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Psychometrically Equivalent Bisyllabic Word-Lists for Word Recognition Testing in Spanish

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PSYCHOMETRICALLY EQUIVALENT BISYLLABIC WORD-LISTS FOR WORD RECOGNITION TESTING IN SPANISH

by

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GRADUATE COMMITTEE APPROVAL

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As chair of the candidate's graduate committee, I have read the thesis of Anna M. Bishop in its final form and have found that (1) its format, citations, and bibliographical style are consistent and acceptable and fulfill university and department style requirements; (2) its illustrative materials including figures, tables, and charts are in place; and (3) the final manuscript is satisfactory to the graduate committee and is ready for submission to the university library.

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ABSTRACT

PSYCHOMETRICALLY EQUIVALENT BISYLLABIC WORD-LISTS

FOR WORD RECOGNITION TESTING IN SPANISH

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The aim of this study was to develop, digitally record, evaluate, and psychometrically equate a set of Spanish bisyllabic word lists to be used for word recognition testing. Frequently used bisyllabic words were selected and digitally recorded by male and female Spanish talkers. Twenty normally hearing subjects were presented each word to find the percentage of words which they could correctly recognize. Each word was measured at 10 intensity levels (-5 to 40 dB HL) in increments of 5 dB. Chi-square analysis was used to determine the equivalency among the final four psychometrically equivalent word lists of 50 words, and each of the eight half-lists containing 25 words each. The results of the analysis indicated that there were no significant differences among the four-lists or eight half-lists. Only minimal adjustments (≤ 0.5 dB) were needed to equate the words in the lists and half-lists for the male and female talkers.

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Introduction

Since its inception, America has been a melting pot of customs, cultures, languages, and people. One of the cultures that has grown rapidly during the last several decades is the Hispanic population. This increase in the Hispanic population is a trend that has been observed since the early 1980s (Danhauer, Crawford, & Edgerton, 1984; Flores, Martin, & Champlin, 1996; Lopez, Martin, & Thibodeau, 1997; McCullough & Wilson, 2001; McCullough, Wilson, Birck, & Anderson, 1994; Schneider, 1992; Weisleder & Hodgson, 1989). Indeed, the 2000 census report concluded that of the 281.4 million residents living in the United States, 35.3 million (or 12.5 percent) were Hispanic (U.S. Census Bureau, 2000). This number represents an overall increase of 57.9 percent since 1990. Comparatively, the overall increase for the entire population of the United States, from the same date, was 13.2 percent.

Given the increase of the Hispanic population, it is more essential now than ever before that adequate SRT (speech reception threshold) and WRS (word recognition score) testing materials be available for the audiological assessment of this populace. While the development of Spanish speech audiometry materials has grown in the last 30 years, development of up-to-date materials has been lacking in the last decade and a half (von Hapsburg & Peña, 2002). Spanish WRS lists that are available through Auditec of St. Louis have been researched, but lack standardization (W.F. Carver, personal communication, October 10, 2007). Statistical analysis of the Auditec Spanish WRS lists shows that list three is statistically different from the other lists (Weisleder & Hodgson, 1989).

Despite the lack of current research, advances have been made in the software available to statistically analyze raw data. Logistic regression analysis allows us to better determine the slope and the 50% correct threshold (R.W. Harris, personal communication, November 15, 2007). Other improvements also include the increased number of words that are included in each list. In the previous thesis by Christensen (1997), completed at Brigham Young University, the WRS lists included only 25 words.

The present research resulted in the development of 4 lists of 50 words and 8 half-lists of 25 words. The word lists described above were drawn from a current frequency-of-use dictionary created by Davies (2006). Before the completion of Davies' book, the most complete frequency-of-use dictionary was completed by Juilland and Chang-Rodriguez (1964). The vocabulary given in previous Spanish word recognition measures may not be current with the vocabulary and language in use today. With the use of a current frequency of use dictionary the items used in this study's word lists are comparable to the vocabulary used at present. It is for these reasons that development of SRT and WRS materials for Spanish-speaking individuals is necessary.

Review of Literature

History of English Speech Audiometry

Word recognition scores provide the audiologist with information on how well a patient recognizes words in a given list at varying suprathreshold levels (Egan, 1948). One of the first researchers to develop WRS lists was Egan who, in 1948, created 8 lists of phonetically balanced words (PB), each with 50 words. The words were recorded on 78 rpm phonograph records by the radio personality Rush Hughes. The recordings, which

were formally titled Psycho-Acoustic Laboratory (PAL) Auditory Tests No. 9 and No. 12, then became know as the Rush Hughes list, or PB-50.

Hirsh et al. (1952) was the next to create a set of PB word recognition lists. Hirsh et al. took 120 words from the original 1000 PAL word lists and added 80 commonly used words. The result was 4 lists of 50 phonetically balanced words called the CID Auditory Test W-22. This test was used routinely beginning in the mid-1950s and is still used today.

The development of other WRS word lists includes the Northwestern University Auditory Test number 6 (NU-6), which, unlike the CID W-22 lists, contained words that were phonemically balanced instead of phonetically balanced (Tillman & Carhart, 1966), the creators of the NU-6 word recognition lists, believed that phonetic balancing of monosyllables was impossible because the acoustics of a given speech sound varies; depending on the sound that precedes it as well as the sound that follows it. Four NU-6 lists of 50 phonemically balanced words were the result of Tillman and Carhart's efforts.

Finally, Causey et al. (1983) took 500 of the original NU-6 words and created ten PB lists, each with 50 different monosyllabic words. Each of the 50 monosyllabic words was of the CNC type (consonant-nucleus-consonant). Like the creators of the NU-6 words, Causey et al. felt that words surrounding the nucleus of a test word affected the production and acoustics of the stimulus item. The word lists were spoken by a male and recorded in an anechoic chamber. Performance intensity functions were obtained from 60 participants with normal hearing between the ages of 18-26 years, and 40 hearing impaired participants with ages ranging from 30-74 years. Of the 10 lists 6 were deemed the most equivalent and were recorded on compact disc.

History of Spanish Speech Audiometry

The creation of WRS materials is not exclusive to the English language. Production of WRS materials for Spanish speaking individuals started as early as 1948. Among the pioneers in the development of Spanish word recognition measures are the following developers, whose work constitutes the early efforts to create Spanish word recognition assessments before 1970: Cancel (1965); Cancel-Ferrer (1952); Ferrer (1960); and Tato (1948). The following is a summary and explanation of their efforts.

Beginning in 1948, Tato created twelve word lists with 25 phonetically balanced trochaic words (one long syllable followed by one short syllable), five lists of 15 trochaic bisyllabic words, and three lists of 50 monosyllabic words (as cited in Ferrer, 1960). None of these lists were phonetically balanced. Tato explained that the trochaic words were used to determine the intelligibility of Spanish consonants relative to vowels, and that the monosyllabic words were used primarily to assess a participants' hearing, due to their degree of difficulty at low intensity levels.

Tato took the 12 bisyllabic phonetically balanced word lists and constructed a Spanish articulation curve (a graph that plots the percentage of words correctly identified as a function of intensity). Tato then compared the Spanish articulation curve that he had constructed to one obtained for English monosyllabic words. Tato concluded: "In the same circumstances we obtain an equal percentage of English with 10 dB less intensity" (as cited in Ferrer, 1960, p. 1543).

Despite Tato's assertions over the quality of his word-lists, his work was met with criticism. Ferrer (1960) commented on some of the criticism surrounding Tato's work. According to Ferrer, Tato did not specify the clinical uses of his materials, and the

conclusions Tato drew using the articulation curve he constructed could vary depending on what kind of materials are used.

Very little was done to follow up on Tato's initial work until Cancel and Ferrer (1952) created a list of words to be used as a hearing test for Spanish speaking persons. From a corpus of *grave* words (an accent on the next to last syllable of the word), Cancel and Ferrer created 7 word lists each containing 6 words in each list. Using participants from 19 Latin-American countries, Cancel and Ferrer measured performance of the lists for intensities from 0 to 30 dB HL in 5dB steps. The carrier phrase was attenuated 5 dB less than the test word. Cancel and Ferrer concluded that the word lists were adequate to find the hearing thresholds for listeners from the 19 countries sampled in their research. In addition, they also stated that the word lists could be used for a variety of ages, from children of pre-school age to adults.

In 1960, Ferrer went on to independently create a Spanish nonsense syllable test. Ferrer believed that, although available Spanish word recognition measures could accurately determine the threshold for speech, a more difficult Spanish measure was needed as a discrimination test. To that end Ferrer created four lists of 50 nonsense syllables. The established criterion for the creation of the lists was phonetic composition representative of the Spanish language, and equal phonetic composition among all lists. Ferrer had eleven Spanish-speaking participants, from seven different Latin American countries, state what they heard after listening to the four word lists at 60 dB SPL. Next the participants listened to the same word lists at varying intensity levels. Each of the four lists was presented at 20, 30, 40, and 50 dB SPL. Each participant listened and responded to the lists 16 times. The results of Ferrer's study showed that the variability among the

lists was small, and that overall the nonsense syllables were more difficult than the bisyllabic phonetically-balanced word lists created by Tato. Ferrer stated: “According to these results it can be said that the nonsense syllable lists proved to be more difficult material than the disyllabic phonetically-balanced lists made by Tato (1948), hence this test may be useful as a discrimination test with the diagnostic purpose of differentiating between a conductive and a non-conductive hearing loss” (pp. 1549-1550).

Cancel (1965) developed 20 lists of 50 Spanish bisyllabic words for use in measuring word recognition ability. Each list contained words that had a grave accent, as these words constitute the most frequently used stress pattern in Spanish and most closely approximate the English spondaic word. Words were selected from newspapers as they would represent the most common reading material in the Spanish language. Ten Spanish-American students were then asked to record the word lists. Each word was preceded by a carrier phrase which presented the word. A small interval of time followed after each word to allow the listener’s time to write their answers on a record sheet. Sixty-five Spanish American subjects, serving in panels of 6-7 each, listened to 8 to 20 lists of grave words as recorded by one speaker. The lists were deemed to be “apparently adequate in length to yield satisfactorily reliable scores in intelligibility testing” (p. 92).

In 1967 Berruecos and Rodriguez worked to create their own phonetically balanced word lists in Spanish. The phonetically balanced word lists were derived from nearly 20,000 words taken from daily papers, widely read books, song books, words recorded in conversation, and words taken from the Linguphone Method for teaching Spanish. A total of 954 trochaic words were selected and distributed among word lists that would closely approximate the phonetic balance of the Spanish language. The end

result was four word lists each containing 25 words. To make these last four word lists more closely approximate the phonetic content in Spanish, certain words were removed and replaced.

Uniquely, in the development of their research, Benitez and Speaks (1968) departed from the use of nonsense syllables, monosyllabic words, and bisyllabic words for word recognition in their research. Instead Benitez and Speaks adopted the use of a synthetic approach. The synthetic approach involves using sentences and continuous speech discourse. In their study Benitez and Speaks developed four sets of sentences. Each set contained 10 sentences which were either first, second, third or fourth order approximations of real Spanish sentences. After the presentation of the target sentence, the listener would then mark which sentence they thought they heard from a closed set of alternatives. The resulting performance intensity function showed that intelligibility increased with small increases in the decibel level. Benitez and Speaks noted that the general shape of the performance intensity function was almost identical to the synthetic sentences developed in English. A second part of the study involved having the participants identify sentences from a closed set of alternatives while a competing message was presented. During the second part of the study the target sentences were presented at a constant intensity level (50 dB SPL), while the competing message was slowly increased from 30 dB to 80 dB HL. As the intensity of the competing message was raised the percentage correct also increased. However the function of the competing message was at no time steeper than the function without the competing message.

Connery (1977) created non-phonetically balanced word lists of 20-26 words per list. She states that: “The words on the lists are common Spanish vocabulary but are not

phonetically balanced. Since there appears to be relatively few one syllable words in the Spanish language, and multisyllable, vowel-ending words predominate, it was felt that these lists would serve as a productive tool" (pp. 13, 41). Connery went on to explain that although selected words from her lists could be used to establish speech recognition thresholds, the lists were not sensitive enough to be used to establish subtle diagnostic conclusions.

Zubick et al. (1983) created eight lists containing 50 trisyllabic words and seven lists containing 50 bisyllabic words in Spanish. These lists created by Zubick et al. were called the Boston College Auditory test. The words used in the lists were derived from a frequency usage dictionary written by Julliand and Chang-Rodriguez (1964). Criteria for the inclusion of words into the lists were as follows: use of the grave stress model in Spanish, word familiarity, phonetic dissimilarity, homogeneity of basic audibility, equal average difficulty, and equal range of difficulty. Each of the lists was spoken by a native Spanish-speaking individual, and was presented to 10 normal-hearing, native Spanish-speaking participants in a sound suite. At the close of the study Zubick et al. commented on the results of their research: "Several remaining issues will be investigated by the final field testing and validation of these lists. The two remaining criteria, equal average difficulty and equal range of difficulty, must be applied. To indicate the average intelligibility of the lists (interlist consistency), articulation versus gain function must be derived" (p. 94). Zubick et al. went on to explain that the lists created in the study might not be appropriate for testing the SRT or WRS of Spanish-speaking children.

Weisleder and Hodgson (1989), in a review of Spanish word recognition measures, found major drawbacks in the creation of word lists developed by Benitez and

Speaks (1968), Berruecos and Rodriguez (1967), Cancel (1965), Connery (1977), and Zubick et al. (1983). The drawbacks discussed by Weisleder and Hodgson (1989) include the use of spondee words rather than bisyllabic tetraphonemic (words with more stress on one syllable than the other) words. Weisleder and Hodgson state that Berruecos and Rodriguez (1967) used spondee words which do not exist in Spanish. Weisleder and Hodgson also included the recording of lists in a non-standardized facility, and the use of different talkers to record separate portions of test lists as drawbacks. Weisleder and Hodgson (1989) then recruited 16 normally hearing, Spanish-speaking adults to evaluate the commercially available word recognition lists from Auditec of St. Louis. The sixteen participants were from various Spanish speaking countries (9 from Mexico, 2 from Panama, 2 from Venezuela, 1 from Spain, 1 from Honduras, and 1 from Colombia). Four lists were used, each containing 50 bisyllabic tetraphonemic Spanish words, and were recorded in a laboratory at Auditec of St. Louis by a native Spanish talker. Weisleder and Hodgson reported:

> Mean intelligibility scores were poorest for list three. Statistical analysis indicated that the intelligibility of list three is significantly different than the other lists at the .05 level. On the average, at the low presentation levels, the nine subjects of Mexican origin obtained better scores than the seven subjects of other nationalities. The slope of the PI-PB function (4.3%) was comparable to that obtained by other investigators of English lists" (p. 276).

Speech materials appropriate for the audiological assessment of children were also constructed during the period 1960-1990. The earliest of these materials were developed by Martin and Hart (1978). They created a word list with 12 words drawn

from a pre-existing pool of 45 words. The words from the pre-existing pool were chosen based on stress pattern, simplicity of concept, and the ability to be depicted pictorially. Each of the 12 words were matched with a picture. Upon hearing the stimulus word the child would be instructed to point to the corresponding picture. The participants' threshold of hearing would be determined by varying the intensity level in which the stimulus item was presented until they received a score at which 50% of the words were correctly identified. After completing their study Martin and Hart found the Spanish word list had a similar range of intelligibility when compared to English spondees.

Following Martin and Hart's (1978) work, Spitzer (1980) created a similar word recognition measure for children that included 51 familiar bisyllabic words including some cognates (words that are similar in both English and Spanish such as *el sueter*, sweater). Spitzer felt that Martin and Hart's list of 12 words did not include a sufficient amount of vocabulary for clinical testing. The construction of Spitzer's (1980) word-recognition test, required children to point to a picture following the presentation of an auditory stimulus. To indicate the desired action of the participants, the carrier phrase, *Muéstreme* (show me) was used before each word. No background knowledge in Spanish on the part of the clinician was needed. The test administrator was given the answers to each testing stimulus as the items were presented, and only one test item was evaluated per page.

Comstock and Martin (1984) felt that at the time of their research the materials available for the auditory assessment of Spanish speaking children, especially monolingual Spanish-speaking children were lacking. According to Comstock and Martin there were no publications available that provided a picture pointing word recognition

test for monolingual Spanish-speaking children. To this end they created a picture-pointing word recognition test that included four lists of 25 bisyllabic words, which, upon the completion of the study, were shown to be essentially equivalent.

The research of Martin and Hart (1978), Spitzer (1980), and Comstock and Martin (1984), spurred others to develop Spanish word recognition materials that incorporated the use of pictures. McCullough et al. (1994) utilized the use of a computer monitor to display visual materials to participants. McCullough et al. considered the computerized format to be better suited to modern clients familiar with television. In their study, 216 common nouns and actions were translated by two native Spanish speakers. The results yielded only six words that needed to be removed from the pool due to their incompatibility in the Spanish language. The words were arranged into four word lists and grouped together based on the number of syllables (two and three syllable words were used), phonetic dissimilarity, and talker gender. Forty normal-hearing, native Spanish speaking adults were then used in a pilot study to assess the functionality of the lists. The results showed that as the syllable length increased, so did the scores of the participants. As a result of these efforts two 50-word lists were created. At the time of the author's research, further psychometric studies were being conducted on the word lists to be used in the multimedia format.

Method

Participants

Twenty native Hispanic participants, 12 female and 8 male, originating from Mexico, between the ages of 18 and 51 years participated in this study. All participants indicated that they speak Spanish on a daily basis. All participants had bilateral pure-tone air-conduction thresholds ≤ 15 dB HL at octave and mid-octave frequencies from 125 to

8000 Hz and static acoustic admittance between 0.3 and 1.4 mmhos with peak pressure between -10 and +50 daPa (ASHA, 1990; Roup, Wiley, Safady, & Stoppenbach, 1998). Table 1 displays a statistical summary of participant thresholds.

Materials

Words. Bisyllabic words were selected from the 2,000 most frequently used Spanish words found in *A Frequency Dictionary of Spanish: Core Vocabulary for Learners* by Davies (2006). Initially 300 trochaic words were selected based on their frequency of occurrence. Words chosen for the lists were trochaic words. According to Zubick et al. (1983) the trochaic stress pattern is the most frequently-used stress pattern in Spanish. In addition, bisyllabic words are preferred instead of the traditional monosyllabic words as are used in English WRS testing procedures, because monosyllabic words are infrequent in the Spanish language (Comstock & Martin, 1984). The performance intensity functions for the bisyllabic words are similar to those typically obtained by established English monosyllabic materials (Cancel, 1968; Comstock & Martin, 1984; Ferrer, 1960; Weisleder & Hodgson, 1989; Zubick et al., 1983).

A total of 300 trochaic words were rated by six native Spanish speakers. The raters were instructed to judge each word based on how familiar they would be to an average Spanish-speaking listener by using the following rating scale: 1 = extremely common, 2 = very common, 3 = averagely common, 4 = seldom used, 5 = rarely used. Any word receiving a score of 4 or 5 by any judge was discarded. The scores for each word were obtained by averaging the ratings given to it by all of the raters. Words receiving a score of three or lower were included in the final selection of 250 words to be recorded. In addition words were discarded if they were (a) thought to be culturally

Table 1

Age (years) and Pure Tone Threshold (dB HL) Descriptive Statistics for 20 Normally Hearing Spanish Speaking Participants

Frequency	*M*	*Minimum*	*Maximum*	*SD*
0.125 kHz	7.3	0	10	3.0
0.25 kHz	4.8	-10	15	5.3
0.5 kHz	6.3	-5	15	4.6
0.75 kHz	6.0	-5	15	5.0
1.0 kHz	6.3	0	15	4.6
1.5 kHz	5.5	-5	15	4.8
2.0 kHz	5.0	0	10	4.0
3.0 kHz	4.5	-5	15	5.6
4.0 kHz	4.5	-5	15	5.8
6.0 kHz	6.8	-10	15	7.1
8.0 kHz	7.3	0	15	6.2
PTA[a]	5.83	0.0	13.3	3.4

[a]PTA = arithmetic average of thresholds at 0.5, 1.0, and 2.0 kHz

insensitive, (b) considered to be unfamiliar, (c) thought to possibly represent inappropriate content, or (d) had the same pronunciation but different meanings.

Talkers. The Spanish WRS lists were recorded by an adult female and an adult male talker, who were native Spanish speakers from Mexico. Initially, four male and four female talkers were recorded. After the initial recordings were made, a panel of eight Spanish judges from Mexico evaluated the performance of each talker, ranking the talkers from best to worst based on Spanish accent, vocal quality, and pronunciation. The highest ranked male and female talkers were selected as the talkers for all subsequent recordings.

Recordings. A total of 250 trochaic words were recorded. Recordings were made in the anechoic chamber located in the Eyring Science Center on the campus of Brigham Young University. A Larson-Davis model 2541 microphone was positioned approximately 15 cm from the talker at a 0° azimuth and was covered by a 7.62 cm windscreen. The microphone was connected to a Larson-Davis model 900B microphone preamp, which was coupled to a Larson-Davis model 2200C preamp power supply. The signal was then digitized by an Apogee AD-8000 24-bit analog-to-digital converter and subsequently stored on a hard drive for later editing. A 44.1 kHz sampling rate with 24-bit quantization was used for all recordings, and every effort was made to utilize the full range of the 24-bit analog-to-digital converter. Ambient noise levels in the anechoic chamber were approximately 0 dB SPL, which allowed a signal-to-noise ratio of approximately 65 dB during recording.

The talker was asked to pronounce each bisyllabic word at least four times with a slight pause between each production during the recording sessions. Talkers were asked

to speak at a natural rate with normal intonation patterns. The first and last repetitions of each word were excluded from the study to avoid possible list effects. In addition, one native judge rated the medial repetitions of each word for perceived quality of production, and the best production of each word was then selected for testing. Any word that was judged to be a poor recording (peak clipping, extraneous noise, etc.), mispronounced, or produced with an unnatural intonation pattern was rerecorded or eliminated from the study prior to listener evaluation.

After the word selection process, the intensity of each word to be included in the test materials was edited as a single utterance using Adobe Audition Version 2.0 (Adobe System Incorporated, 2003) to yield the same average RMS power as that of a 1000 Hz calibration tone in an initial attempt to equate test word threshold audibility (Harris, Nielson, McPherson, Skarzynski, & Eggett, 2004; Wilson & Strouse, 1999). Each of the individually recorded and edited words was then saved as a 24-bit *wav* file.

Procedures

Custom software was used to control randomization, timing and presentation of the words by routing the 24-bit *wav* files to the external input of a Grason Stadler model 1761 audiometer. The stimuli were routed from the audiometer to the participant via a single TDH-50P headphone. All testing was carried out in a double-walled sound suite that met ANSI S3.1 standards for maximum permissible ambient noise levels for the ears not covered condition using one-third octave-bands (ANSI, 1999).

Prior to testing each participant, the external inputs to the audiometer were calibrated to 0 VU using a 1000 Hz calibration tone. The audiometer was calibrated prior to and at the conclusion of data collection. Audiometric calibration was performed in

accordance with ANSI S3.6 specifications (ANSI, 2004). No changes in calibration were necessary throughout the course of data collections.

The participants were not familiarized with thebisyllabic words prior to testing. The 250 bisyllabic words were randomly grouped into ten lists of 25 words each. These ten lists were used for presentation to the first ten participants. The 250 words were then randomly combined in a second group of ten different lists for presentation to the next group of ten participants. Ten presentation levels were selected for the lists: -5 to 40 dB HL in 5 dB steps. One list was presented at each level. The order of the presentation of the lists and the order of the words within the list were randomized for each participant. Each word was presented an equal number of times at each intensity level across the entire participant population. Prior to administration of the word recognition test, the following instructions were given to the participants in English as follows:

> You will hear Spanish words at a number of different loudness levels. Each word is two syllables in length. At the very soft loudness levels, it may be difficult for you to hear the words. Please listen carefully and repeat out loud the word that you hear. If you are unsure of the word, you are encouraged to guess. If you have no guess, say, I don't know. Do you have any questions?

A native interpreter was available to assist with any questions the participants had prior to the collection of data. Participants were not familiarized with the bisyllabic words prior to testing. Each list was presented one time per participant during each evaluation session. Participants were asked to verbally respond to the stimuli by repeating the perceived word. Responses were scored as either correct or incorrect by a native speaker of Spanish from Mexico and subsequently recorded into an Excel spreadsheet.

Results

During the data collection period the 250 bisyllabic words were presented once to each participant. Each of the 250 words was presented a total of 20 times across all participants. Each of the 250 words were then rank ordered according to difficulty. After the words were ranked, 50 of the least intelligible words were discarded. Upon being ranked, those words having the same or approximately the same degree of difficulty were then assigned among four different lists using an S-distribution. At the end of the process four lists containing 50 words each were created. After the four lists were constructed each list was then divided, using an S-distribution, into two half-lists resulting in 8 half-lists, each containing 25 words. Table 2 and Table 3 present the resulting four lists of 50 words for male and female talkers, and Table 4 and Table 5 the eight half-lists.

Following the construction of bisyllabic lists and half-lists, regression slopes and regression intercepts were calculated using logistic regression for each of the four lists and eight half-lists for both the male and female talker recordings. The regression slopes and regression intercepts are presented in Table 6 (male talker) and Table 7 (female talker).

Equation 1 was utilized to calculate percentage of correct performance at any specified intensity level. The percentage of correct recognition as a function intensity was subsequently used to construct psychometric functions.

$$P = (1 - \frac{\exp(a + b \times i)}{1 + \exp(a + b \times i)}) * 100 \quad (1)$$

In Equation 1 P is a percentage of correct recognition, a is the regression intercept, b is the regression slope, i is the intensity level of presentation in dB HL. The percentage of correct recognition at any specified intensity level is calculated by inserting

Table 2

Spanish Male Bisyllabic Lists in Rank Order from Most Difficult to Easiest

List 1		List 2		List 3		List 4	
cae	aquí	mezclar	nunca	llenar	bueno	inglés	otro
leen	mejor	cinco	boca	día	dentro	norte	doce
así	juego	mismo	lista	aquél	oro	allá	frente
río	raro	moda	blanco	quemar	nota	contar	lento
bebe	arma	canta	cada	causar	nueve	frío	cosa
cama	error	plata	hacer	mesa	compra	niña	duda
después	dónde	cuento	puede	planta	ocho	comen	favor
débil	golpe	junto	cara	curso	alto	juzga	este
puesto	guerra	calle	ojo	juegan	correr	once	fuerza
daño	mujer	poner	alma	llegan	normal	jamás	cuatro
cómo	marca	cumple	autor	pleno	pueblo	coche	niño
lleno	lugar	bien	cuanto	pronto	chico	mente	habla
dolor	ayer	rico	hoja	pero	forma	cuidar	amor
orden	loco	cuándo	lejos	centro	entre	contra	cabo
doble	color	ahí	feliz	pobre	papel	grado	pena
metro	firma	gente	esto	mucho	cerca	duro	cobra
grande	guardar	obra	hijo	ambos	para	costa	nombre
corto	abrir	padre	hombre	lucha	cargar	lleva	ella
libro	lograr	querer	pared	igual	eso	menos	cuarto
quita	poder	malo	dueño	muerto	azúl	paga	cuerpo
control	claro	listo	noche	rato	rojo	hora	haber
madre	cuadro	quince	café	llora	oír	fuerte	fecha
marco	doctor	letra	cuenta	piso	leche	corte	país
falta	hallar	banco	hambre	goza	bajo	razón	regla
resto	atrás	algo	puerta	dedo	perro	hija	calor

Table 3

Spanish Female Bisyllabic Lists in Rank Order from Most Difficult to Easiest

List 1		List 2		List 3		List 4	
falta	mucho	arma	once	mano	niña	cuenta	buscan
planta	inglés	lucha	lleva	algo	gente	carne	dedo
muerto	juego	regla	poner	ese	nunca	doce	boca
eso	aquí	fácil	aquél	leche	banco	bosque	ocho
nombre	feliz	daño	grande	orden	ahí	hallar	rojo
ella	llora	plata	contra	coche	lista	pobre	perro
logra	cuento	joven	ayer	moda	edad	pero	bien
mover	menos	cabo	letra	cosa	golpe	desde	azúl
firma	grado	quince	calle	bebe	dolor	pronto	chico
norte	nueve	cuidar	dentro	madre	alto	cruzan	día
niño	calor	ambos	libro	así	alma	cuatro	nota
cara	quemar	este	mejor	corto	detrás	debe	pared
entrar	habla	juegan	error	obra	país	corte	andar
cuanto	loco	otro	después	débil	amor	cinco	lejos
curso	poder	listo	cuarto	duda	hijo	paga	hora
autor	crea	blanco	metro	hija	dura	juzga	cerca
mente	cama	esto	contar	noche	guerra	claro	jamás
mesa	favor	fecha	duro	cargar	querer	hambre	mujer
resto	normal	río	papel	mío	lugar	causa	control
ojo	correr	dueño	oro	pueblo	oír	mundo	igual
dónde	razón	entre	lleno	cine	hoja	junto	para
compra	doble	cumple	bajo	hombre	causar	puente	grupo
centro	doctor	jefe	guardar	cómo	abrir	comen	café
cada	bueno	gusto	atrás	mismo	hacer	breve	llenar
cae	once	cuadro	llora	dejan	causar	demás	rico

Table 4

Spanish Male Bisyllabic Half-lists in Rank Order from Most Difficult to Easiest

1A	1B	2A	2B	3A	3B	4A	4B
leen	cae	mezclar	cinco	día	llenar	inglés	norte
así	río	moda	mismo	aquél	quemar	contar	allá
cama	bebe	canta	plata	mesa	causar	frío	niña
después	débil	junto	cuento	planta	curso	juzga	comen
daño	puesto	calle	poner	llegan	juegan	once	jamás
cómo	lleno	bien	cumple	pleno	pronto	mente	coche
orden	dolor	rico	cuándo	centro	pero	cuidar	contra
doble	metro	gente	ahí	pobre	mucho	duro	grado
corto	grande	obra	padre	lucha	ambos	costa	lleva
libro	quita	malo	querer	igual	muerto	paga	menos
madre	control	listo	quince	llora	rato	hora	fuerte
marco	falta	banco	letra	piso	goza	razón	corte
aquí	resto	algo	nunca	bueno	dedo	hija	otro
mejor	juego	lista	boca	dentro	oro	frente	doce
arma	raro	blanco	cada	nueve	nota	lento	cosa
error	dónde	puede	hacer	compra	ocho	favor	duda
guerra	golpe	cara	ojo	correr	alto	este	fuerza
mujer	marca	autor	alma	normal	pueblo	niño	cuatro
ayer	lugar	cuanto	hoja	forma	chico	habla	amor
loco	color	feliz	lejos	entre	papel	pena	cabo
guardar	firma	esto	hijo	para	cerca	cobra	nombre
abrir	lograr	pared	hombre	cargar	eso	cuarto	ella
claro	poder	dueño	noche	rojo	azúl	cuerpo	haber
cuadro	doctor	cuenta	café	oír	leche	país	fecha
atrás	hallar	hambre	puerta	perro	bajo	regla	calor

Table 5

Spanish Female Bisyllabic Half-lists in Rank Order from Most Difficult to Easiest

1A	1B	2A	2B	3A	3B	4A	4B
falta	planta	arma	lucha	mano	algo	carne	cuenta
eso	muerto	fácil	regla	leche	ese	doce	bosque
nombre	ella	daño	plata	orden	coche	pobre	hallar
mover	lograr	cabo	joven	cosa	moda	pero	desde
firma	norte	quince	cuidar	bebe	madre	cruzan	pronto
cara	niño	este	ambos	corto	así	cuatro	debe
entrar	cuanto	juegan	otro	obra	débil	cinco	corte
autor	curso	blanco	listo	hija	duda	paga	juzga
mente	mesa	esto	fecha	noche	cargar	hambre	claro
ojo	resto	dueño	río	pueblo	mío	causa	mundo
dónde	compra	entre	cumple	cine	hombre	puente	junto
cada	centro	gusto	jefe	mismo	cómo	comen	breve
cae	mucho	cuadro	once	dejan	niña	buscan	demás
juego	inglés	poner	lleva	nunca	gente	dedo	boca
aquí	feliz	aquél	grande	banco	ahí	rojo	ocho
cuento	llora	ayer	contra	edad	lista	perro	bien
menos	grado	letra	calle	golpe	dolor	chico	azúl
calor	nueve	libro	dentro	alma	alto	día	nota
quemar	habla	mejor	error	detrás	país	andar	pared
poder	loco	cuarto	después	hijo	amor	lejos	hora
crea	cama	metro	contar	dura	guerra	jamás	cerca
normal	favor	papel	duro	lugar	querer	mujer	control
correr	razón	oro	lleno	oír	hoja	para	igual
doctor	doble	guardar	bajo	abrir	causar	grupo	café
bueno	haber	atrás	color	hacer	frío	mezclar	llenar

Table 6

Mean Performance of Spanish Male Bisyllabic Lists and Half-lists

List	a[a]	b[b]	Slope at 50% [c]	Slope 20-80%[d]	Threshold[e]	ΔdB[f]
1	1.89558	-0.21140	5.3	4.6	9.0	0.24
2	1.86306	-0.20690	5.2	4.5	9.0	0.26
3	1.83025	-0.20351	5.1	4.4	9.0	0.27
4	1.99944	-0.21875	5.5	4.7	9.1	0.42
M	1.89708	-0.21014	5.3	4.5	9.0	0.30
Minimum	1.83025	-0.21875	5.1	4.4	9.0	0.24
Maximum	1.99944	-0.20351	5.5	4.7	9.1	0.42
Range	0.16919	0.01524	0.4	0.3	0.2	0.17
SD	0.07327	0.00659	0.2	0.1	0.1	0.08
1A	1.98609	-0.22330	5.6	4.8	8.9	0.17
1B	1.81637	-0.20100	5.0	4.3	9.0	0.31
2A	2.32754	-0.25443	6.4	5.5	9.1	0.43
2B	1.55037	-0.17597	4.4	3.8	8.8	0.09
3A	1.93372	-0.21310	5.3	4.6	9.1	0.35
3B	1.73583	-0.19484	4.9	4.2	8.9	0.19
4A	2.13220	-0.23133	5.8	5.0	9.2	0.49
4B	1.88161	-0.20771	5.2	4.5	9.1	0.34
M	1.92047	-0.21271	5.3	4.6	9.0	0.30
Minimum	1.55037	-0.25443	4.4	3.8	8.8	0.09
Maximum	2.32754	-0.17597	6.4	5.5	9.2	0.49
Range	0.77717	0.07846	2.0	1.7	0.4	0.41
SD	0.23858	0.02400	0.6	0.5	0.1	0.14

[a]*a* = regression intercept. [b]*b* = regression slope. [c]Psychometric function slope (%/dB) at 50% was calculated from 49.999 to 50.001%. [d]Psychometric function slope (%/dB) from 20-80%. [e]Intensity required for 50% intelligibility. [f]Change in intensity required to adjust threshold to the mean threshold for male and female lists (8.73 dB HL).

Table 7

Mean Performance of Spanish Female Bisyllabic Lists and Half-lists

List	a[a]	b[b]	Slope at 50% [c]	Slope 20-80%[d]	Threshold[e]	ΔdB[f]
1	2.08170	-0.24846	6.2	5.4	8.4	-0.35
2	1.99023	-0.23803	6.0	5.2	8.4	-0.37
3	2.02046	-0.23870	6.0	5.2	8.5	-0.26
4	1.70995	-0.20190	5.0	4.4	8.5	-0.28
M	1.95059	-0.23177	5.8	5.0	8.4	-0.31
Minimum	1.70995	-0.24846	5.0	4.4	8.4	-0.37
Maximum	2.08170	-0.20190	6.2	5.4	8.5	-0.26
Range	0.37175	0.04656	1.2	1.0	0.1	0.11
SD	0.16487	0.02048	0.5	0.4	0.1	0.05
1A	2.21490	-0.26531	6.6	5.7	8.3	-0.37
1B	1.96774	-0.23412	5.9	5.1	8.4	-0.32
2A	1.74348	-0.21148	5.3	4.6	8.2	-0.48
2B	2.32261	-0.27459	6.9	5.9	8.5	-0.26
3A	2.15363	-0.25522	6.4	5.5	8.4	-0.28
3B	1.90650	-0.22464	5.6	4.9	8.5	-0.24
4A	1.45467	-0.17378	4.3	3.8	8.4	-0.35
4B	2.07552	-0.24350	6.1	5.3	8.5	-0.20
M	1.97988	-0.23533	5.9	5.1	8.4	-0.31
Minimum	1.45467	-0.27459	4.3	3.8	8.2	-0.48
Maximum	2.32261	-0.17378	6.9	5.9	8.5	-0.20
Range	0.86794	0.10081	2.5	2.2	0.3	0.28
SD	0.28013	0.03246	0.8	0.7	0.1	0.09

[a]*a* = regression intercept. [b]*b* = regression slope. [c]Psychometric function slope (%/dB) at 50% was calculated from 49.999 to 50.001%. [d]Psychometric function slope (%/dB) from 20-80%. [e]Intensity required for 50% intelligibility. [f]Change in intensity required to adjust threshold to the mean threshold for male and female lists (8.73 dB HL).

the regression slope, regression intercept, and intensity level into Equation 1. Thus the percentage of correct word recognition was predicted through for each of the bisyllabic lists and half-lists. The range of presentation intensity levels was -5 to 40 dB HL in 5 dB increments. After the percentages were predicted using Equation 1, psychometric functions were constructed. Equation 2 was then used to find the threshold (presentation intensity required for 50% word recognition performance), the slope at threshold, and the slope from 20-80% for the bisyllabic lists and half-lists. The calculation was performed by inserting specific proportions into Equation 2.

$$i = \frac{\log \frac{p}{1-p} - a}{b} \qquad (2)$$

In Equation 2, i is the presentation level in dB HL, p is the proportion of correct recognition, a is the regression intercept, and b is the regression slope. Presented in Table 6 (male) and Table 7 (female) are the results for threshold, slope at threshold, and slope from 20-80% for each list and half-list.

After the lists and half-lists were compiled, a two-way Chi-Square (χ^2) analysis (intensity and list as independent variables with response as the dependent variable) was completed in order to discern any statistically significant differences among the bisyllabic word lists or half-lists. This Chi-Square analysis was conducted as part of the logistic regression analysis of the lists and half-lists. The results of the analysis indicated that there were no significant differences among the 50-word lists for the male talker, $\chi^2(3, N = 20) = 0.57, p = 0.90$, and the female talker $\chi^2(3, N = 20) = 3.02, p = 0.39$. Results also indicated that there were no significant differences found among the eight half-lists for the male talker $\chi^2(7, N = 20) = 6.88, p = 0.44$ and female talker

$\chi^2(7, N = 20) = 10.26, p = 0.17$. There were no significant intensity by list interactions, which indicated that there were no differences among the psychometric function slopes for the lists or half-lists. Although there were not any statistically significant differences among the lists or half-lists, intensity level adjustments were digitally completed using Adobe Audition Version 2 (Adobe Systems Incorporated, 2003). These intensity adjustments were performed in order to increase the psychometric equivalency of the lists and half-lists. The intensity of each word from the male and female bisyllabic lists and half-lists was adjusted digitally so that the 50% threshold of each list was equal to the midpoint (8.73 dB HL) between the mean threshold of the eight male half-lists and the mean threshold of the eight female half-lists. Presented in Table 6 (male) and Table 7 (female) are the intensity adjustments which were made to each word in the four lists and eight half-lists. Figure 1 exhibits the psychometric functions for the male talker and female talker bisyllabic lists and half-lists prior to the intensity adjustments. Figure 2 represents the psychometric functions for the female talker and male talker bisyllabic lists and half-lists after the intensity adjustments were performed to produce 50% performance at 8.73 dB HL. Figure 3 presents the mean psychometric functions for the combined male and female talker bisyllabic lists both before and after the intensity adjustments. The predicted psychometric functions and those created after the intensity adjustments were very similar for both the male and female talker lists. When comparing Figure 1 and Figure 2, it is evident that only minimal adjustments (≤ 0.5 dB) to the words in the lists and half-lists were necessary to equate the 50-word lists and 25-word half-lists for the male and female talkers.

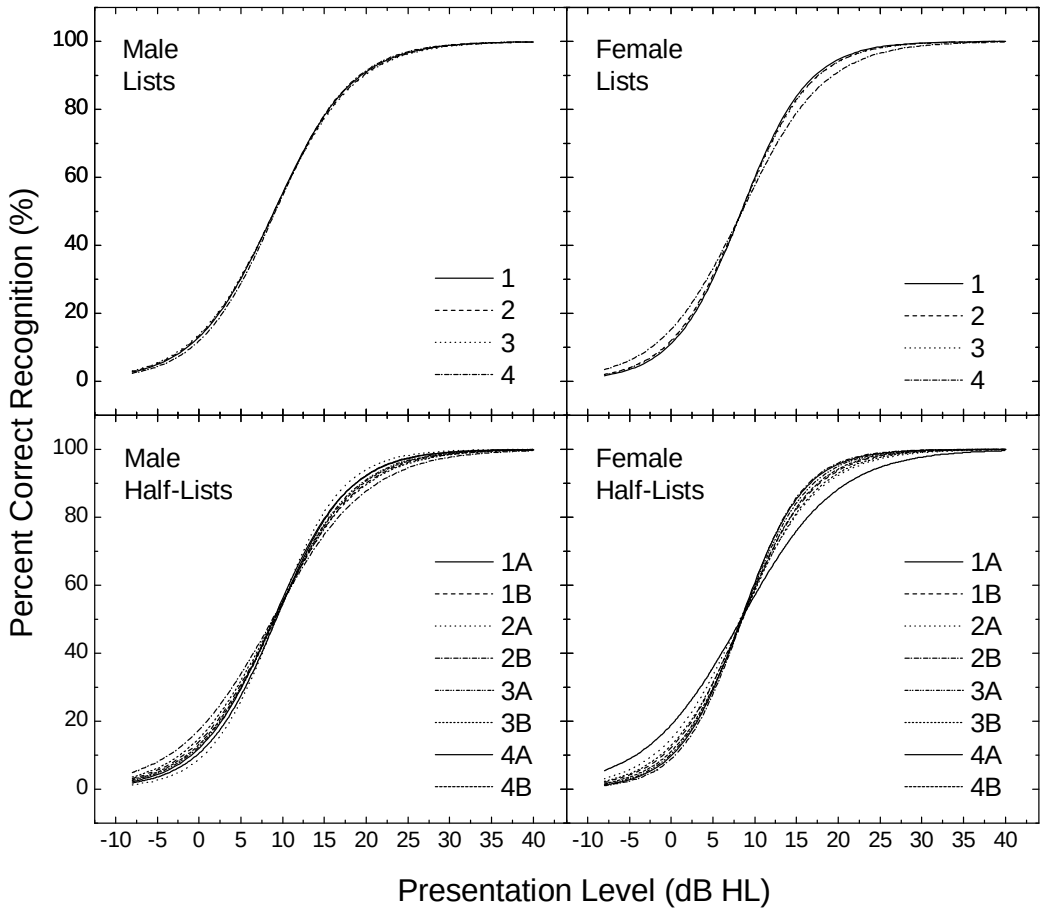

Figure 1.

Psychometric functions for the four Spanish bisyllabic lists and eight half-lists for male talker and female talker recordings before intensity adjustments to produce 50% performance at 8.73 dB HL.

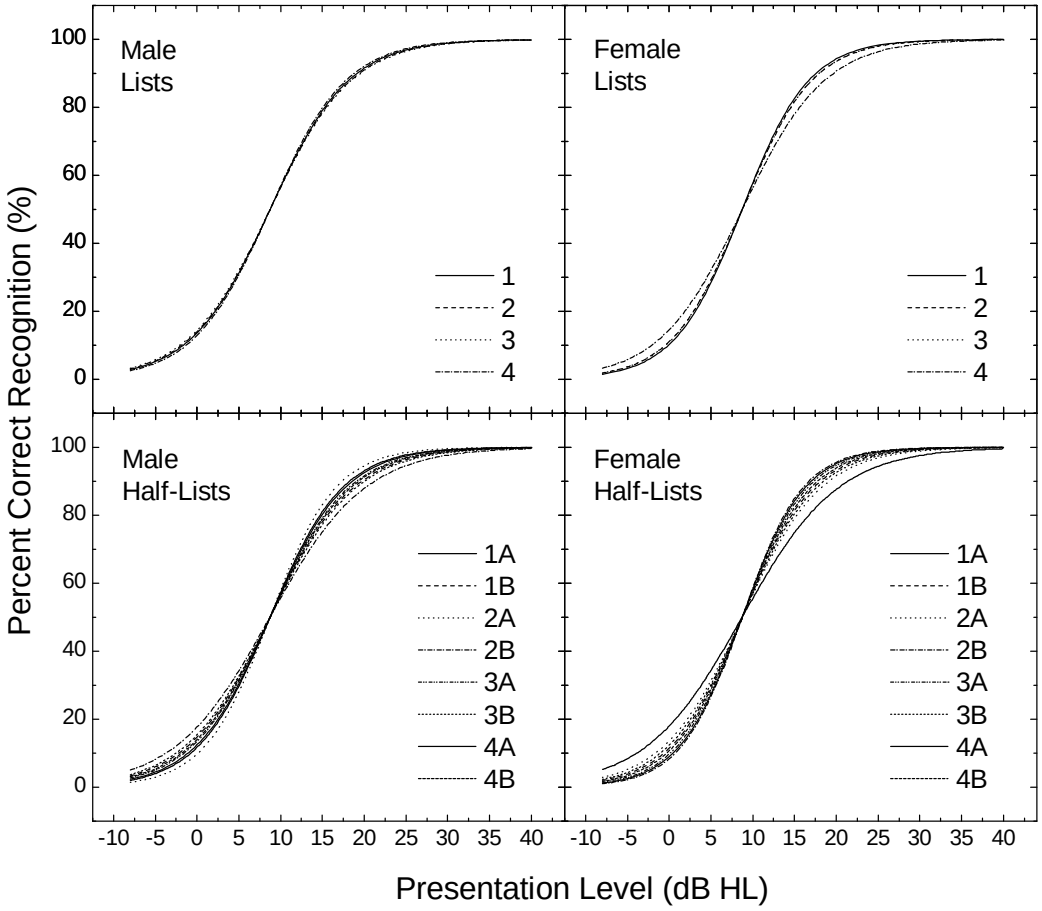

Figure 2.

Psychometric functions for the four Spanish bisyllabic lists and eight half-lists for male talker and female talker recordings after intensity adjustments to produce 50% performance at 8.73 dB HL.

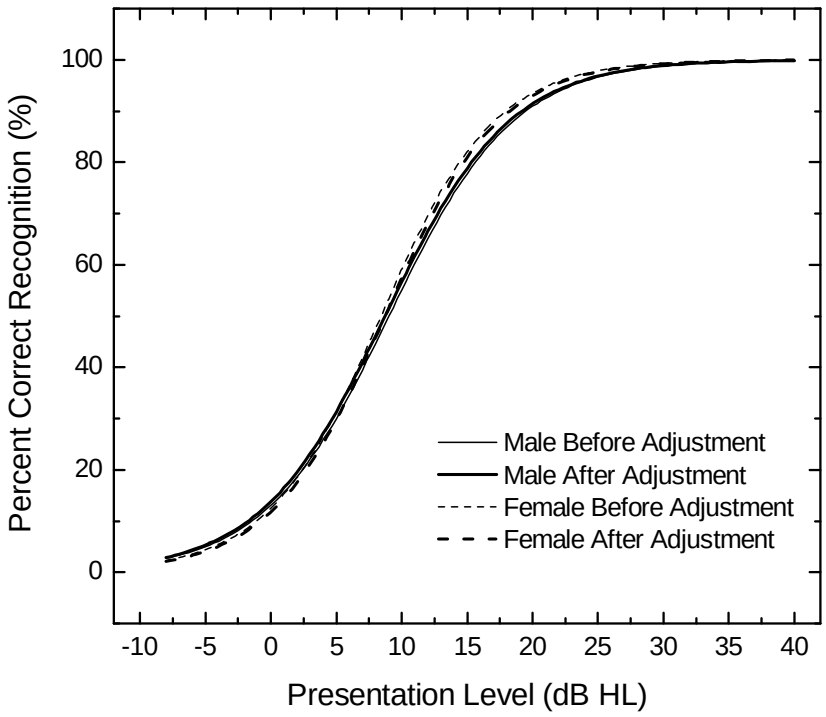

Figure 3.

Mean psychometric functions for male and female Spanish talker bisyllabic word lists before and after intensity adjustment. Intensity adjustments were made to each list and half-list to produce 50% correct performance at 8.73 dB HL.

Discussion

The aim of this study was to develop word-recognition materials for Spanish-speaking individuals. This was accomplished by creating psychometrically and statistically equivalent bisyllabic lists and half-lists. The lists were created to be relatively homogenous with respect to audibility and psychometric function slope, as Figures 1-3 demonstrate. As discussed in the results section, a two-way Chi-square analysis found no statistically significant differences between each list containing 50 words and each of the half-lists containing 25 words.

In review, Tables 6 (male) and 7 (female) present the regression slopes and regression intercepts for the four lists and eight half-lists for the male and female talker. For the male recordings, the psychometric function slopes ranged from 5.1 to 5.5 %/dB (M = 5.3%/dB) at 50% and ranged from 4.4 to 4.7 %/dB (M = 4.5 %/dB) when measured from 20-80%. The mean psychometric function slopes for the female recordings were slightly steeper, with ranges from 5.0 to 6.2%/dB (M = 5.8%/dB) at 50% and 4.4 to 5.4%/dB (M = 5.0%/dB) when measured from 20-80%. The psychometric function slopes at the 50% threshold measured slightly higher than the psychometric slopes from 20-80%.

When compared to word recognition materials developed in English, the psychometric function slopes of the Spanish word lists in this study were found to be similar. Beattie, Edgerton, and Svihovec (1977) reported a mean slope of 4.2%/dB for the NU-6 word lists and 4.6%/dB for the CID W-22 word lists from 20 to 80%. When using recordings from Auditec of St. Louis, Wilson and Oyler (1997) reported slightly different mean slopes for the NU-6 word lists (M = 4.4%/dB) and the CID W-22 lists

(M = 4.8%/dB). These findings are similar to the 4.5%/dB and 5.0%/dB for the male and female talker lists in the present investigation.

The psychometric slopes of the Spanish WRS materials created by Weisleder and Hodgson (1989) compared favorably to the slopes in the present study. Weisleder and Hodgson reported in their study that the average slope of lists 1-4, from 20 to 80% correct, was 4.2%/dB. In the present study the average slope for the male bisllyabic lists and half-lists was 4.6%/dB when measured from 20-80%. For the female talker, in the present study, the average slope for the bisllyabic lists and half-lists was 5.1%/dB. Additional psychometric slopes for Spanish WRS measures were reported by Comstock and Martin. The psychometric slopes in their study for lists 1-3 were shallower than those in the present study. Comstock and Martin reported an average slope of 2.9%/dB for the linear portion of the curve, or from 20-80%.

Some limitations of the present study may be the effect that dialect has on the outcome of speech audiometry test results (Schneider, 1992). Spanish is spoken in many areas of the world including, though not limited to, Central and South America, (excluding Brazil) Spain and the Caribbean. Use of everyday vocabulary, including verbs, nouns, and adjectives, may vary significantly depending on the region where Spanish is spoken. Regional use of different phonemes in Spanish will also vary. For example in northern and central Spain the distinction between /θ/ and /s/ is emphasized (Spanish language, 2008). This distinction is not emphasized in Southern Spain or in Latin American countries. There /θ/ or /s/ have merged into just /s/. These differences may impact the results of hearing tests and should be taken into consideration when testing a Spanish speaking client, and when interpreting speech audiometry test results.

Future extensions of research could include the creation of Spanish WRS lists for children. To date, the most current Spanish WRS materials for children were created by Comstock and Martin (1984). The need for up-to-date hearing measures is essential for children. Hearing loss affects a child's ability to participate in all aspects of life. In a study completed by Most (2006), 33 Israeli Arabic speaking children with hearing impairments were compared to 60 normally hearing students in academic functioning using the Arabic version of the assessment SIFTER (Screening Instrument for Targeting Educational Risks). The results of the study completed by Most (2006) showed that the hearing impaired students functioned lower than their normally hearing peers. This demonstrates not only the necessity for increasing the availability of hearing measures throughout the world, but helps to emphasize the importance of modernizing existing materials. Additional research may lead to testing instruments that better match a child's linguistic repertoire, which may help to increase the early identification of hearing loss.

Another possible avenue of research related to this study would be to administer the lists created in this study in the presence of background noise. Most listening environments include a fair amount of noise. These listening situations are challenging to those with hearing impairment. In a study by Stephens, Gianopoulos, and Kerr (2001), elderly hearing impaired individuals rated the activities most impacted by their hearing loss. Among the highest impacted activities were receiving spoken messages, conversations, telephone conversations, and listening activities (such as listening to the television). In addition, Wilson and MacArdle (2005) suggested that all audiological evaluations contain a speech-in-noise task. Inclusion of this task will better approximate

day-to-day speaking conditions and will therefore provide valuable clinical information in the treatment of hearing loss.

Testing the lists in this study on a group of elderly participants with hearing loss would be another possible extension of this study. Jerger (2006) discussed the importance of administering word recognition materials to the population for which they are intended. Typically word recognition measures are standardized using normally hearing young adults. Word recognition materials created with normal hearing young participants may show inter-list equivalence, however, these materials may not be equivalent for elderly persons with hearing impairment. Some lists may be easier while by other lists may be harder. The difference in difficulty demonstrates the need to test word recognition measures on an elderly population.

Lastly another possible research application would be to study the effects that dialect has on a listener's ability to correctly identify auditory stimuli. There are many differences in the way Spanish is spoken throughout the world. These differences may include how vocabulary is used and the way in which different phonemes are articulated (Spanish language, 2008). These differences may have an impact on a listener's ability to correctly identify words.

In summary, the goals of the study were to construct and digitally record bisyllabic lists and half-lists utilizing commonly occurring words in the Spanish language for use in word recognition testing. All lists are homogenous with respect to audibility and psychometric function slope. The resulting lists from this study were recorded onto a compact disc to be used for word recognition testing of individuals who speak Spanish.

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Appendix A

Informed Consent

RESEARCH PARTICIPATION FORM

Participant:_____Age:_____

You are asked to participate in a research study sponsored by the Department of Communications Disorders at Brigham Young University, Provo, Utah. The faculty director of this research is Richard W. Harris, Ph.D. Students in the Audiology and Speech-Language Pathology program may assist in data collection.

This research project is designed to evaluate a word list recorded using improved digital techniques. You will be presented with this list of words at varying levels of intensity. Many will be very soft, but none will be uncomfortably loud to you. You may also be presented with this list of words in the presence of a background noise. The level of this noise will be audible but never uncomfortably loud to you. This testing will require you to listen carefully and repeat what is heard through earphones or loudspeakers. Before listening to the word lists, you will be administered a routine hearing test to determine that your hearing is normal and that you are qualified for this study.

It will take approximately two hours to complete the test. Testing will be broken up into 2 or 3 one hour blocks. Each subject will be required to be present for the entire time, unless prior arrangements are made with the tester. You are free to make inquiries at any time during testing and expect those inquiries to be answered.

As the testing will be carried out in standard clinical conditions, there are no known risks involved. Standard clinical test protocol will be followed to ensure that you will not be exposed to any unduly loud signals.

Names of all subjects will be kept confidential to the investigators involved in the study. Participation in the study is a voluntary service and no payment of monetary reward of any kind is possible or implied.

You are free to withdraw from the study at any time without any penalty, including penalty to future care you may desire to receive from this clinic.

If you have any questions regarding this research project you may contact Dr. Richard W. Harris, 131 TLRB, Brigham Young University, Provo, Utah 84602; phone (801) 422-6460. If you have any questions regarding your rights as a participant in a research project you may contact Dr. Christopher Dromey, Chair of the Institutional Review Board, 133 TLRB, Brigham Young University, Provo, UT 84602; phone (801) 422-6461, email: dromey@byu.edu.

YES: I agree to participate in the Brigham Young University research study mentioned above. I confirm that I have read the preceding information and disclosure. I hereby give my informed consent for participation as described.

_____ _____

Signature of Participant Date

_____ _____

Signature of Witness Date.

Appendix B

Male Bisyllabic Word Definitions

1	abrir	to open
2	ahí	there
3	algo	something somewhat
4	allá	there, over there
5	alma	soul
6	alto	tall, high
7	ambos	both
8	amor	love
9	aquél	that one over there
10	aquí	here
11	arma	weapon
12	así	like that
13	atrás	back, behind, go
14	autor	author, writer
15	ayer	yesterday
16	azúl	blue
17	bajo	under
18	banco	bank, bench
19	bebe	to drink
20	bien	good
21	blanco	white
22	boca	mouth, entrance, opening
23	bueno	good
24	cabo	end, bit
25	cada	each, every
26	cae	to fall
27	café	coffee, café
28	calle	street
29	calor	heat, warmtth
30	cama	bed
31	canta	sing
32	cara	face, expression
33	cargar	to load, carry
34	causar	to cause, bring about
35	centro	to use
36	cerca	close, near
37	chico	boy
38	cinco	five
39	claro	clear
40	cobra	to charge (money)
41	coche	car, carriage
42	color	color
43	comen	to eat
44	cómo	how
45	compra	shopping, buy, purchase
46	contar	to tell, count
47	contra	against, opposite
48	control	control
49	correr	to run
50	corte	court
51	corto	short, brief
52	cosa	thing
53	costa	coast
54	cuadro	painting, picture
55	cuándo	when
56	cuanto	in terms of, regarding
57	cuarto	room, chamber
58	cuatro	fourth
59	cuenta	bill, account
60	cuento	story, tale
61	cuerpo	body
62	cuidar	to take care of
63	cumple	to fulfill
64	curso	course, direction
65	daño	harm, injury, damage
66	débil	weak
67	dedo	finger, toe, digit
68	dentro	inside
69	después	after
70	día	day
71	doble	double
72	doce	twelve
73	doctor	doctor
74	dolor	pain, ache, sorrow

75	dónde	where
76	duda	to doubt
77	dueño	owner
78	duro	hard
79	ella	she
80	entre	between
81	error	error, mistake
82	eso	that one over there
83	este	this
84	esto	this
85	falta	lack, shortage
86	favor	favor, benefit
87	fecha	date, day
88	feliz	happy, fortune
89	firma	to sign
90	forma	form, shape, way
91	frente	facing across from
92	frío	cold
93	fuerte	strong
94	fuerza	strength
95	gente	people
96	golpe	hit, strike
97	goza	to enjoy
98	grado	degree, grade
99	grande	large, big
100	guardar	to keep, save
101	guerra	war
102	haber	to have
103	habla	to speak, talk
104	hacer	to do, make
105	hallar	to find
106	hambre	hunger, starvation
107	hija	daughter
108	hijo	son
109	hoja	sheet, leaf
110	hombre	man, mankind, husband
111	hora	hour, time
112	igual	equal, same
113	inglés	English
114	jamás	never
115	juegan	to play
116	juego	play, sport
117	junto	together
118	juzga	to judge
119	leche	milk
120	leen	to read
121	lejos	far
122	lento	slow
123	letra	letter, handwriting, lyrics
124	libro	book
125	lista	roster, roll
126	listo	ready, clever, smart
127	llegan	to arrive
128	llenar	to fill
129	lleno	full, filled
130	lleva	to take, carry
131	llora	to cry
132	loco	crazy, insane
133	lograr	to achieve, get manage
134	lucha	fight, struggle, wrestle
135	lugar	place, position
136	madre	mother
137	malo	bad
138	marca	to mark, note, dial
139	marco	frame, mark, setting
140	mejor	best, better
141	menos	less, fewer
142	mente	mind
143	mesa	table, board
144	metro	meter, subway
145	mezclar	to mix
146	mismo	same
147	moda	fashion
148	mucho	much, many, a lot
149	muerto	dead
150	mujer	woman, wife
151	niña	child, young girl
152	niño	child, little boy
153	noche	night, evening
154	nombre	name, noun
155	normal	normal, usual
156	norte	north

157	nota	to notice
158	nueve	nine
159	nunca	never, ever
160	obra	work, book, deed
161	ocho	eight
162	oír	to hear
163	ojo	eye
164	once	eleven
165	orden	order, sequence
166	oro	gold
167	otro	other, another
168	padre	father
169	paga	center, middle
170	país	country
171	papel	paper, role, part
172	para	for, in order to, to
173	pared	wall
174	pena	trouble
175	pero	but, yet, except
176	perro	dog
177	piso	floor, story
178	planta	plant, floor
179	plata	silver, money
180	pleno	complete, full
181	pobre	poor
182	poder	power
183	poner	to put on
184	pronto	soon, quick
185	pueblo	people, village
186	puede	to be able to, can
187	puerta	door
188	puesto	job, place, position
189	quemar	to burn
190	querer	to want, love
191	quince	fifteen
192	quita	to remove, take away
193	raro	strange, rare
194	rato	moment, while, time
195	razón	reason
196	regla	rule, regulation
197	resto	rest, remainder
198	rico	rich, tasty
199	río	river
200	rojo	red

Appendix C

Female Bisyllabic Word Definitions

1	abrir	to open
2	ahí	there
3	algo	something somewhat
4	alma	soul
5	alto	tall, high
6	ambos	both
7	amor	love
8	andar	to walk, function
9	aquél	that one over there
10	aquí	here
11	arma	weapon
12	así	like that
13	atrás	back, behind, go
14	autor	author, writer
15	ayer	yesterday
16	azúl	blue
17	bajo	under
18	banco	bank, bench
19	bebe	to drink
20	bien	good
21	blanco	white
22	boca	mouth, entrance, opening
23	bosque	forest
24	breve	brief short
25	bueno	good
26	buscan	to look for
27	cabo	end, bit
28	cada	each, ever,
29	cae	to fall
30	café	coffee, café
31	calle	street
32	calor	heat, warmth
33	cama	bed
34	cara	face, expression
35	cargar	to load, carry
36	carne	meat, flesh
37	causa	cause
38	causar	to cause, bring about
39	centro	to use
40	cerca	close, near
41	chico	boy
42	cinco	five
43	cine	cinema
44	claro	clear
45	coche	car, carriage
46	comen	to eat
47	cómo	how
48	compra	shopping, buy, purchase
49	contar	to tell, count
50	contra	against, opposite
51	control	control
52	correr	to run
53	corte	court
54	corto	short, brieft
55	cosa	thing
56	crea	to create
57	cruzan	to cross
58	cuadro	when
59	cuanto	in terms of, regarding
60	cuarto	room, chamber
61	cuatro	fourth
62	cuenta	bill, account
63	cuento	story, tale
64	cuidar	to take care of
65	cumple	to fulfill
66	curso	course, direction
67	daño	harm, injury, damage
68	debe	duty, obligation
69	débil	weak
70	dedo	finger, toe, digit
71	dejan	to let, leave
72	demás	the rest, others
73	dentro	inside
74	desde	from, since

75	después	after
76	detrás	behind
77	día	day
78	doble	double
79	doce	twelve
80	doctor	doctor
81	dolor	pain, ache, sorrow
82	dónde	where
83	duda	to doubt
84	dueño	owner
85	dura	to last
86	duro	hard
87	edad	age
88	ella	she
89	entrar	to enter
90	entre	between
91	error	error, mistake
92	ese	that one over there
93	eso	that one over there
94	este	this
95	esto	this
96	fácil	easy
97	falta	lack, shortage
98	favor	favor, benefit
99	fecha	date, day
100	feliz	happy, fortune
101	firma	to sign
102	gente	people
103	golpe	hit, strike
104	grado	to enjoy
105	grande	degree, grade
106	grupo	group
107	guardar	to keep, save
108	guerra	war
109	gusto	pleasure, taste, preference
110	habla	to speak, talk
111	hacer	to do, make
112	hallar	to find
113	hambre	hunger, starvation
114	hija	daughter
115	hijo	son
116	hoja	sheet, leaf
117	hombre	man, mankind, husband
118	hora	hour, time
119	igual	equal, same
120	inglés	English
121	jamás	never
122	jefe	leader, boss
123	joven	young
124	juegan	to play
125	juego	play, sport
126	junto	together
127	juzga	to judge
128	leche	milk
129	lejos	far
130	letra	letter, handwriting, lyrics
131	libro	book
132	lista	roster, roll
133	listo	ready, clever, smart
134	llenar	to fill
135	lleno	full, filled
136	lleva	to take, carry
137	llora	to cry
138	loco	crazy, insane
139	logra	to achieve, get manage
140	lucha	fight, struggle, wrestle
141	lugar	place, position
142	madre	mother
143	mano	hand
144	mejor	best, better
145	menos	less, fewer
146	mente	mind
147	mesa	table, board
148	metro	meter, subway
149	mío	mine
150	mismo	same
151	moda	fashion
152	mover	to move, incite
153	mucho	much, many, a lot
154	muerto	dead
155	mujer	woman, wife
156	mundo	world

157	niña	child, young girl
158	niño	child, little boy
159	noche	night, evening
160	nombre	name, noun
161	normal	normal, usual
162	norte	north
163	nota	to notice
164	nueve	nine
165	nunca	never, ever
166	obra	work, book, deed
167	ocho	eight
168	oír	to hear
169	ojo	eye
170	once	eleven
171	once	eleven
172	orden	order, sequence
173	oro	gold
174	otro	other, another
175	paga	center, middle
176	país	country
177	papel	paper, role, part
178	para	for, in order to, to
179	pared	wall
180	pero	but, yet, except
181	perro	dog
182	planta	plant, floor
183	plata	silver, money
184	pobre	complete, full
185	poder	poor
186	poner	power
187	pronto	to put on
188	pueblo	soon, quick
189	puente	people, village
190	quemar	to burn
191	querer	to want, love
192	quince	fifteen
193	razón	reason
194	regla	rule, regulation
195	resto	rest, remainder
196	rico	rich, tasty
197	río	river
198	rojo	red