, 1997). Factors that can contribute to variability include

differences in pitch, voice quality, speaking rate, dialectical differences and accents (Mullennix et al., 1988). According to ASHA (1988), it is impossible to produce a word list the same way every time during MLV. This statement is supported by research beginning in the1960's, when researchers were first beginning to see statistically significant differences in WRS between presentations by the same speaker (Brandy, 1966). For example, Brandy observed that when the same word list was presented by the same speaker on successive days, there was variability in the speaker's performance.

One of the purposes of assessing word recognition ability during re-evaluations is to look for significant decreases which could possibly be an indicator of a retrocochlear pathology. If MLV is used there is no way of knowing if a significant change has actually occurred or if the change was influenced by the speaker (Stach, 1998).

According to Stach (1998), "…if you are using MLV you should not even bother doing the testing because results obtained by testing with monitored live voice testing are uninterpretable" (p. 11). Even though the preponderance of the evidence suggests MLV is not the optimal testing method, 82% of audiologists' reported that they use MLV during word recognition testing (Martin et al., 1998). This figure is surprising given the amount of published research showing the large degree of variability present when using MLV over standardized recorded materials.

The advantages of standardized recorded material include the fact that published data are based on standardized recorded material and there is better

control over the intensity and quality of the speech signal (ASHA, 1988). One disadvantage of standardized recorded material for speech audiometry is the difficulty using standardized recorded speech for testing children because of a longer administration time and reduced flexibility, compared to MLV testing. In addition, standardized recorded speech requires the use of additional equipment (CDs, CD player) compared to MLV.

Familiarity of Talker's Voice. Nygaard, Sommers and Pisoni (1994) studied listeners' familiarity with a speaker's voice to see if it had any effect on the recognition of words. Two groups of 19 listeners learned to recognize the voices of 10 speakers over a nine day period. Listeners who were presented with words from a familiar speaker were able to recognize unfamiliar words better than listeners presented with words from an unfamiliar speaker. This data indicated that voice recognition and understanding the phonetic contents of speech were not independent. "This study provides the first direct demonstration of the role of long-term memory and perceptual learning of source characteristics in speech perception and spoken word recognition" (Nygaard et al., p. 45)."

Linguistic Variation. According to The ASHA Leader, "speech audiometry is most affected by multiculturalism because tests are language-based" (2003, p. 1). Previous studies have found that non-native English speakers perform poorly when compared to native-English speakers on word recognition tests (Gat & Keith, 1978). It has been shown that the non-native listeners require greater intensity for equal intelligibility than the native listeners (Takayanagi, Dirks, & Moshfegh, 2002).

A linguistic variation is defined as "the differences existing linguistically (phonemes, morphemes, syntax, semantics, pragmatics) which affect production relative to the differences in speech situations, speakers, or both (Nicolosi, Harryman, & Kresheck, 1996)." Linguistic variations are increasing in importance to speech audiometry because the population of the United States is growing more multicultural (Anderson & Wilkerson, 1993; United States Census, 2002). According to the 2000-2002 United States Census, of the 288,366,698 people in the U.S., 75% are white. The next largest ethnic group is the Hispanic population which accounts for 13% of the U.S. population. In 2000, 32.8% of Hispanics lived in the South (Maryland was included with the Southern states). Similar ethnic trends are seen in ASHA's audiology membership, with Hispanic members making up one of the largest minorities, although the percentage of minority members in ASHA is far below the percentage in the general population. A demographic profile of the 12,899 ASHA member and nonmember certificate holders certified in audiology revealed 92% are white, 2.4 % are Asian, and 2.0% are Hispanic (ASHA, 2003). ASHA is currently conducting a large scale marketing and recruiting effort to attract minority students into the professions of speech-language pathology and audiology.

According to the U.S. Census, Spanish is spoken by almost 400 million people worldwide in 21 different countries. There are many Spanish dialects and the two most common ones are Latin American Spanish and Castilian Spanish (U.S. Census, 2000). Other dialects include Andalusian, Murcain, Aragonese, Navarrese, Leonese, and Canary Islands Spanish. In the United States, Latin

American Spanish is the most common dialect spoken. Latin American Spanish

is also spoken in Mexico, Cuba, Puerto Rico, the Caribbean, Central America

and South America. More than 20 million Mexican Americans live in the United

States, comprising 7.3% of the total population and 58% of the Hispanic

population, making them the largest subgroup of the largest minority group in this

country.   Similar ethnic trends are seen in the state of Maryland. In 2000, the

total population in Maryland was 5,296,486. The Hispanic population comprised

227,916 or 4.3% of the total Maryland population, including 39,900 of Mexican

descent (U.S. Census).

Despite the steady increase in multiculturalism in the United States, there

is insufficient research investigating the effects of listeners' and speakers'

linguistic backgrounds on WRS performance. Cakiroglu and Danhauer (1992)

investigated Turkish, East Indian and American speakers as well as listeners

from each language group and the effects their linguistic backgrounds had on W-

22 test performance. They found statistically significant differences in the WRS's

of listeners based on the listeners' ethnic background. The researchers

suggested that even though there were significant differences, these differences

may not be clinically significant and that linguistic backgrounds should not pose a

problem in the clinical evaluation of Turkish or East Indian listeners. Only the

Turkish listeners' word recognition scores improved when obtained by the

speakers' of their own linguistic backgrounds, while the East Indian and

American listeners' scores were not significantly affected by the speakers'

linguistic background.

Statement of Purpose

Previous studies investigating the effects of linguistic variation on word recognition have focused on native-English speakers and non-native English listeners (Takayanagi et al., 2002; Gat & Keith, 1978). Only one study (Cakiroglu & Danhauer) investigated the effects of non-native speakers, and these non-native speakers were of Turkish and East Indian descent. ASHA has recognized the importance of multiculturalism within the United States and has been actively working to recruit students and professionals from different ethnic backgrounds into the field of Audiology. The Hispanic population is of particular interest because it is the second largest ethnic group in the United States.

Given the emphasis on increasing the number of Hispanic professionals in the field, and the fact that one of the largest minority groups in audiology is Hispanic, and the fact that the majority of audiologists use MLV as part of their test protocol for WRS assessment, it is important to determine if WRS is significantly affected by a Spanish dialect. Specifically, does the most common Spanish dialect (Latin American) affect WRS score? The purpose of this study was to conduct WRS tests with native-English speaking listeners using English word lists read by Latin American Spanish speakers with varying degrees of dialect.   For this study, the word lists were recorded to control for intensity between words, with the focus on how the accent itself affects WRS.

CHAPTER 3

Methodology

Development of Speech Material

There are several Spanish dialects; however, in the United States Latin American Spanish is the most common dialect spoken and was used in the study. This study was approved by the Towson University Institutional Review Board (IRB) for the protection of human subjects (Appendix A). A group of Latin Americans who speak English were recruited by flyers posted around the Towson University campus. The Latin American Spanish speakers reported speaking English secondary to their primary language, Spanish. They further reported passing the Test of English as a Foreign Language (TOEFL) exam as a Towson University requirement for all non-native English speakers residing in the United States for less than five years. The TOEFL exam measures the ability of non-native speakers of English to use and understand English as it is spoken, written, and heard in college and university settings. Towson University requires a minimum score of 500 for paper-based or 173 for computer-based tests for admissions into an undergraduate program. The Speech-Language Pathology Master program and the Audiology Doctoral program at Towson University require a minimum of 600 score for paper-based or 250 for computer-based tests.

The speech of the Latin American Spanish speakers was screened by a certified speech-language pathologist and a graduate student in the speech-language pathology program. Each speaker produced two speech samples; a three minute spontaneous speech sample and reading the rainbow passage (see Assessment in Speech-Language Pathology a Resource Manuel 3rd Edition). The speech-language pathologist and graduate student independently rated the speakers for strength of speech dialect relative to General American English using a six point Speech Dialect Rating Scale adapted from Morley (1991). From this sample, the speakers for the study were selected. According to the Morley scale:

- Level one - speech is basically unintelligible; only an occasional word/phrase can be recognized.

- Level two – speech is largely unintelligible; great listener effort is required; constant repetitions and verifications are required.

- Level three – speech is reasonably intelligible, but significant listener effort is required due to speaker's pronunciation/grammatical errors which impeded communication and cause listener distraction; ongoing need for repetitions and verifications.

- Level four – speech is largely intelligible; while sound and prosodic variances from native speaker norm are obvious, listeners can understand if they concentrate on the message.

- Level five – speech is fully intelligible; occasional sound and prosodic variances from native speaker norm are present but not seriously distracting to listener.

- Level six – speech is "near-native"; only minimal features of divergence from native speaker can be detected; near-native sound and near-native prosodic patterning.

Two adult male Latin American Spanish speakers and one male native-English speaker (Nat Eng), ranging in age from 18-27 years served as the speakers in the study. The Latin America Spanish speakers were selected based on their age, dialect rating and because their native countries spoke Latin American Spanish. The native-English speaker was selected based on age and state of origin. The native-English speaker is a native of Maryland and was judged to speak with a General American English dialect by a graduate student in the speech-language pathology program. The first Latin American Spanish speaker (Lat Amer M) was originally from Mexico and had been living in the United States and learning English for two years. The second Latin American Spanish speaker (Lat Amer G) was originally from Guatemala and had also been living in the United States and learning English for two years.

Both of the speakers reported similar language status (bilingual), language history (circumstantial bilinguals - no choice but to learn English in order to communicate in the United States and learned English as an adult), and language competence (passed TOEFL exam). The main difference between the two speakers was their demand to speak English. Lat Amer M reported speaking

The WRS of native-English listeners from native-Spanish speakers 21

Spanish as his primary mode of communication whereas Lat Amer G reported

speaking English as his primary mode of communication. This difference in

language demand was consistent with the ratings assigned to the two speakers.

Lat Amer M was rated a three for the rainbow passage and a four on his

spontaneous speech sample on the Morley scale by both the speech-language

pathologist and the graduate student. Lat Amer G was rated a four and a five for

the rainbow passage by the graduate student and speech-language pathologist,

respectively. The speaker was rated a five for the spontaneous speech sample

on the Morley scale by both of the raters. Therefore, Lat Amer M was rated as

having a more pronounced accent than Lat Amer G based on the Morley criteria.

The speakers were audio-recorded in a sound-treated booth, using a

digital recorder, while closely monitoring their voice on a VU meter to ensure that

the peak value was within +/- 2 dB for all words. Lists 1-3, version A of the

Central Institute of the Deaf (CID) W-22 word list (Appendix C) were recorded for

each speaker.

Participants

Twenty-one native-English speaking adults (10M, 11F) between 18 and 27 years

of age (mean 19 years) served as listeners. All participants were otologically

normal. Otologically normal was defined as SRTs of 20 dB HL or better, normal

tympanograms, no history of otologic disorders and pure-tone air- and bone-

conduction thresholds of 20 dB HL or better in both ears for the octave frequency

range of 250-8000 Hz. The mean pure-tone air conduction thresholds are shown

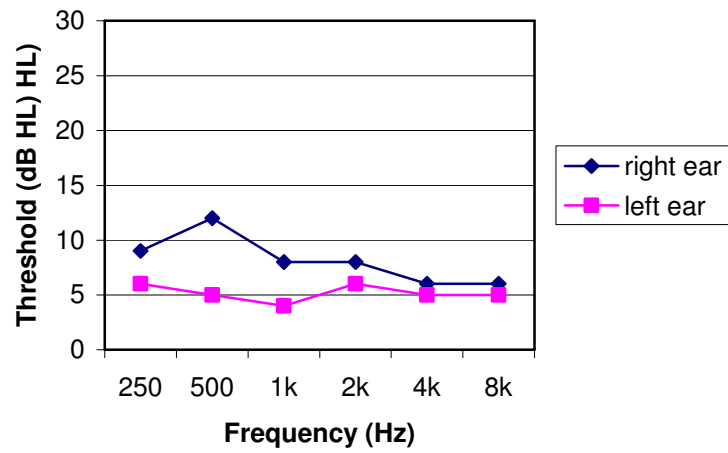in Figure 1. The figure illustrates that air conduction thresholds were

Figure 1. Mean pure-tone air conduction thresholds of the participants (n=21).

The WRS of native-English listeners from native-Spanish speakers 23 well within normal limits, ranging from 6 -12 dB HL for the right ear and from 4 – 6 dB HL for the left ear across the frequency range.

Each participant was asked the following questions:

- Do you speak another language fluently? If yes, what language?

- Have you ever studied foreign language(s) in school? If yes, what language(s) and how long did you study the language?

All of the participants, with the exception of two, answered no to the first question. The two who answered yes both reported they were semi-fluent in Spanish. They both reported studying Spanish for six years and spending one year studying abroad. A summary of the responses to the other questions are shown in Figures 2 and 3. Of the 21 participants, only four of the participants reported never learning Spanish in school. Figure 2 illustrates that 81 % of the participants reported previously studying Spanish. Seventeen of the 21 participants reported studying Spanish in school for six months to as long as six years. Figure 3 illustrates that the average length of time participants studied Spanish in school was approximately two and a half years.

Experimental Procedure

Testing was conducted in a two-room audiologic suite meeting ANSI standards for maximum permissible background noise (ANSI S3.1-1999). All stimuli were presented through an Aurical clinical audiometer using Etymotic ER 3A insert earphones. Tympanometric data were obtained using a Madsen Zodiac 901 immitance bridge. SRTs were obtained using MLV and the CID Auditory Spondee word list A. All recorded speech stimuli were routed from a

Figure 2. Percentage of participants who studied foreign language(s) in school.
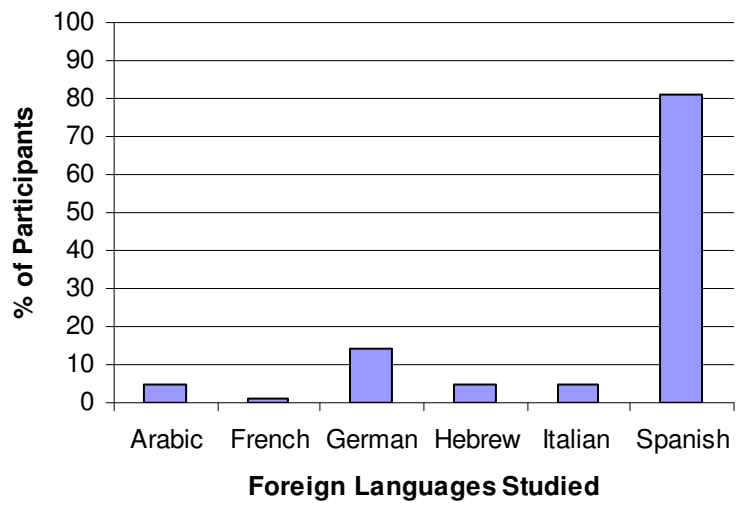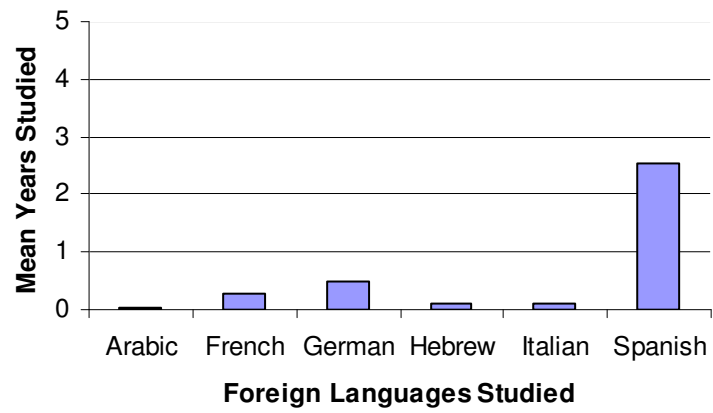
Figure 3. Length of time participants studied foreign language(s).

The WRS of native-English listeners from native-Spanish speakers 26

Zodiac 901 immitance bridge. SRTs were obtained using MLV and the CID

Auditory Spondee word list A. All recorded speech stimuli were routed from a

TASCAM TEAC Professional Division DAP1 digital audio tape recorder to the

accessory input of the audiometer and then to the earphones. Calibration was

checked before and after the experiment and indicated the equipment was in

good working order throughout the experiment.

After the audiometric testing each participant was given the following

instructions:

>You are going to hear recordings of three male
>
>speakers saying lists of words. Before each word, the
>
>speaker will say "say the word." Write down each
>
>word as you heard the talker say it. If you are not
>
>sure of the word, please guess. Please write each
>
>word clearly.

The participants were presented with three lists of 50 words from the W-22 word

lists (one from each speaker) in quiet. The stimuli were presented in only the

participant's right ear and the word lists were presented at 40 dB SL re: SRT.

The presentation order of the three speakers and three word lists was

counterbalanced across listeners and is shown in Table 1. In addition, the

combination of speaker and wordlist was counterbalanced such that no one

speaker x list combination appeared in an unusual frequency.

Although this study was based on the use of MLV compared with

Table 1

Presentation Order of Speakers/Word Lists

Participant	Presentation order		
1	Speaker 1 – List a	Speaker 2 – List b	Speaker 3 – List c
2	Speaker 1 – List b	Speaker 2 – List c	Speaker 3 – List a
3	Speaker 1 – List c	Speaker 2 – List a	Speaker 3 – List b
4	Speaker 1 – List a	Speaker 3 – List b	Speaker 2 – List c
5	Speaker 1 – List b	Speaker 3 – List c	Speaker 2 – List a
6	Speaker 1 – List c	Speaker 3 – List a	Speaker 2 – List b
7	Speaker 2 – List b	Speaker 1 – List a	Speaker 3 – List c
8	Speaker 2 – List c	Speaker 1 – List b	Speaker 3 – List a
9	Speaker 2 – List a	Speaker 1 – List c	Speaker 3 – List b
10	Speaker 3 – List b	Speaker 1 – List a	Speaker 2 – List c
11	Speaker 3 – List c	Speaker 1 – List b	Speaker 2 – List a
12	Speaker 3 – List a	Speaker 1 – List c	Speaker 2 – List b
13	Speaker 2 – List b	Speaker 3 – List c	Speaker 1 – List a
14	Speaker 2 – List c	Speaker 3 – List a	Speaker 1 – List b
15	Speaker 2 – List a	Speaker 3 – List b	Speaker 1 – List c
16	Speaker 3 – List c	Speaker 2 – List b	Speaker 1 – List a
17	Speaker 3 – List a	Speaker 2 – List c	Speaker 1 – List b
18	Speaker 3 – List b	Speaker 2 – List a	Speaker 1 – List c
19	Speaker 1 – List b	Speaker 3 – List a	Speaker 2 – List c
20	Speaker 2 – List c	Speaker 3 – List a	Speaker 1 – List b
21	Speaker 3 – List c	Speaker 1 – List a	Speaker 2 – List b

The WRS of native-English listeners from native-Spanish speakers 28

standardized recorded speech, it examined only one aspect of possible variability

based on speaker characteristics; that is the dialect of the speaker. In order to

attempt to control for other possible causes of variability associated with MLV,

the presentations were recorded. The number of words correct was determined

by comparing the participant's written responses to the master list.

CHAPTER 4

Results

Although the order of presentation was counterbalanced by list, speaker and list x speaker to control for potential order effects, the performance of the listeners based on list and order were examined along with the speaker to confirm that these factors did not confound the results of the study. The group mean number of words correct out of 50 for each main effect (order, list, and speaker) are shown in Table 2. This table reveals that the mean number of words correct was similar for the first, second, and third order of presentation, with the second presentation being slightly higher (36.81) compared with the first (34.86) and third (35.43) presentations. However, examination of the boxplot of these data (Figure 4) indicates an overlap in the data which suggests that they were not significantly different and this was confirmed by a non-significant repeated measures analysis of variance (ANOVA), $F(2,19) = 0.98$, $p = 0.84$.

Table 2 also reveals that the mean number of words correct was similar for the list one, list two, and list three, with list three being slightly higher (37.38) compared with list one (34.76) and list two (34.95). However, examination of the boxplot of these data (Figure 5) indicates an overlap in the data which suggests that they were not significantly different and this was confirmed by a

Table 2

Listeners' Number of Words Correct Across Word Order, List and Speaker

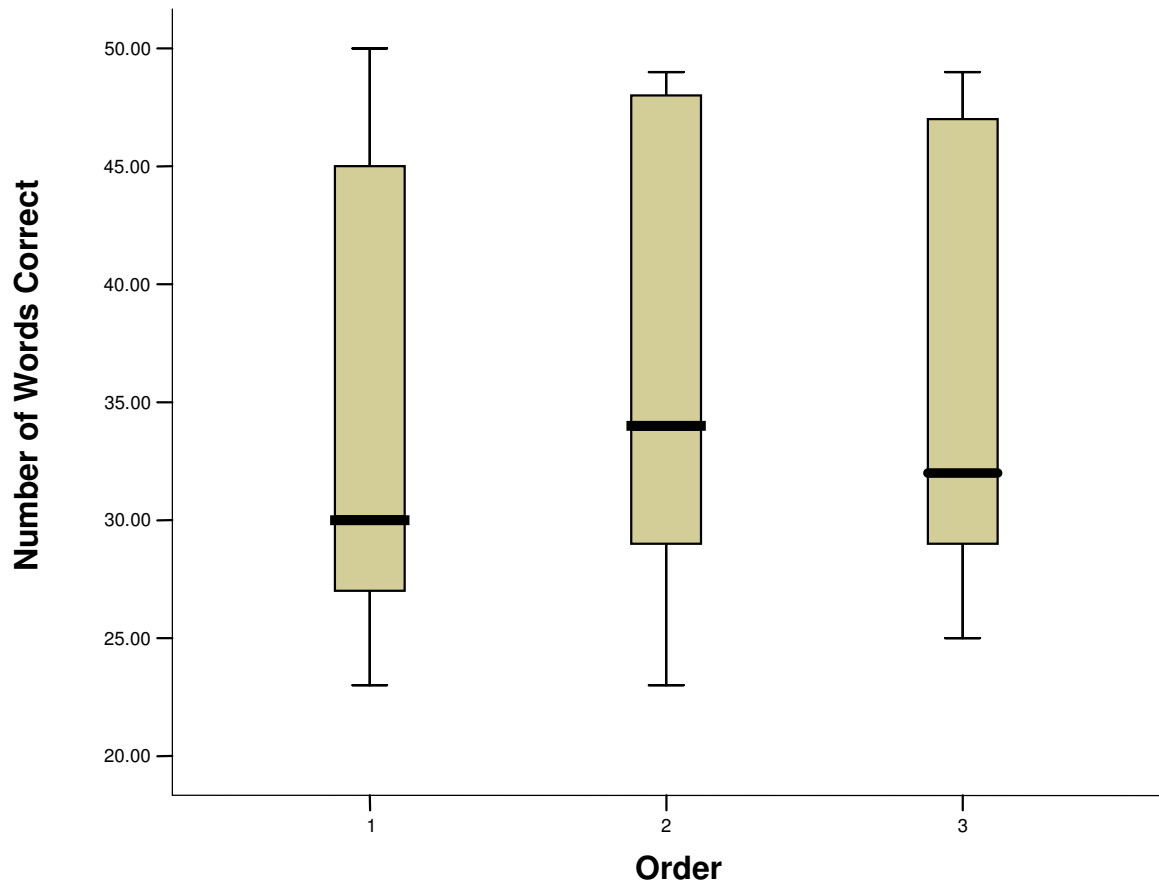|	N	Mean	Std. Deviation
Order one	21	34.86	9.70
Order two	21	36.81	8.94
Order three	21	35.43	8.47
List one	21	34.76	10.01
List two	21	34.95	9.15
List three	21	37.38	7.60
Lat Amer M	21	28.62	2.75
Lat Amer G	21	31.10	4.31
Nat Eng	21	47.38	1.86

Figure 4. The mean number of words correct for the first, second, and third presentation.

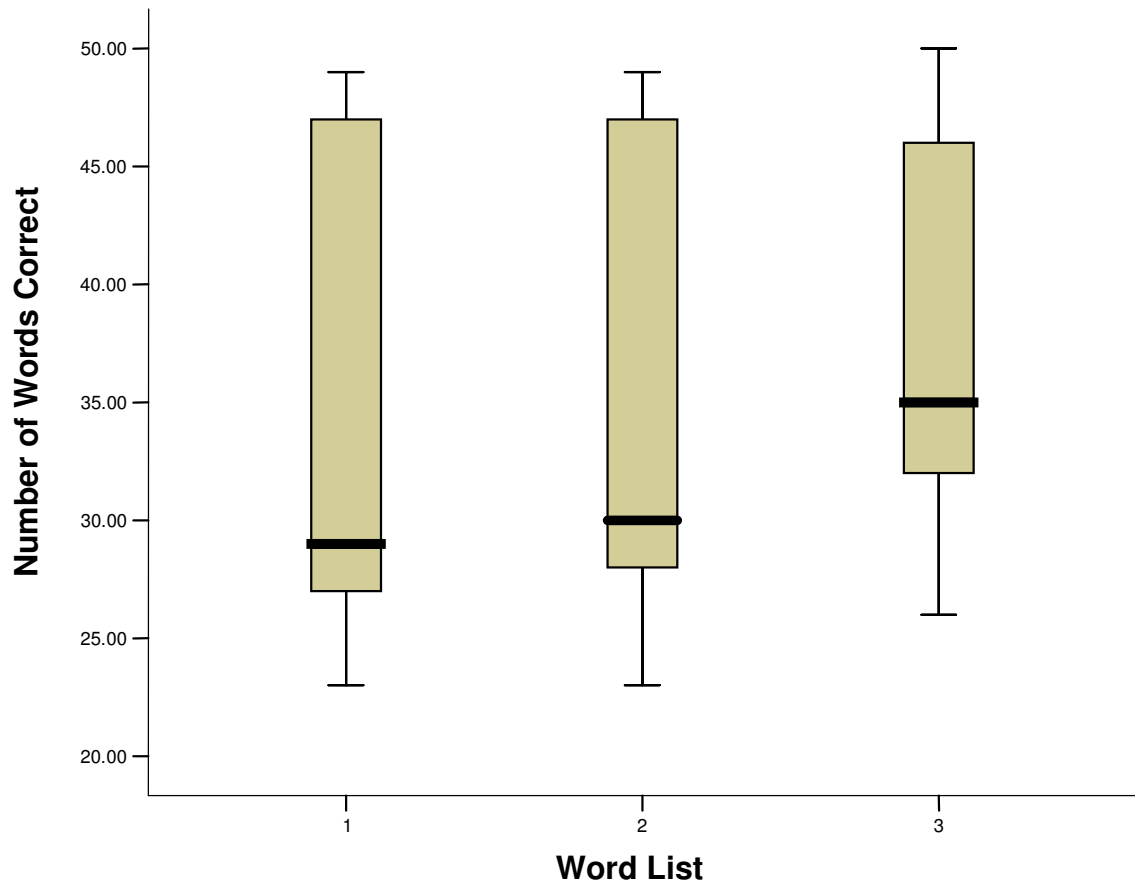The WRS of native-English listeners from native-Spanish speakers 32

Figure 5. The mean number of words correct for list one, list two, and list three.

The WRS of native-English listeners from native-Spanish speakers 33 non-significant repeated measures ANOVA, $F(2,19) = .95$, $p = .64$.

Finally, Table 2 reveals that the mean number of words correct was similar for Lat Amer M and Lat Amer G with Nat Eng being much greater (47.38) compared with Lat Amer M (28.62) and Lat Amer G (31.10). Examination of the boxplot of these data (Figure 6) indicates an overlap in the data for Lat Amer M and Lat Amer G but not for Nat Eng which further illustrates the differences between groups. This boxplot also demonstrates that the variance across the groups was not homogeneous. A Levene's test of equality of error variances indicated that there was a statistically significant difference in variance across the three groups ($p = .000$); therefore, non-parametric statistics were used for analysis of the speaker data.

A Friedman test was conducted to examine the main effect for speaker. A significant main effect was found ($\chi^2(2) = 32.75$, $p = .000$). Post-hoc analysis using the Wilcoxon test was conducted. The alpha level for these tests was set at 0.01 to control for the overall error rate. The Wilcoxon test compared Lat Amer M to Lat Amer G, Lat Amer G to Nat Eng, and Lat Amer M to Nat Eng. No significant difference was found between Lat Amer M and Lat Amer G ($Z = -2.034$, $p > 0.01$). A significant difference was found between Lat Amer G and Nat Eng ($Z = -4.02$, $p < .01$) and between Lat Amer M and Nat Eng ($Z = -4.03$, $p < .01$).
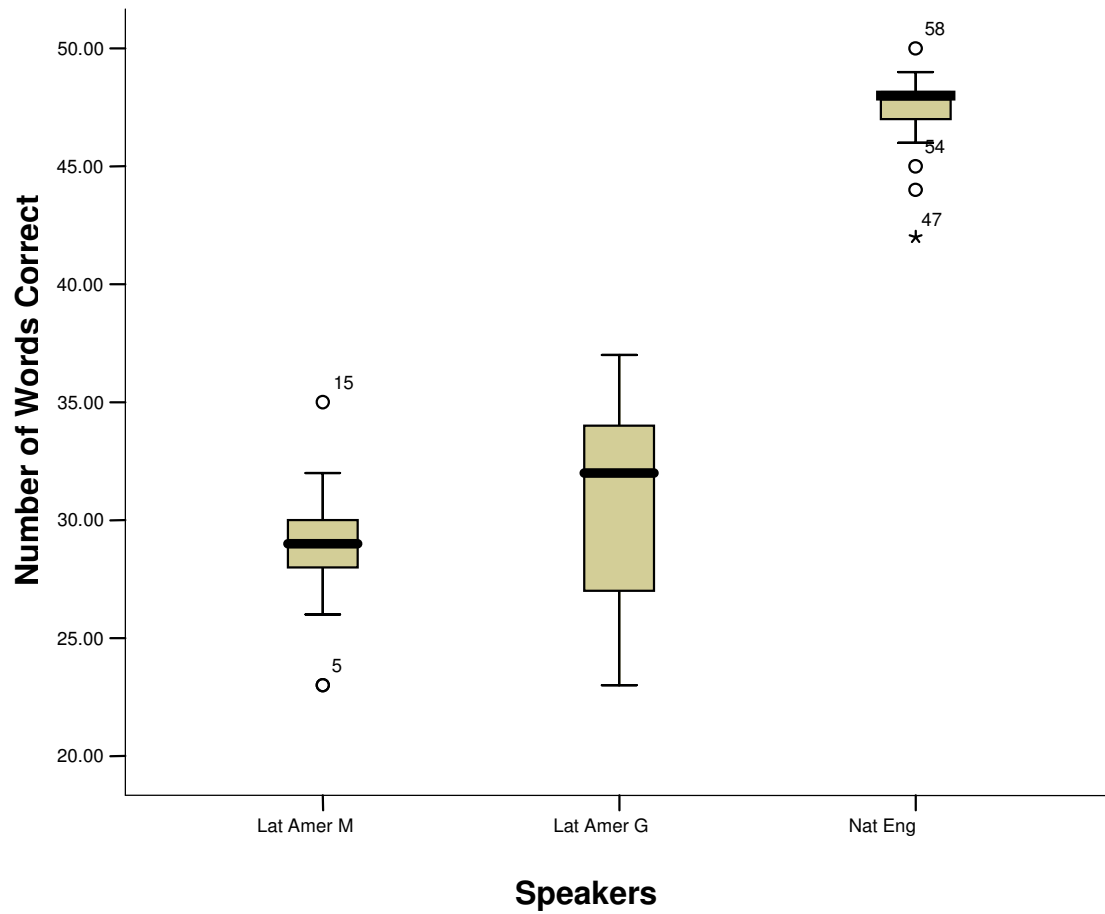
Figure 6. The mean number of words correct for Lat Amer M, Lat Amer G, and Nat Eng.

The data were also examined to determine if the previous exposure of listeners to the Spanish language had an effect on the WRS. Seventeen of the 21 participants reported studying Spanish in school (mean = 2.55 years). Two of the 17 participants considered themselves to be semi-fluent in Spanish. Both of these participants scored slightly higher when words were presented from Lat Amer G compared to Lat Amer M. The WRSs for these two participants were 34 and 35 out of 50 for Lat Amer G and 29 and 30 out of 50 for Lat Amer M. The range of scores for all participants for Lat Amer G was 26 - 37 out of 50 (mean = 33/50) and the range of scores for all participants for Lat Amer M was 23 - 32 out of 50 (mean = 28/50); thus the listeners who considered themselves semi-fluent scored in the high end of the range, but did not achieve the highest score. These data suggest that being semi-fluent in Spanish does not necessarily result in an overwhelming advantage in WRS score. However, the scores were on the high end of the range and the sample size of "semi-fluent" speakers (n = 2) was not large enough to make definitive conclusions on this portion of the study. Therefore, an advantage cannot be ruled out.

In contrast to the findings that familiarity with Spanish does not necessarily result in an advantage in WRS score, it does seem that having no familiarity with Spanish may have a negative impact on WRS score, but these results were also preliminary (n = 4 with one outlier). For each speaker/word list combination, three out of the four participants received the lowest or second to lowest score compared to the other participants. On the other hand, one of the four participants received the highest and second highest score when words were

The WRS of native-English listeners from native-Spanish speakers 36 presented from Lat Amer M and Lat Amer G respectively. These data suggest that having no previous formal education of Spanish may result in a slightly lower WRS compared to participants with some exposure to Spanish, but further research would be needed to confirm this and to determine if the behavior of the outlier was actually not an unusual occurrence.

Phonemic analysis

A phonetic transcription of the three word lists was conducted (Appendix D). The native-English transcription was compared with the two Latin American Spanish transcriptions. An analysis of these transcriptions indicated that Lab Amer M substituted 22% of the phonemes with other phonemes and 25% were substituted by Lat Amer G. Table 3 illustrates the phonemes that were most frequently in error and Table 4 illustrates the common phoneme substitutions. Lat Amer M pronounced 37% of the words differently from Nat Eng, while Lat Amer G pronounced 41% of the words differently from Nat Eng. The most common consonant changes observed were: assimilation, devoicing, voicing, stopping, affrication of a glide and omission. The most common vowel changes include: tensing of lax vowels, raising of lower vowels, lowering of high vowels, fronting of back or central vowels, and diphthong reduction to monophthongs.

Table 5 illustrates common word substitutions made by the listeners. Of the 23 word substitutions made when words were presented by Lat Amer M, 10 of the words were commonly written just as the speaker had mispronounced them and eight of the words, mispronounced by the speaker, were commonly misperceived (or guessed). Five words correctly pronounced by the speaker

Table 3

Common Phonemic Errors

Phonemic Errors	Number of Occurrences
/z/	13
/ɪ/	11
/d/	11
/v/	11
/ɔ/	7
/ð/	6
/æ/	5
/j/	5
/t/	5
/oʊ/	4
/g/	4
/ʌ/	4
/r/	3
/k/	3

Table 4

Common Phonemic Substitutions

Phonemic Substitution	Number of Occurrences
/z/ → [s]	8
/d/ → [t]	6
/ɹ/ → [r]	5
/v/ → [f]	4
/ʌ/ → [æ]	3
/ɪ/ → [i]	3
/ð/ → [t]	3
/n/ → [ŋ]	3
/k/ → [g]	3
/j/ → [dʒ]	3
/ð/ → [d]	3
/v/ → [b]	2
/d/ → [t]	2
omit /t/ in final position	2
/i/ → [ɪ]	2
/æ/ → [ɛ]	2
/oʊ/ → [o]	2
/æ/ → [ɑ]	2

Table 5

Most Common Word Errors Made by Listeners across Speakers

Lat Amer M	Lat Amer G	Nat Eng
1. way → why - 8	1. though → tough - 8	air → ear - 5
2. thing → think - 7	2. raw → row - 7	an → and - 3
3. ran → run - 7	3. ease → easy - 6	
4. toe → doe - 6	4. thin → thing - 6	
5. bin → bean - 5	5. young → junk - 6	
6. tare → dare - 5	6. jam → ham - 6	
7. three → tree - 5	7. felt → fell - 5	
8. stove → dope - 5	8. tare → tar - 5	
9. knees → niece - 4	9. send → sent - 5	
10. have → half - 3	10. three → tree - 5	
1. shove → shelf - 6	11. add → at - 4	
2. could → good - 5	12. tan → ten - 4	
3. raw → row - 5	1. hunt → hand - 6	
4. year → chair - 4	2. yard → jar - 6	
5. knit → neat - 4	3. smooth → move - 6	
6. dull → do - 4	4. end → and - 6	
7. year → chair - 4	5. owes → always - 4	
8. owes → house - 3	6. gave → gay - 4	
1. dad → that - 7	7. bill → meal - 4	

2. true → drew - 5   8. there → dare - 4

3. pie → bye - 4   9. dull → do - 4

4. else → elves - 4   1. he → heat - 7

5. an → and - 3   2. farm → firm - 6

3. lie → light - 4

4. else → elf - 4

The WRS of native-English listeners from native-Spanish speakers 41 were associated with listener substitutions. Of the 25 word substitutions made when words were presented by Lat Amer G, 12 of the words were commonly written just as the speaker had mispronounced them and nine of the words, mispronounced by the speaker, were commonly misperceived (or guessed). Four words correctly pronounced by the speaker were associated with listener substitutions.

CHAPTER 5

Discussion

The results indicated that the speech of the Latin American Spanish speakers did have an effect on the word recognition scores of native-English listeners. The mean number of words correct was not influenced by the order of the presentation or the word lists; it was influenced solely by the speakers. When the words were presented by Lat Amer M or Lat Amer G, the listeners scored significantly lower when compared to words presented by Nat Eng. Although scores tended to be higher when words were presented by Lat Amer G compared to Lat Amer M, there was not a significant difference between the two speakers.

Lat Amer M was rated a three and four for the rainbow passage and on his spontaneous speech sample respectively. According to Morley (1991), a rating of a three would have the following impact on communication: "accent causes frequent interference with communication through the combined effect of the individual features of mispronunciation and the global impact of the variant speech pattern" (p. 502). A rating of four would be described as the "accent causes interference primarily at the distraction level; listener's attention is often diverted away from the content to focus instead on the novelty of the speech pattern." Lat Amer G was rated a four and five for the rainbow passage and on

his spontaneous speech sample respectively. A rating of a five would have the following impact on communication, "accent causes little interference; speech is fully functional for effective communication."

The different ratings, Lat Amer M being rated lower than Lat Amer G, were also consistent with the mean word correct scores of the participants. The mean word correct when words were presented by Lat Amer M was 28.62. This is lower, but not significantly lower, than Lat Amer G's score of 31.10. Although this study only examined two speakers, it is possible that an examination of additional Latin American Spanish speakers, with the same general profile but slight variations in ratings or even within the same ratings categories could result in greater WRS differences.

The focus on increasing diversity and inclusion of multicultural issues is not a new matter. The membership and legislative council of ASHA have determined that this is an important component of the professions of speech-language pathology and audiology in a diverse society. Because of this, it is anticipated ASHA will continue to recruit students from different ethnic backgrounds into the field of audiology to accommodate the increasingly diverse population.

Based on surveys of audiometric practice, the majority of audiologists are using monitored live voice for some portion of their speech testing even though the importance of using standardized recorded material has been stressed in the literature. The combination of an increasingly ethnically diverse profession and the practice of MLV may be problematic. Although this study only examined one

The WRS of native-English listeners from native-Spanish speakers 44 of the many variables associated with MLV, the results are in agreement with previously reported literature and strongly support the need to use standardized recorded materials. The average WRSs were significantly lower for both of the Latin American Spanish speakers compared to the native-English speaker, even though the participants in this study were otologically normal. It is unknown if the presence of auditory pathology would exacerbate this difference.

It is likely that audiologists with a number of different dialects, even those with appropriate TOEFL scores and many years of communication in English, will create erroneous test results using MLV. The mean WRS from the native-English speaker's list was 94% (47.38 words correct) and the lowest mean from the two Latin American Spanish speakers was 58% (28.62 words correct). In 1978, Thornton and Raffin examined the normal variability associated with WRS testing and printed confidence intervals for WRS scores. For each possible WRS, they listed the range of normal scores. If WRS is tested twice and the second score does not fall into the confidence interval of the first score, then the second WRS is significantly different from the first. If a patient received a WRS of 94% during one test and 58% on another test, this would be considered a clinically significant finding. It is hypothetically possible that a patient could have a WRS conducted by a native-English speaking audiologist and then return for follow up testing that is conducted by an audiologist with a dialect and who is using MLV. A significant difference in WRS scores could possibly lead to additional unnecessary testing (e.g. ABR, MRI) to rule out retrocochlear pathology when in fact the difference should be attributed to the tester's dialect.

Word recognition scores obtained using monitored live voice by a native-Spanish audiologist who speaks with a Latin American dialect need to be interpreted with caution. How can the audiologist determine if the WRS is a true reflection of the hearing loss or the speaker's dialect? Proper diagnosis and treatment of patients by audiologists requires the use of valid test results generated by standardized recorded material.

Future Research

This study examined the effect the speech of two male native-Spanish speakers with different degrees of Latin American Spanish dialect had on the WRS of native-English listeners with normal hearing in quiet. If the majority of audiologists continue to obtain WRS's using MLV, future research will be needed in this area. For example, it is unknown how many audiologists have a dialect different from General American English, either international or U.S. regional. It is also unknown how many audiologists with a pronounced dialect use MLV and if these audiologists use MLV with native- English listeners and/or with non-native English listeners. Future research should be conducted using female speakers because male voices differ from female voices (spectrally). Future research should be conducted using individuals with hearing impairment because the majority of the patients seen for an audiological evaluation have some degree of hearing loss. A future study could compare WRS obtained using standardized recorded material and MLV of a Latin American Spanish speaker with a Latin American Spanish dialect.   Finally, further research should include native-

The WRS of native-English listeners from native-Spanish speakers 46

Spanish participants to see if their scores would be significantly higher than those

obtained by the non native-Spanish participants.

APPENDICES

Appendix A

TOWSON
UNIVERSITY

APPROVAL NUMBER: 06-A077

To: Monica   Labbe
From: Institutional Review Board for the Proctection of Human
            Subjects Larence Becker, Member, APPROVED
Date: Wednesday, April 12, 2006
RE: Application for Approval of Research Involving the Use of
            Human Participants

Thank you for submitting an Application for Approval of Research
Involving the Use of Human Participants to the Institutional Review Board
for the Protection of Human Participants (IRB) at Towson University.
The IRB hereby approves your proposal titled:

*The Word Recognition Scores of Native-English Listeners Using Word
Lists Recorded in English from Hispanic Speakers with Varied Dialect*

If you should encounter any new risks, reactions, or injuries while
conducting your research, please notify the IRB. Should your research
extend beyond one year in duration, or should there be substantive changes
in your research protocol, you will need to submit another application for
approval at that time.

We wish you every success in your research project. If you have any
questions, please call me at (410) 704-2236.

CC: J. Sinnott
       File

Appendix B

Informed Consent Form

PRINCIPAL INVESTIGATOR: **Monica Labbe**   E-MAIL: **mlabbe1@towson.edu**

Purpose of the Study:

      This study is a doctoral research project designed to investigate the effect varying degrees of Hispanic dialect have on the word recognition score (WRS) of native-English listeners under controlled experimental conditions.

Procedures:

      Participants will receive a full audiological evaluation consisting of otoscopy, tympanometry, and pure tone thresholds (air and bone) and speech audiometry, in a sound treated booth, to determine normal hearing in both ears. Participants with normal hearing will be asked to listen to 3 word lists, each containing 50 words, read by 3 different speakers. The participants will be asked to write down the word they heard.

Risks/Discomfort:

      There are no risks associated with participation in this study.

Benefits:

      It is hoped that the results of this study will support the benefit of using standardized recorded material when conducting speech audiometry

Alternatives to Participation:

      Participation in this study is voluntary. You are free to withdraw or discontinue participation at any time.

Compensation:

      Each participant will receive a free hearing assessment and referral information as needed.

Confidentiality:

      Participant's participation in this study will remain strictly confidential. Recorded data will be classified through assigned identification numbers. Any publications or reports that appear as a result of this study will not include identifying information on any participant.

___   I have read and understood the information on this form.

If you agree to join this study, please sign your name below.

_____   _____

Participant's Signature   Date

_____   _____

Principal Investigator   Date

If you have any questions regarding this study, please contact Dr. Diana Emanuel at (410) 704-2417 or the Institutional Review Board Chairperson, Dr. Patricia Alt, Office of University Research Services, 8000 York Road, Towson University, Towson, Maryland 21252; phone (410) 704-2236.

Appendix C

CID W-22 Word Lists

List 1 A

1. an	18. high	35. isle
2. yard	19. there	36. or
3. carve	20. earn	37. law
4. us	21. twins	38. me
5. day	22. could	39. none
6. toe	23. what	40. jam
7. felt	24 bathe	41. poor
8. stove	25. ace	42. him
9. hunt	26. you	43. skin
10. ran	27. as	44. east
11. knees	28. wet	45. thing
12. not	29. chew	46. dad
13. mew	30. see	47. up
14. low	31. deaf	48. bells
15. owl	32. them	49. wire
16. it	33. give	50. ache
17. she	34. true	

List 2 A

1. yore	18. send	35. own
2. bin	19. else	36. key
3. way	20. tare	37. oak
4. chest	21. does	38. new
5. then	22. too	39. live
6. ease	23. cap	40. off
7. smart	24. with	41. ill
8. gave	25. air	42. rooms
9. pew	26. and	43. ham
10. ice	27. young	44. star
11. odd	28. cars	45. eat
12. knee	29. tree	46. thin
13. move	30. dumb	47. flat
14. now	31. that	48. well
15. jaw	32. die	49. by
16. one	33. show	50. ail
17. hit	34. hurt	

List 3 A

1. bill	18. smooth	35. owes
2. add	19. farm	36. jar
3. west	20. this	37. no
4. cute	21. done	38. may
5. start	22. use	39. knit
6. ears	23. camp	40. on
7. tan	24. wool	41. is
8. nest	25. are	42. raw
9. say	26. aim	43. glove
10. if	27. when	44. ten
11. out	28. book	45. dull
12. lie	29. tie	46. though
13. three	30. do	47. chair
14. oil	31. hand	48. we
15. king	32. end	49. ate
16. pie	33. shove	50. year
17. he	34. have	

Appendix D

Phonetic Transcription

List 1A

	Lat Amer M	Lat Amer G	Nat Eng
an	æn	æn	æn
yard	jɑɹt	dʒɑɹd	jɑɹd
carve	kɑɹv	kɝ	kɑɹv
us	ʌs	ʌs	ʌs
day	deɪ	deɪ	deɪ
toe	doʊ	toʊ	toʊ
felt	fɛlt	fɛl	fɛlt
stove	dop	stʌb	stoʊv
hunt	hʌnt	hænt ⊥	hʌnt
ran	ɹʌn	ræn	ɹæn
knees	nis	nis	niz
not	natʰ	natʰ	natʰ
mew	mju	mju	mju
low	loʊ	loʊ	loʊ
owl	oʊl	aʊl	aʊəl
it	ɪt	itʰ	ɪtʰ
she	ʃi	ʃi	ʃi
high	haɪ	haɪ	haɪ
there	ðəɹ	dɛɹ	ðɛr
earn	ɛɚn	eɪɹn	ɝn
twins	twɪnz	twɪnz	twɪnz
could	gʊΘ	Kul	kʊd
what	wʌtʰ	wʌtʰ	wʌtʰ
bathe	bæΘ	beɪt	beɪð
ace	eɪs	eɪs	eɪs
you	ju	ju	ju
as	ʌs	æs	æz
wet	wɛt	wɛt	wɛt

chew	tʃu	tʃu	tʃu
see	si	si	si
deaf	dɛf	dɛf	dɛf
them	ðɛm	dɛm	ðɛm
give	gɪf	gɪʔ	gɪv
true	tɹu	tru	tɹu
isle	aɪəl	aɪəl	aɪəl
or	ɔɹ	ɔɹ	ɔɹ
law	laʊ	laʊ	lɔ
me	mi	mi	mi
none	nʌn	nʌn	nʌn
jam	djæm	hæm	dʒæm
poor	pɔɹ	pɔɹ	pɔɹ
him	hɪm	hɪm	hɪm
skin	skɪm	skɪn	skɪn
east	ist	ɪstʰ	istʰ
thing	θɪnk	θɪŋk	θɪŋgə
dad	dæd	dæt	dæd
up	upʰ	ʌpʰ	ʌpʰ
bells	bɛlz ⊥	bɛls	bɛlz
wire	waɪɚ	waɪɚ	waɪɚ
ache	eɪʔ	eɪkʰ	eɪkʰ

List 2A

	Lat Amer M	Lat Amer G	Nat Eng
yore	jɔɹ	dʒɔʊ	jɔɹ
bin	bin	bin	bɪn
way	waɪ	weɪ	weɪ
chest	tʃɛst	tʃɛs	tʃɛst
then	ðɛn	dɛn	ðɛn
ease	is	isɪ	iz
smart	smaɹtʰ	smaɹtʰ	smaɹtʰ
gave	geɪf	geɪb	geɪv
pew	pju	pju	pju
ice	aɪs	aɪs	aɪs
odd	at	aɗ	ad
knee	ni	ni	ni
move	muv	muv	muv
now	naʊ	naʊ	naʊ
jaw	dʒa	dʒaʊ	dʒɔ
one	wɔɹn	wʌn	wʌn
hit	hɪt	hɪtʰ	hɪt
send	sɛnd	sɛntʰ	sɛnd
else	ɛls	ɛls	ɛls
tare	dɛɹ	taɹ	tɛr
does	dʌs	dʌs	dʌz
too	tu	tu	tu
cap	kap	kæp	kæp
with	wɪθ	wɪθ	wɪθ
air	ɛɚ	ɛɹ	ɛɚ
and	ænd	ɛn	ænd
young	dʒʌŋ	dʒʌŋk	jʌŋgə
cars	kaɹs	kaɹs	kaɹz
tree	tri	tri	tɹi
dumb	dʌm	dʌm	dʌm
that	ðætʰ	dæt	ðæt
die	daɪ	daɪ	daɪ

show	ʃoʊ	ʃoʊ	ʃoʊ
hurt	hɝt	haɹt	hɝtʰ
own	oʊn	oʊn	oʊn
key	geɪ	ki	ki
oak	oʊkʰ	oʊkʰ	oʊk
new	nju	nu	nu
live	laɪf	laɪv	laɪv
off	ɑf	ɑf	ɔf
ill	il	aɪl	ɪl
rooms	rums	ɹums	ɹumz
ham	hæm ⊥	hæm	hæm ⊥
star	stɑɹ	stɑɹ	stɑɹ
eat	itʰ	itʰ	it
thin	Ɵɪn	Ɵɪŋ	Ɵɪn
flat	flætʰ	flæt	flætʰ
well	wɛl	wɛl ⊥	wɛl
by	baɪ	baɪ	baɪ
ail	eɪ	eɪəl	eɪl

List 3A

	Lat Amer M	Lat Amer G	Nat Eng
bill	bil	bil	bɪl
add	æt	æt	æd
west	wɛst	wɛstʰ	wɛst
cute	kjutʰ	kjutʰ	kjutʰ
start	staɹtʰ	staɹtʰ	staɹtʰ
ears	jɪrs	iɚs	iɚz
tan	tæn ⊥	tɛn ⊥	tæn
nest	nɛstʰ	nɛstʰ	nɛstʰ
say	seɪ	seɪ	seɪ
if	ɪf	ɪf	ɪf
out	aʊtʰ	aʊtʰ	aʊtʰ
lie	laɪ	laɪ	laɪ
three	tɹi	tri	Ɵɹi
oil	ɔɪəl	ɔɪc	ɔɪjəl
king	kɪŋ	kɪŋk	kɪŋgə
pie	paɪ	paɪ	paɪ
he	hi	hi	hi
smooth	smuƟ	smu	smuð
farm	faɹm	faɹm	faɹm
this	ðɪs	dɪs	ðɪs
done	dʌn	dʌn	dʌn
use	jus	jus	juz
camp	kæmp ⊥	kæmpʰ	kæmp
wool	wʊl	wʊl	wʊl
are	ar	aɹ	aɹ
aim	eɪm	em	eɪm
when	Mɛn	wɛn ⊥	wɛn
book	bʊk	bʊkʰ	bʊkʰ
tie	taɪ	taɪ	taɪ

do	du	du	du
hand	hænd	hænt^h	hænd
end	ɛnd	ɛnt^h ⊥	ɛnd
shove	ʃʌf	ʃʌb	ʃʌv
have	hæf	hæv	hæv
owes	oʊs	aʊs	oʊz
jar	ʤaɹ	ʤaɹ	ʤaɹ
no	no	no	noʊ
may	meɪ	meɪ	meɪ
knit	nit^h	nɪt^h	nɪt^h
on	ɑn	ɑn	ɑn
is	ɪs	ɪs	ɪz
raw	ɹo	ɹaʊ	ɹɔ
glove	glʌf	glʌv	glʌv
ten	tɛn	tɛn	t^{h}ɛn
dull	dul	dul	dʌl
though	ðo	tʌf	ðoʊ
chair	tʃɛɚ	tʃɛɹ	tʃɛɹ
we	wi	wi	wi
ate	et^h	eɪt^h	eɪt^h
year	ʤɛɹ	jɪr	jɪr

REFERENCES

American National Standards Institute. (1999). *American National Standard*

Maximum Permissible Ambient Noise Levels for Audiometric Test Rooms

(ANSI S3.1-1999). New York: American National Standards Institute.

American Speech-Language-Hearing Association (1988). Guidelines for

determining threshold level for speech. *ASHA,* 85-89.

American Speech-Language-Hearing Association (2003). Serving multilingual

clients with hearing loss. *The ASHA Leader*, 8 (3), 1, 10.

Anderson, N. B., & Lee-Wilkerson, D. (1993). Reaching multicultural

populations. *ASHA, 35* (8), 43-44, 51.

Beattie, R. C., Edgerton, B. J., & Svihovec, D. A. (1977). A comparison of the

Auditec of St. Louis cassette recordings of NU-6 and CID W-22 on a

normal-hearing population. *Journal of Speech and Hearing*

Disorders, 42 (1), 60-64.

Beattie, R. C., Svihovec, D. A., & Edgerton, B. J. (1978). Comparison of speech

detection and spondee thresholds and half- versus full-list intelligibility

scores with mlv and taped presentations of NU-6. *Journal of*

the American Audiology Society, 3(6), 267-272.

Bell, T. S., & Wilson, R. H. (2001). Sentence recognition materials based on

frequency of word use and lexical confusability. *Journal of the American*

Academy of Audiology, 12, 514-522.

Brandy, W. (1966). Reliability of voice tests of speech discrimination. *Journal of*

Speech and Hearing Research, 9, 461-465.

Brandy, W. (2002). Speech audiometry. In J. Katz, *Handbook of clinical audiology. 5th ed* (pp. 96-110). Baltimore, MD: Williams & Wilkins.

Cakiroglu, S. & Danhauer, J. L. (1992). Effects of listeners' and talkers' linguistic backgrounds on W-22 test performance, *Journal of the American Academy of Audiology, 3(3),* 186-192.

Carhart, R. (1946). Monitored live-voice as a test of auditory acuity. *Journal of the Acoustical Society of America, 17(4),* 339-349.

Dirks, D. D., Takayanagi, S., & Mosfegh, A. (2001). Effects of lexical factors on word recognition among normal-hearing and hearing-impaired listeners. *Journal of the American Academy of Audiology, 12,* 233-244.

Fletcher, H., & Steinberg, J. C. (1929). Articulation testing methods. *Bell Telephone Systems Technical Publications, 8,* 806-854.

Gat, I. & Keith, R. (1978). An effect of linguistic experience. *Audiology, 17,* 339-345.

Gelfand, S. A. (1975). Use of the carrier phrase in live voice speech discrimination testing. *Journal of Auditory Research, 15,* 107-110.

Gelfand, S. A. (2001). *Essentials of Audiology* (2nd ed.). New York: Thieme.

Gladstone, V. S., & Siegenthaler, B. M. (1971). Carrier phrase and speech intelligibility score. *Journal of Auditory Research, 11,* 101-103.

Hirsh, I. J., Davis, H., Silverman, S. R., Reynolds, E. G.,Eldert, E., & Benson, R. W. (1952). Development of materials for speech audiometry. *Journal of Speech and Hearing Disorders, 17*, 321-337.

Luce, P. A. (1986). A computational analysis of uniqueness points in auditory

   word recognition. *Perceptual Psychophysiology, 39*, 155-58.

Luce, P. A. & Pisoni, D. B. (1998). Recognizing spoken words: The

   Neighborhood Activation Model. *Ear and Hearing, 19*, 1-36.

Mackersie, C. L. (2002). Tests of speech perception abilities. *Current Opinion in

   Otolaryngology & Head & Neck Surgery, 10 (5),* 392-397.

Martin, F. N., Champlin, C. A., & Chambers, J. A. (1998). Seventh survey of

   audiometric practices in the United States. *Journal of the American

   Academy of Audiology, 9*, 95-104.

Martin, F. N., Hawkins, R. R., Bailey, H. A. (1962). The non-essentiality of the

   carrier phrase in phonetically balanced (PB) word testing. *Journal of

   Auditory Research*, *2,* 319-322.

Morley, J. (1991). The pronunciation component in teaching English to

   speakers of other languages. *TESOL Quarterly, 25 (3),* 481-520.

Mullennix, J. W., Pisoni, D. B., & Martin, C.S. (1998). The effects of talker

   variability on spoken word recognition, *The Journal of the Acoustical

   Society of America, 85(1),* 365-378.

Nicolosi, L., Harryman, E., & Kresheck, J. (1996). *Terminology of

   Communication Disorders*. 4th ed. Baltimore, MD: Williams & Wilkins.

Nygaard, L. C., Sommers, M. S., & Pisoni, D. B. (1994). Speech perception as a

   talker-contingent process. *American Psychological Society, 5 (1),* 42-46.

Penrod*,* J. P. (1994). Speech threshold and word recognition/discrimination

   testing. In J. Katz, *Handbook of clinical audiology. 5th ed* (pp. 147-164).

Baltimore, MD: Williams & Wilkins.

Posner, J., & Ventry, IJ. (1977). Relationships between comfortable loudness levels for speech and speech discrimination in sensorineural hearing loss. *Journal of Speech and Hearing Disorders, 42,* 370-375.

Shipley, K. G., & McAfee, J. G. (2004). *Assessment in Speech-Language Pathology : A Resource Manual. 3rd ed.* New York, NY: Thomson Delmar Learning.

Stach, B. A. (1998). Word recognition testing: Why not do it well? *The Hearing Journal, 5 (6),* 10-16.

Takayanagi, S., Dirks, D., & Moshfegh, A. (2002). Lexical and talker effects on word recognition among native and non-native listeners with normal and impaired hearing. *Journal of Speech, Language, and Hearing Research, 45,* 585-597.

Thornton, A. R., & Raffin, M. J. (1978). Speech-discrimination scores modeled as a binomial variable. *Journal of Speech and Hearing Research, 21,* 507-518.

Tillman, T. W., & Carhart, R. (1966). An expanded test for speech discrimination utilizing CNC monosyllabic words: Northwestern University auditory test no. 6. San Antonio, TX: USAF School of Aerospace Medicine, Brooks Air Force Base.

Ullrich, K., & Grimm, D. (1976). Most comfortable listening level presentation versus maximum discrimination for word discrimination material. *Audiology, 15,* 338-347.

United States Census 2000 the Hispanic population. Retrieved January 4, 2006,

   from http://www.census.gov/main/www/cen2000.html

Wiley, T. L. (1997). Practice versus evidence in diagnostic audiology. *ASHA,*

   39(4), 46-47.

Wiley, T. L., Stoppenbach, D. T., Feldhake, L. J., Moss, K. A., & Thordardottir, E.

   T. (1995). Audiologic practices: What is popular versus what is supported

   by evidence. *American Journal of Audiology, 4*, 26-33.

Wilson, R. H. (2004). Adding speech-in-noise testing to your clinical protocol:

   Why and how*. The Hearing Journal, 57(2), 10-18.*

Wilson, R. H., & Oyler, A. L. (1997). Psychometric functions for the CID W-22

   and NU auditory test no. 6 materials spoken by the same speaker. *Ear*

   and Hearing, 18, 430-433.

Wilson, R. H., Zizz, C. A., Shanks, J. E., & Causey, G. D. (1990). Normative

   data in quiet, broadband noise, and competing message for northwestern

   university auditory test no. 6 by a female speaker. *Journal of Speech and*

   Hearing Disorders, 55, 771-778.

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