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Psychometrically Equivalent Trisyllabic Words for Speech Reception Threshold Testing in Cantonese

Misty Noelani Kim
Brigham Young University - Provo

PSYCHOMETRICALLY EQUIVALENT TRISYLLABIC WORDS FOR SPEECH RECEPTION THRESHOLD TESTING IN CANTONESE

by

Misty N. Kim

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of a thesis submitted by

Misty N. Kim

This thesis has been read by each member of the following graduate committee and by majority vote has been found to be satisfactory.

Date	Richard W. Harris, Chair
Date	Shawn L. Nissen
Date	David L. McPherson

BRIGHAM YOUNG UNIVERSITY

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Date	Richard W. Harris Chair, Graduate Committee

Accepted for the Department

Date	Ron W. Channell Graduate Coordinator

Accepted for the College

Date	K. Richard Young Dean, David O. McKay School of Education

ABSTRACT

PSYCHOMETRICALLY EQUIVALENT TRISYLLABIC WORDS FOR SPEECH RECEPTION THRESHOLD TESTING IN CANTONESE

Misty Noelani Kim

Department of Audiology and Speech-Language Pathology

Master of Science

The purpose of this study was to develop, digitally record, evaluate, and equate Cantonese trisyllabic words which could then be used in the measurement of the speech reception threshold. A selection of 90 frequently utilized trisyllabic words were selected and then digitally recorded by male and female talkers of Standard Cantonese and presented to 20 subjects with normal hearing beginning at 6 dB below their pure-tone average (PTA) and ascending in 2 dB increments until one of the following criteria had been met: (a) the participant responded correctly to 100% of the test items, or (b) the presentation level reached 16 dB HL. Using logistic regression, psychometric functions were calculated for each word. Twenty-eight trisyllabic words with the steepest psychometric function slopes were selected. The psychometric function slopes for the 28 selected words, at 50% threshold, ranged from 10.3 %/dB to 19.6 %/dB (*M* = 14.5 %/dB)

for the male talker and from 10.3 %/dB to 22.7 %/dB (*M* = 14.9 %/dB) for the female talker. To decrease the variability among the words the intensities were digitally adjusted to match the mean subject PTA (4.5 dB HL). The resulting lists included mean slopes from 20 to 80% with of a range of 8.9 %/dB to 16.9 %/dB (*M* = 12.6 %/dB) for the male talker and a range of 8.9 %/dB to 19.7 %/dB (*M* = 12.9 %/dB) for the female talker. Digital recordings of the psychometrically equivalent trisyllabic words are available on compact disc.

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Introduction

Hearing evaluations are used to evaluate the degree and type of a hearing impairment in an individual. Pure-tone audiometry is used to test the auditory system by means of simple stimuli and determine the extent of a hearing impairment. However, pure-tone audiometry does very little in determining the effect of the hearing impairment on an individual's communication abilities (Egan, 1979). Since we use our hearing primarily for communicative purposes (Hagerman, 1993) and our auditory system is a critical link in our communicative abilities, a hearing evaluation would be considered incomplete without assessing the ability of an individual to process the more complex acoustic signals present in speech (Martin, Champlin, & Perez, 2000; Ramkissoon, 2001; Weisleder & Hodgson, 1989; Wilson & McArdle, 2005).

Although the tests used in speech audiometry are more complicated than the standard pure-tone audiometric procedure, there are several reasons it is important to use speech audiometry for diagnostic hearing evaluations. First, the majority of auditory stimuli that a person encounters during a day are made up of speech. The human auditory system appears to be specialized for speech perception. Second, the ability of an individual to comprehend speech is important for integration into society. Third, since clients are typically familiar with the words used in speech audiometry, the tests have a high degree of validity (Ramkissoon, 2001). Furthermore, speech audiometry can also be beneficial in diagnosing peripheral and central auditory disorders, determining hearing aid candidacy and performance, and in validating pure-tone results.

Seeing the benefits that come from speech audiometry, nearly 99% of audiologists perform some sort of speech measure for complete diagnostic evaluations (Martin, Armstrong, & Champlin, 1994). However, audiologists today are faced with an increasing population of non-native English speakers. Audiologists will typically use the materials they have available to them; even though English may not be an individual's native language, there is a high probability that the individual will still be administered speech stimuli in English. Clinical decisions based on testing done in a language other than the native language should be considered very carefully because test bias presents a real problem for this population (Rudmin, 1987).

Researchers and audiologists have recognized the need for native language testing and have undertaken the responsibility of creating speech audiometry materials in other languages such as Arabic (Ashoor & Prochazka, 1985), Russian (Aleksandrovsky, McCullough, & Wilson, 1998), Spanish (Christensen, 1995), Italian (Greer, 1997), Portuguese (Harris, Goffi, Pedalini, Gygi, & Merrill, 2001), Korean (Harris, Kim, & Eggett, 2003), Polish (Harris, Nielson, McPherson, Skarzynski, & Eggett, 2004), Japanese (Mangum, 2005) and Mandarin (Harris, Nissen, & Jennings, 2004; Nissen, Harris, Jennings, Eggett, & Buck, 2005) in order to make the materials available to individuals who speak these languages. The distribution of such materials has been available throughout the United States and also to the countries who speak the above named languages. These materials have been extremely beneficial in accurately describing individuals' speech communication abilities within their native language.

The purpose of this study is to develop digital speech audiometry materials that can be used to evaluate the speech reception threshold (SRT) of individuals who speak Cantonese. Cantonese is spoken by 71 million people residing in the regions of Guangdong, Hong Kong, Macau, some areas of Southeast Asia, and by many individuals living overseas who originated in either Guangdong or Hong Kong (Wikipedia, 2006).

The current investigation will aim to digitally record, evaluate, and psychometrically equate SRT materials so audiologists in the United States familiar with Cantonese can use these materials to obtain accurate results in the testing of individuals whose native language is Cantonese. These materials will also be distributed to regions where Cantonese is the native language for the use in measuring the SRT.

Review of Literature

Speech Audiometry

The purpose of an audiometric evaluation is to properly determine a person's hearing ability. There are several different methods that are routinely used to assess this ability including tympanometry, otoacoustic emissions, and pure-tone audiometry. Pure-tone audiometry is typically the preferred method of audiologists to determine the hearing loss of an individual because of its high reliability, validity, and the simplicity with which it is administered. In pure-tone audiometry a pure-tone average (PTA) is determined by taking the listener's average hearing thresholds at 500 Hz, 1000 Hz, and 2000 Hz. This procedure provides the audiologist with data regarding frequency-specific hearing loss; however, pure-tone audiometry results are not able to provide specific information regarding one's ability to comprehend speech. Since we use our hearing primarily for the processing of speech signals (Hagerman, 1993) and speech audiometry is considered to be an effective measure of an individual's communicative ability (Bell & Wilson, 2001) a comprehensive hearing evaluation will typically include a speech audiometry component as a further diagnostic procedure.

One of the first speech tests used was the Western Electric 4-C. This particular test used numbers as the stimuli to determine an individual's sensitivity to speech. These stimuli were recorded using a phonograph, which was later criticized because it was unable to produce an adequate intensity range which decreased its ability to predict high-frequency hearing loss (Hudgins, Hawkins, Karlin, & Stevens, 1947). Through many revisions and advancements in speech audiometry materials, the CID-W1 and W-22 lists were produced (Hirsh et al., 1952) and were one of the first widespread recorded materials used by audiologists (Wilson, Preece, & Thornton, 1990).

Through the evolution of speech audiometry materials, speech audiometry has become an invaluable tool in audiology as it offers useful information in quantifying social disability caused from a hearing loss, assessing suprathreshold intelligibility, measuring progress in auditory training, evaluating hearing aid performance, predicting the effectiveness of otoacoustic surgery, and aiding in the diagnosis of peripheral and central auditory disorders (Hood & Poole, 1977; Jerger, Speaks, & Trammell, 1968; Van Dijk, Duijndam, & Graamans, 2000). The speech audiometry measure that this study focused on is the SRT.

Speech Reception Threshold

The SRT is defined as the lowest intensity level at which an individual can understand 50% of the words presented (Epstein, 1978) and is the most commonly used method for determining at what level an individual can understand speech (Egan, 1979). The SRT has proven to be an efficient testing procedure and should be relatively congruent with pure-tone audiometry results. Furthermore, a divergence between pure-tone and speech reception results can aid in the identification of an attempted exaggeration of a hearing impairment, (American Speech-Language Hearing Association [ASHA], 1988; Egan, 1979; Epstein, 1978) or could possibly indicate the presence of a retrocochlear disorder (Van Dijk et al., 2000). Therefore, the SRT provides a dependable estimate of an individual's loss of sensitivity for the spoken language (Epstein, 1978), is an invaluable tool in the prescribing of hearing aids (Hood & Poole, 1977), and is useful in providing a reference intensity level for other speech audiometry tests (Egan, 1979; Young, Dudley, & Gunter, 1982).

Among the materials typically used in SRT testing include a two room, sound insulated testing suite, speech audiometers that follow the guidelines of American National Standards Institute (American National Standards Institute [ANSI], 2004), and a list of bisyllabic (spondaic) words with equal emphasis put on both syllables of the word (Epstein, 1978).

Recorded speech materials have been created in order to standardize the materials used in audiology clinics. One such recording for SRT testing is the CID W-1 lists (Hirsh et al., 1952). In selecting the words which were used in creating the spondaic lists, Hudgins et al. (1947) identified four essential characteristics that must be present in each word: (a) familiarity, (b) phonetic dissimilarity, (c) the encompassing of a normal sample of English speech sounds, and (d) homogeneity of audibility. Ramkissoon (2001) later determined that although these factors are all necessary for suprathreshold tests, only familiarity and homogeneity of audibility were necessary for threshold tests.

Factors Influencing the Quality of Speech Audiometry Materials

Among the factors that influence the quality of speech materials include familiarity, phonetic dissimilarity, homogeneity of the psychometric function, and method of presentation. Familiarity of the testing words is one of the most important components to consider because it will ensure test validity (Nissen et al., 2005). If high frequency usage words are not used in speech audiometry, the participants’ vocabulary, rather than their sensitivity to speech, is being assessed. (Ramkissoon, 2001). This particular factor creates a caveat when testing clients in a language other than their native tongue. Although the words may be familiar to an English speaker, people from other countries or who are considered to have limited English proficiency (LEP) may not have had the same opportunities to be exposed to the words; therefore, their vocabulary, rather than their auditory abilities would be tested.

Phonetic dissimilarity is also an important factor in speech audiometry. Words selected as stimuli should be familiar but should not have several words that are phonemically similar (Luce, 1986). A study by Dirks, Takayanagi, and Moshfegh (2001) determined that when developing speech materials lexical properties and acoustic-phonetic properties of selected stimuli should be considered. The frequency of occurrence of a word as well as the number of words that are phonemically similar to the target word affect the speed and accuracy of recognition. Words that are lexically "easy" occur frequently and have few phonemically similar words. These types of words result in better recognition scores. This concept is particularly important when testing individuals with a hearing impairment. When someone's hearing is impaired, their ability to identify specific phonemes is diminished; therefore, if there is a high number of words that are phonemically similar to the target word the task then becomes even more difficult (Bell & Wilson, 2001). Familiarity and phonetic dissimilarity affect the homogeneity of a list as well.

Homogeneity has been identified as another important factor when creating stimuli to be used for speech audiometry (Epstein, 1978; Wilson & Carter, 2001; Wilson & Strouse, 1999). Words need to be homogenous with respect to audibility and psychometric function slope. Wilson and Carter (2001) state:

> Psychometric functions for word recognition tasks reflect the ability of a listener to understand a given set of speech materials (dependent variable) as a function of either the presentation level of the speech material or the signal-to-noise ratio of the stimulus material and a masking agent (independent variable). (p. 7)

Wilson and Carter further define psychometric function as the “relation between the change in correct recognition performance (Δy) and the change in the presentation level of the signal (Δx)” (p. 7). Increasing the homogeneity of test stimuli is deemed necessary to equate the basic audibility of the testing materials (Epstein, 1978). Furthermore, by ensuring homogeneity of psychometric slope and audibility, test-retest variability will decrease and test time is likely to be reduced (Wilson & Carter, 2001; Wilson & Strouse, 1999).

Since the establishment of SRT testing, there have been advancements in the way the spondaic lists have been presented to the listener. Lists have been presented via phonographic records, tape recordings (Hughes & Scott, 1967), monotonal live voice, and digital presentation using compact discs (CDs). Overall, it has been determined that CDs provide the most favorable quality-value ratio in that they are relatively inexpensive and provide audiologists with many advantages such as: high-fidelity recordings, enhanced signal-to-noise ratio, wider frequency response, almost infinite channel separation, no print through, less damage due to use, near instantaneous access to any track, and an increased amount of recording time (Wilson et al., 1990). Furthermore, digital recordings are preferred as the method of presentation because they provide a greater deal of standardization than monitored live voice (ASHA, 1988). A digital recording provides a more reliable presentation level than monitored live voice and one that is stored on the computer provides other advantages such as the ability to manipulate the signal by means of compression, speeding, slowing, mixing, editing, timing, measuring, and filtering (Kamm, Carterette, Morgan, & Dirks, 1980). Each of these characteristics were taken into consideration during the development of the materials for the current investigation.

Native Language Testing

A recent census concluded that of the 262 million people in the United States 5-years old and over, approximately 47 million speak a language other than English and that approximately 21 million have reported that they speak English less than very well, (U.S. Census Bureau, 2000). These numbers indicate that in the year 2000, approximately 8% of America's population reported speaking English with limited proficiency. With the rising rate of immigration, it can be determined that since 2000, the number of LEP individuals in the United States has increased. Therefore, audiologists are dealing with an ever growing LEP population; since 99% of audiologists have reported to perform some sort of speech measure (Martin et al., 1994), accommodations need to be made for individuals with a native language other than English (Comstock & Martin, 1984).

Without the availability of native language testing, individuals are required to be assessed in a language that they may or may not be proficient in, therefore calling into question the familiarity of the test stimuli. Pisoni (1985) indicated that the understanding of a spoken language involves being able to access knowledge regarding the language structure and combine that knowledge with the sensory input to develop a representation of a spoken message. This puts non-native English speakers at a disadvantage when tested in English. The test stimuli may then become nonsense syllables to individuals who are unfamiliar with a particular lexicon (Weisleder & Hodgson, 1989). Other researchers have also concluded that a "nonaudibility-based cost" exists in second-language processing especially when speech measures are being tested in background noise (Rudmin, 1987; Von Hapsburg & Pena, 2002). Therefore, testing in this manner will result in test bias and will compromise the validity of the results (Rudmin, 1987; Von Hapsburg, 2004). With these factors in mind, there have been efforts made to accommodate LEP individuals.

When presented with clients that are difficult to test, including individuals who are unfamiliar with test items, some audiologists have reduced the number of test items and only administer familiar words. However, a decreased number of test stimuli may result in a lower SRT, thereby overestimating a person's speech recognition abilities. This method of testing is, therefore, not a suggested way to remediate the problem of testing non-native English speakers (Ramkissoon, 2001; Ramkissoon, Proctor, Lansing, & Bilger, 2002).

Another method that has been used when testing multilingual populations is to include English digits in the diagnostic process. Digits are believed to have an appeal to people from many different linguistic backgrounds. The method of using digits was introduced by Fletcher in the early 1900s and is considered by some to be a viable alternative for selected stimuli than the traditional spondaic words that are currently used for SRT testing (Fletcher, 1929; Ramkissoon, 2001). Although digit testing has provided more accurate SRT results than the typical spondaic words for SRT, the most valuable method of testing someone is in their native language.

Speech Audiometry in Cantonese

Language. Cantonese is spoken by almost all citizens residing in Hong Kong, and is the most common dialect spoken by Chinese individuals now residing overseas in

Great Britain, the United States, Australia, and Southeast Asia (Lau & So, 1988). There are at least four different dialects of Cantonese; however, Standard Cantonese is generally considered the prestige dialect. Standard Cantonese is the official spoken language of Hong Kong and Macau and the prestige dialect in Guangdong province. In total there are approximately 71 million individuals that speak Cantonese (Wikipedia, 2005). Furthermore, Cantonese has been reported to be the 16th most commonly spoken language in the world (Bauer & Benedict, 1997).

There are several differences between Standard Cantonese and English some of which include lexical tone, unreleased final stops, and aspirated versus unaspirated stops (Leung, Law, & Fung, 2004; Whitehill, 1997). Furthermore, all root words are monosyllabic; multisyllabic words are formed by the combination of two or more characters (Lau & So, 1988). Due to the differences between English and Cantonese, it is necessary to create speech audiometry materials in Cantonese to accurately assess the communication abilities of individuals that speak Cantonese as their native language.

Materials. There is evidence that some speech audiometry materials have been created for individuals who speak Cantonese; however, it is difficult to produce speech audiometry material in Cantonese because the language is tonal and there are many homophones. Recognizing that speech audiometry materials are valuable in the assessment of hearing loss, individuals have begun to develop materials for speech audiometry. Lau and So (1988) piloted a study in an attempt to create short word lists that are “equal in phonemic distribution” (p. 297). Lau and So took into consideration equal average difficulty for the word lists as well as using only words that were common. In doing so, they were able to create ten 10-word monosyllabic lists in Cantonese.

Another study, by Kei and Smyth (1997) began by implementing the use of conventional speech audiometry using Cantonese monosyllabic words in testing children with hearing impairment. After determining the extent of the hearing impairment in the children, the use of connected speech in Cantonese was then implemented in order to determine if children with hearing impairment could extract meaning from connected discourse.

Additional efforts have been made by Wong and Soli (2005) to create a standardized test based on the same principles as the English Hearing in Noise Test (HINT; Nilsson, Soli, & Sullivan, 1994). Wong and Soli successfully created the Cantonese Hearing in Noise Test (CHINT), and it is the first standardized sentence speech intelligibility test in Cantonese.

In addition to sentence intelligibility, SRT testing has been proven to be beneficial in quantifying an individual’s communication abilities. Since there are no documented or widespread materials available in the Cantonese language for SRT testing, the purpose of this study is to (a) identify a native male and a native female Cantonese talker who use Standard Cantonese dialect to serve as talkers for the Cantonese speech audiometry recordings; (b) construct a list of familiar trisyllabic Cantonese words which have steep psychometric function slopes for use in measurement of the SRT; (c) create high-quality digital recordings of the selected Cantonese trisyllabic words; (d) collect normative data on the trisyllabic words; and (e) select a subset of words which are homogeneous with respect to audibility and psychometric function slope. These materials can then be distributed for the use of audiologists in the United States as well as other countries who are familiar with Cantonese and who are responsible for testing individuals whose native language is Cantonese.

Method

Participants

The individuals who participated in this study all grew up as native talkers of Cantonese. In addition, all participants self-reported speaking Standard Cantonese as is commonly used in standard broadcast news media, and indicated that they have continued to speak Cantonese on a regular basis. A total of 20 subjects (10 male, 10 female), participated in evaluating the Cantonese trisyllabic words. All participants had pure-tone air-conduction thresholds ≤ 15 dB HL at octave and mid-octave frequencies from 125 to 8000 Hz and had 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). Summary statistics of the subject thresholds are presented in Table 1.

Materials

Words. Trisyllabic words were chosen as stimuli for the SRT materials based on previous research in other languages (Nissen et al., 2005) and a pilot investigation which found that the steepness of psychometric function slopes for trisyllabic words was similar to the steepness of slope for spondaic words in English. Initially, 165 Chinese trisyllabic words were selected from two electronic word corpora (McEnery & Xiao, 2004; Xiao, 2005). The initial list was then reviewed and edited by five native speakers of Cantonese to ensure that the list was representative of familiar words in Modern Cantonese. These

Table 1

Age (years) and Pure Tone Threshold (dB HL) Descriptive Statistics for 20 Normally Hearing Cantonese Subjects

kHz	*M*	*Minimum*	*Maximum*	*SD*
0.125	3.0	-10	10	5.9
0.25	2.3	-5	15	5.3
0.5	5.8	0	10	3.7
0.75	5.0	-5	10	4.3
1.0	4.5	0	15	4.3
1.5	4.0	-5	10	3.8
2.0	3.3	-5	10	4.1
3.0	0.0	-5	5	3.6
4.0	-0.8	-5	5	4.4
6.0	-2.3	-10	5	5.3
8.0	-0.5	-10	10	5.8
PTA[a]	4.5	0	12	3.0
Age	23.2	19	29	2.8

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

words were then rated by three native judges on a scale of 1 to 5 based on how familiar a word would be to a native speaker of Cantonese (1 = extremely, 2 = very, 3 = average, 4 = seldom used, 5 = rarely used). Only words with an average familiarity rating of ≤ 3 were selected for recording. Of the 165 trisyllabic words considered, 75 words were eliminated prior to listener evaluation for the following reasons: (a) thought to be culturally insensitive, (b) considered to be unfamiliar, (c) thought to possibly represent inappropriate content, or (d) had the same pronunciation but different meanings.

Talkers. Initial test recordings were made using eight native Cantonese-speaking individuals, four males and four females. All talkers were from Hong Kong, who self-reported speaking Cantonese on a daily basis. After the initial recordings were made, a panel of eight Cantonese judges from Hong Kong evaluated the performance of each talker, rank ordering the talkers from best to worst based on vocal quality, Cantonese accent, and pronunciation. The highest ranked male and female talkers were selected as the talkers for all subsequent recordings. Due to the selected female talker's inability to participate, an alternate female talker was used whose ratings were equivalent to the initial talker based on vocal quality, accent, and pronunciation.

Recordings. All recordings were made in a large anechoic chamber located on the Brigham Young University campus in Provo, Utah, USA. 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 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 at least 65 dB during recording, which was verified by measurement of ambient noise and speech levels on the recording.

During the recording sessions, the talker was asked to pronounce each trisyllabic word at least four times with a slight pause between each production. Talkers were asked to speak at a natural rate with normal intonation patterns. To avoid possible list effects, the first and last repetition of each word were excluded from the study. 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 inclusion in the Cantonese speech audiometry trisyllabic test words. Any word that was judged to be a poor recording (peak clipping, extraneous noise, etc.), mispronounced, or produced with an unnatural intonation pattern were rerecorded or eliminated from the study prior to listener evaluation.

After the word selection process, the intensity of each trisyllabic word to be included in the test materials was edited as a single utterance using Adobe Audition (Adobe Systems Incorporated, 2006) and Sadie Disk Editor software (Studio Audio & Video Limited, 2004) 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 et al., 2004; Wilson & Strouse, 1999). Each of the individually recorded and edited words were then saved as 24-bit *wav* files.

Procedures

Custom software was used to control randomization and timing of the presentation of the words from 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 subject 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 subject, the external inputs to the audiometer were calibrated to 0 VU using a 1000 Hz calibration tone. The audiometer was calibrated prior to, weekly during, 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.

Each subject participated in two test sessions after passing a screening exam. The 90 trisyllabic words were presented to each of the participants beginning at 6 dB below their PTA and ascending in 2 dB increments until one of the following criteria had been met: (a) the participant responded correctly to 100% of the test items, or (b) the presentation level reached 16 dB HL. The sequence of the 90 words was randomized prior to presentation at each intensity level. Each subject listened to both the male and female talker recordings of all 90 trisyllabic words, in a sequence determined randomly. Subjects repeated words verbally which were scored as being correct or incorrect by a native Cantonese judge. Each subject was allowed to have several rest periods during each test session. Prior to the evaluation of the trisyllabic words, each individual was given the following instructions:

> You will hear trisyllabic words, which may become louder or softer in intensity. At the very soft levels it may be difficult for you to hear the words. Please listen carefully and repeat the words that you hear. If you are unsure of a word, you are encouraged to guess. If you have no guess, please be quiet and listen for the next word. Do you have any questions?

Data Analysis

After the raw data were collected, logistic regression was used to obtain the regression slope and intercept for each of the 90 trisyllabic words. These values were then inserted into a modified logistic regression equation that was designed to calculate the percent correct at each intensity level. The original logistic regression equation follows:

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

In Equation 1, *p* is the proportion correct at any given intensity level, *a* is the regression intercept, *b* is the regression slope, and *i* is the presentation level in dB HL. When Equation 1 is solved for *p* and multiplied by 100, Equation 2 is obtained where *P* is percent correct recognition:

$$P = (1 - \frac{\exp(a + b \times i)}{1 + \exp(a + b \times i)}) * 100 \qquad (2)$$

By inserting the regression slope, regression intercept, and presentation level into Equation 2, it is possible to predict the percentage correct at any specified intensity level. Percentage of correct recognition was calculated for each of the trisyllabic words for a range of -10 to 18 dB HL in 1 dB increments.

In order to calculate the intensity level required for a given proportion, Equation 1 was solved for *i* (see Equation 3). By inserting the desired proportions into Equation 3, it is possible to calculate the threshold (intensity required for 50% intelligibility), the slope (%/dB) at threshold, and the slope from 20 to 80% for each psychometric function. When solving for the threshold (p = 0.5), Equation 3 can be simplified to Equation 4:

$$i = \frac{\log \frac{p}{1-p} - a}{b} \quad (3)$$

$$i = \frac{-a}{b} \quad (4)$$

Calculations of threshold (intensity required for 50% correct perception), slope at 50%, and slope from 20% to 80% were made for each trisyllabic word using the logistic regression slopes and intercepts.

A subset of words with steep slopes was then selected for inclusion based on the 50% intelligibility threshold level. The words that had a 50% intelligibility threshold presentation level that matched the mean pure tone average of the subjects were selected and saved as 24-bit wav files.

Results

Thresholds for the 90 trisyllabic words ranged from 0.7 dB HL to 11.2 dB HL (M = 6.2 dB HL) for the male talker words, and from -4.0 dB HL to 5.7 dB HL (M = 0.3 dB HL) for the female talker words. Psychometric functions for each trisyllabic word were calculated with Equation 2 using the logistic regression intercept and slope values. The slopes at 50% ranged from 8.7 %/dB to 19.6 %/dB (M = 13.7) for the male talker and from 7.0 %/dB to 24.6 %/dB (M = 14.4) for the female talker. The slopes from

20-80% ranged from 7.6 %/dB to 16.9 %/dB (*M* = 11.8) for the male talker and from 6.1 %/dB to 21.3 %/dB (*M* = 12.4) for the female talker. Thus, the slopes at 50% threshold were steeper when compared to the slopes at 20-80%. Slopes of the psychometric functions and 50% thresholds for all trisyllabic words are presented in Table 2 (male talker) and Table 3 (female talker).

Words used to measure SRT should have relatively homogeneous and steep psychometric function slopes (Wilson & Strouse, 1999). In order to reduce test time as well as improve reliability, steeper slopes are used. The 28 words that had the steepest psychometric function slopes for both the male and female talker recordings (≥ 10.0 %/dB for both male and female talkers) were selected for inclusion in the final list of trisyllabic words. The threshold, slope at threshold, and the slope from 20% to 80% for the 28 selected trisyllabic words are listed in Table 4 (male talker) and Table 5 (female talker). Inspection of Figure 1 reveals much less variability in slope of the psychometric functions for the 28 selected words (C-D) when compared to the slopes of the entire group of 90 words (A-B). Figure 2 (male talker) and Figure 3 (female talker) contain the psychometric functions for each of the 28 words with the logistic regression slopes and intercepts (see Table 4 and Table 5) being used to fit the data. The composite psychometric functions for the selected 28 words are shown in the middle panels (C-D) of Figure 1. The psychometric function slopes for the 28 selected words, at 50% threshold, ranged from 10.3 %/dB to 19.6 %/dB (*M* = 14.5 %/dB) for the male talker recording and from 10.3 %/dB to 22.7 %/dB (*M* = 14.9 %/dB) for the female talker.

To decrease the variability that still existed across the thresholds of the final 28 words, the intensity of each of these words was digitally adjusted so that the

Table 2

Mean Performance for 90 Cantonese Male Trisyllabic SRT words

#	Character	Romanization	a[a]	b[b]	Slope at 50% [c]	Slope 20-80%[d]	Threshold[e]	ΔdB[f]
1	辦公室	baan6gung1sat1	2.04311	-0.50380	12.6	10.9	4.1	-0.4
2	畢業生	bat1jip6sang1	4.11970	-0.78252	19.6	16.9	5.3	0.8
3	不鏽鋼	bat1sau3gong3	2.09517	-0.62159	15.5	13.5	3.4	-1.1
4	並唔係	bing3m4hai6	3.39174	-0.50811	12.7	11.0	6.7	2.2
5	差唔多	caa1m4do1	1.09801	-0.49549	12.4	10.7	2.2	-2.3
6	出版社	ceot1baan2se5	4.47935	-0.67371	16.8	14.6	6.6	2.1
7	打電話	daa2din6waa6	3.70272	-0.66592	16.6	14.4	5.6	1.1
8	打官司	daa2gun1si1	3.94227	-0.41013	10.3	8.9	9.6	5.1
9	大多數	daai6do1sou3	1.26006	-0.48080	12.0	10.4	2.6	-1.9
10	頂唔順	deng2m4seon6	4.83735	-0.65839	16.5	14.2	7.3	2.8
11	對唔住	deoi3m4zyu6	1.08758	-0.69423	17.4	15.0	1.6	-2.9
12	電單車	din6daan1ce1	1.84117	-0.42385	10.6	9.2	4.3	-0.2
13	電視機	din6si6gei1	4.70590	-0.58308	14.6	12.6	8.1	3.6
14	到宜家	dou3ji4gu1	2.76501	-0.52526	13.1	11.4	5.3	0.8
15	發脾氣	faat3pei4hei3	3.77415	-0.69107	17.3	15.0	5.5	1.0
16	分公司	fan1gung1si1	3.86446	-0.63808	16.0	13.8	6.1	1.6
17	飛機場	fei1gei1coeng4	1.90308	-0.49417	12.4	10.7	3.9	-0.6
18	火車站	fo2ce1zaam6	2.54992	-0.64192	16.0	13.9	4.0	-0.5
19	副產品	fu3caan2ban2	3.20050	-0.55534	13.9	12.0	5.8	1.3
20	計數機	gai3sou3gei1	2.30006	-0.74602	18.7	16.1	3.1	-1.4
21	基本上	gei1bun2soeng6	3.40940	-0.55317	13.8	12.0	6.2	1.7
22	記唔到	gei3m4dou3	4.72809	-0.55679	13.9	12.0	8.5	4.0
23	講唔明	gong2m4ming4	3.22339	-0.36072	9.0	7.8	8.9	4.4
24	工程師	gung1cing4si1	5.40212	-0.69783	17.4	15.1	7.7	3.2
25	公務員	gung1mou6jyun4	3.84161	-0.55142	13.8	11.9	7.0	2.5
26	關節炎	gwaan1zit3jim4	3.18272	-0.36579	9.1	7.9	8.7	4.2
27	過日子	gwo3jat6zi2	4.08902	-0.37610	9.4	8.1	10.9	6.4
28	下半年	haa6bun3nin4	2.93462	-0.48315	12.1	10.5	6.1	1.6
29	係唔係	hai6m4hai6	2.03819	-0.58804	14.7	12.7	3.5	-1.0
30	可能性	ho2nang4sing3	3.16043	-0.47265	11.8	10.2	6.7	2.2
31	好開心	hou2hoi1sam1	1.91625	-0.52420	13.1	11.3	3.7	-0.8
32	一定要	jat1ding6jiu3	5.61940	-0.68998	17.2	14.9	8.1	3.6
33	一方面	jat1fong1min6	3.63800	-0.40093	10.0	8.7	9.1	4.6
34	一個人	jat1go3jan4	1.23830	-0.44160	11.0	9.6	2.8	-1.7
35	一嘢就	jat1je5zau6	4.23965	-0.42759	10.7	9.3	9.9	5.4
36	幼兒園	jau3ji4jyun4	2.51526	-0.41277	10.3	8.9	6.1	1.6
37	游泳池	jau4wing6ci4	2.84573	-0.68177	17.0	14.8	4.2	-0.3
38	有意思	jau5ji3si1	4.31989	-0.61234	15.3	13.3	7.1	2.6
39	研究院	jin4gwai2jyun2	3.69280	-0.35730	8.9	7.7	10.3	5.8
40	郁啲就	juk1di1zau6	3.43405	-0.41984	10.5	9.1	8.2	3.7
41	用唔著	jung6m4zoek3	4.43111	-0.57800	14.4	12.5	7.7	3.2

#	Character	Romanization	a[a]	b[b]	Slope at 50% [c]	Slope 20-80%[d]	Threshold[e]	ΔdB[f]
42	越嚟越	jyut6lai4jyut6	5.37547	-0.58401	14.6	12.6	9.2	4.7
43	吸塵器	kap1can4hei3	3.29864	-0.55316	13.8	12.0	6.0	1.5
44	留學生	lau4hok6saang1	3.01601	-0.59553	14.9	12.9	5.1	0.6
45	嚟得切	lei4dak1cit3	3.16043	-0.47265	11.8	10.2	6.7	2.2
46	嚟唔切	lei4m4cit3	5.73817	-0.71374	17.8	15.4	8.0	3.5
47	兩個人	loeng5go3jan4	0.79303	-0.55810	14.0	12.1	1.4	-3.1
48	錄音帶	luk6jam1daai3	5.84179	-0.56174	14.0	12.2	10.4	5.9
49	錄音機	luk6jam1gei1	3.15586	-0.55727	13.9	12.1	5.7	1.2
50	唔單止	m4daan1zi2	3.52447	-0.52841	13.2	11.4	6.7	2.2
51	唔覺得	m4gaau3dak1	3.09050	-0.48458	12.1	10.5	6.4	1.9
52	唔緊要	m4gan2jiu3	4.39565	-0.54358	13.6	11.8	8.1	3.6
53	唔係咁	m4hai6gam3	3.69127	-0.40732	10.2	8.8	9.1	4.6
54	唔可以	m4ho2ji5	1.72427	-0.42718	10.7	9.2	4.0	-0.5
55	唔捨得	m4se2dak1	3.92639	-0.58969	14.7	12.8	6.7	2.2
56	唔在乎	m4zoi6fu4	3.09026	-0.54561	13.6	11.8	5.7	1.2
57	微波爐	mei4bo1lou4	2.33371	-0.54744	13.7	11.8	4.3	-0.2
58	未至到	mei6zi3dou3	5.22897	-0.55428	13.9	12.0	9.4	4.9
59	望遠鏡	mong6jyun5geng3	4.11072	-0.72648	18.2	15.7	5.7	1.2
60	無幾耐	mou4gei2loi6	3.61175	-0.56775	14.2	12.3	6.4	1.9
61	無所謂	mou4so2wai6	0.65833	-0.45413	11.4	9.8	1.4	-3.1
62	冇關系	mou5gwaan1hai6	2.36193	-0.62628	15.7	13.6	3.8	-0.7
63	男朋友	naam4pang4jau5	2.62615	-0.60127	15.0	13.0	4.4	-0.1
64	女朋友	neoi5pang4jau5	2.90644	-0.74909	18.7	16.2	3.9	-0.6
65	牛仔褲	ngau4zai2fu3	3.47320	-0.59266	14.8	12.8	5.9	1.4
66	外國人	ngoi6gwok3jan4	1.15316	-0.40084	10.0	8.7	2.9	-1.6
67	三五年	saam1ng5lin4	5.59090	-0.51836	13.0	11.2	10.8	6.3
68	生活費	saang1wut6fai3	4.25281	-0.57757	14.4	12.5	7.4	2.9
69	細路仔	sai3lou6zai2	3.11416	-0.65313	16.3	14.1	4.8	0.3
70	晨咁早	san4gam3zou2	2.16725	-0.53376	13.3	11.6	4.1	-0.4
71	實際上	sat6zai3soeng6	1.57300	-0.55137	13.8	11.9	2.9	-1.6
72	收音機	sau1jam1gei1	1.97697	-0.51281	12.8	11.1	3.9	-0.6
73	手續費	sau2zuk6fai3	0.98636	-0.49163	12.3	10.6	2.0	-2.5
74	事實上	si6sat6soeng6	4.11072	-0.72648	18.2	15.7	5.7	1.2
75	成班人	sing4baan1jan4	2.84573	-0.68177	17.0	14.8	4.2	-0.3
76	小提琴	siu2tai4kam4	2.31514	-0.64781	16.2	14.0	3.6	-0.9
77	上個月	soeng6go3jyut6	2.42225	-0.59546	14.9	12.9	4.1	-0.4
78	說明書	syut3ming4syu1	1.85692	-0.44799	11.2	9.7	4.1	-0.4
79	睇唔慣	tai2m4gwaan3	1.68136	-0.46213	11.6	10.0	3.6	-0.9
80	圖書館	tou4syu1gun2	3.10739	-0.57940	14.5	12.5	5.4	0.9
81	通知書	tung1zi1syu1	5.30649	-0.50724	12.7	11.0	10.5	6.0
82	屋企人	uk1kei2jan4	3.14032	-0.75170	18.8	16.3	4.2	-0.3
83	話唔埋	waa6m4maai4	1.78780	-0.47736	11.9	10.3	3.7	-0.8
84	維他命	wai4taa1ming6	1.90802	-0.53638	13.4	11.6	3.6	-0.9
85	盡可能	zeon6ho2nang4	1.86857	-0.52564	13.1	11.4	3.6	-0.9

#	Character	Romanization	a[a]	b[b]	Slope at 50% [c]	Slope 20-80%[d]	Threshold[e]	ΔdB[f]
86	自動化	zi6dung6faa3	3.92722	-0.34974	8.7	7.6	11.2	6.7
87	自信心	zi6seon3sam1	3.32998	-0.49866	12.5	10.8	6.7	2.2
88	足球賽	zuk1kau4coi3	0.34322	-0.47514	11.9	10.3	0.7	-3.8
89	總經理	zung2ging1lei5	3.90824	-0.65614	16.4	14.2	6.0	1.5
90	總公司	zung2gung1si1	4.84996	-0.61723	15.4	13.4	7.9	3.4
		Average	3.15021	-0.55181	13.7	11.8	6.2	1.7
		Minimum	0.34322	-0.78252	8.7	7.6	0.7	-3.8
		Maximum	5.84179	-0.34974	19.6	16.9	11.2	6.7
		Range	5.49857	0.43278	10.8	9.4	10.5	10.5
		Standard Deviation	1.28312	0.10304	2.6	2.2	2.5	2.5

[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 the threshold of a word to the mean PTA of the subjects (4.5 dB HL)

Table 3

Mean Performance for 90 Cantonese Female Trisyllabic SRT words

#	Character	Romanization	a[a]	b[b]	Slope at 50% [c]	Slope 20-80%[d]	Threshold[e]	ΔdB[f]
1	辦公室	baan6gung1sat1	-0.51886	-0.60617	15.2	13.1	-0.9	-5.4
2	畢業生	bat1jip6sang1	1.05078	-0.69263	17.3	15.0	1.5	-3.0
3	不鏽鋼	bat1sau3gong3	-0.59436	-0.71240	17.8	15.4	-0.8	-5.3
4	並唔係	bing3m4hai6	2.01314	-0.90969	22.7	19.7	2.2	-2.3
5	差唔多	caa1m4do1	-1.14144	-0.40454	10.1	8.8	-2.8	-7.3
6	出版社	ceot1baan2se5	0.92893	-0.70835	17.7	15.3	1.3	-3.2
7	打電話	daa2din6waa6	-0.70423	-0.48650	12.2	10.5	-1.4	-5.9
8	打官司	daa2gun1si1	0.38917	-0.48144	12.0	10.4	0.8	-3.7
9	大多數	daai6do1sou3	-1.40009	-0.59483	14.9	12.9	-2.4	-6.9
10	頂唔順	deng2m4seon6	0.27103	-0.68942	17.2	14.9	0.4	-4.1
11	對唔住	deoi3m4zyu6	1.29076	-0.80114	20.0	17.3	1.6	-2.9
12	電單車	din6daan1ce1	0.23520	-0.48172	12.0	10.4	0.5	-4.0
13	電視機	din6si6gei1	1.37646	-0.58078	14.5	12.6	2.4	-2.1
14	到宜家	dou3ji4gu1	-0.25121	-0.55912	14.0	12.1	-0.4	-4.9
15	發脾氣	faat3pei4hei3	0.12844	-0.68204	17.1	14.8	0.2	-4.3
16	分公司	fan1gung1si1	0.41165	-0.44802	11.2	9.7	0.9	-3.6
17	飛機場	fei1gei1coeng4	-2.30794	-0.58323	14.6	12.6	-4.0	-8.5
18	火車站	fo2ce1zaam6	0.52687	-0.46557	11.6	10.1	1.1	-3.4
19	副產品	fu3caan2ban2	0.80900	-0.48675	12.2	10.5	1.7	-2.8
20	計數機	gai3sou3gei1	-0.60205	-0.55535	13.9	12.0	-1.1	-5.6
21	基本上	gei1bun2soeng6	-0.49656	-0.57359	14.3	12.4	-0.9	-5.4
22	記唔到	gei3m4dou3	0.99484	-0.57087	14.3	12.4	1.7	-2.8
23	講唔明	gong2m4ming4	1.20113	-0.65641	16.4	14.2	1.8	-2.7
24	工程師	gung1cing4si1	0.44786	-0.43504	10.9	9.4	1.0	-3.5
25	公務員	gung1mou6jyun4	-0.51607	-0.33388	8.3	7.2	-1.5	-6.0
26	關節炎	gwaan1zit3jim4	0.42049	-0.32360	8.1	7.0	1.3	-3.2
27	過日子	gwo3jat6zi2	1.63786	-0.49866	12.5	10.8	3.3	-1.2
28	下半年	haa6bun3nin4	0.51719	-0.41207	10.3	8.9	1.3	-3.2
29	係唔係	hai6m4hai6	-1.10779	-0.53616	13.4	11.6	-2.1	-6.6
30	可能性	ho2nang4sing3	0.59618	-0.65900	16.5	14.3	0.9	-3.6
31	好開心	hou2hoi1sam1	-0.17404	-0.46539	11.6	10.1	-0.4	-4.9
32	一定要	jat1ding6jiu3	-0.01133	-0.67906	17.0	14.7	0.0	-4.5
33	一方面	jat1fong1min6	0.38917	-0.48144	12.0	10.4	0.8	-3.7
34	一個人	jat1go3jan4	-0.40078	-0.98546	24.6	21.3	-0.4	-4.9
35	一嘢就	jat1je5zau6	0.65248	-0.48649	12.2	10.5	1.3	-3.2
36	幼兒園	jau3ji4jyun4	0.39226	-0.56004	14.0	12.1	0.7	-3.8
37	游泳池	jau4wing6ci4	-0.85228	-0.74902	18.7	16.2	-1.1	-5.6
38	有意思	jau5ji3si1	0.89710	-0.54570	13.6	11.8	1.6	-2.9
39	研究院	jin4gwai2jyun2	1.11928	-0.45936	11.5	9.9	2.4	-2.1
40	郁啲就	juk1di1zau6	1.64215	-0.56443	14.1	12.2	2.9	-1.6
41	用唔著	jung6m4zoek3	0.98714	-0.46969	11.7	10.2	2.1	-2.4

#	Character	Romanization	a[a]	b[b]	Slope at 50% [c]	Slope 20-80%[d]	Threshold[e]	ΔdB[f]
42	越嚟越	jyut6lai4jyut6	1.30696	-0.76188	19.0	16.5	1.7	-2.8
43	吸塵器	kap1can4hei3	0.53682	-0.47515	11.9	10.3	1.1	-3.4
44	留學生	lau4hok6saang1	-0.86866	-0.45063	11.3	9.8	-1.9	-6.4
45	嚟得切	lei4dak1cit3	0.96251	-0.73481	18.4	15.9	1.3	-3.2
46	嚟唔切	lei4m4cit3	1.04619	-0.60273	15.1	13.0	1.7	-2.8
47	兩個人	loeng5go3jan4	-0.00880	-0.75706	18.9	16.4	0.0	-4.5
48	錄音帶	luk6jam1daai3	-0.77348	-0.67098	16.8	14.5	-1.2	-5.7
49	錄音機	luk6jam1gei1	-0.08236	-0.70285	17.6	15.2	-0.1	-4.6
50	唔單止	m4daan1zi2	0.44381	-0.55133	13.8	11.9	0.8	-3.7
51	唔覺得	m4gaau3dak1	-0.36508	-0.44438	11.1	9.6	-0.8	-5.3
52	唔緊要	m4gan2jiu3	1.96095	-0.74264	18.6	16.1	2.6	-1.9
53	唔係咁	m4hai6gam3	1.45675	-0.41558	10.4	9.0	3.5	-1.0
54	唔可以	m4ho2ji5	-0.12220	-0.44670	11.2	9.7	-0.3	-4.8
55	唔捨得	m4se2dak1	0.61758	-0.50154	12.5	10.9	1.2	-3.3
56	唔在乎	m4zoi6fu4	0.69320	-0.51977	13.0	11.2	1.3	-3.2
57	微波爐	mei4bo1lou4	-0.30249	-0.41042	10.3	8.9	-0.7	-5.2
58	未至到	mei6zi3dou3	1.19425	-0.61523	15.4	13.3	1.9	-2.6
59	望遠鏡	mong6jyun5geng3	-0.21578	-0.43126	10.8	9.3	-0.5	-5.0
60	無幾耐	mou4gei2loi6	-0.85872	-0.57134	14.3	12.4	-1.5	-6.0
61	無所謂	mou4so2wai6	-1.62009	-0.63579	15.9	13.8	-2.5	-7.0
62	冇關系	mou5gwaan1hai6	-0.12555	-0.48442	12.1	10.5	-0.3	-4.8
63	男朋友	naam4pang4jau5	-0.02029	-0.50574	12.6	10.9	0.0	-4.5
64	女朋友	neoi5pang4jau5	-0.01708	-0.55563	13.9	12.0	0.0	-4.5
65	牛仔褲	ngau4zai2fu3	0.14169	-0.50919	12.7	11.0	0.3	-4.2
66	外國人	ngoi6gwok3jan4	-1.26899	-0.46996	11.7	10.2	-2.7	-7.2
67	三五年	saam1ng5lin4	1.61048	-0.28074	7.0	6.1	5.7	1.2
68	生活費	saang1wut6fai3	0.45168	-0.75546	18.9	16.3	0.6	-3.9
69	細路仔	sai3lou6zai2	-0.91596	-0.67306	16.8	14.6	-1.4	-5.9
70	晨咁早	san4gam3zou2	-0.37163	-0.56486	14.1	12.2	-0.7	-5.2
71	實際上	sat6zai3soeng6	-1.04355	-0.43280	10.8	9.4	-2.4	-6.9
72	收音機	sau1jam1gei1	-0.85604	-0.44139	11.0	9.6	-1.9	-6.4
73	手續費	sau2zuk6fai3	-0.77348	-0.67098	16.8	14.5	-1.2	-5.7
74	事實上	si6sat6soeng6	-0.33030	-0.60912	15.2	13.2	-0.5	-5.0
75	成班人	sing4baan1jan4	-1.03819	-0.71327	17.8	15.4	-1.5	-6.0
76	小提琴	siu2tai4kam4	-0.24312	-0.53227	13.3	11.5	-0.5	-5.0
77	上個月	soeng6go3jyut6	0.85356	-0.59907	15.0	13.0	1.4	-3.1
78	說明書	syut3ming4syu1	-0.15449	-0.70419	17.6	15.2	-0.2	-4.7
79	睇唔慣	tai2m4gwaan3	0.56189	-0.62017	15.5	13.4	0.9	-3.6
80	圖書館	tou4syu1gun2	-0.79714	-0.69461	17.4	15.0	-1.1	-5.6
81	通知書	tung1zi1syu1	1.86094	-0.53588	13.4	11.6	3.5	-1.0
82	屋企人	uk1kei2jan4	-0.82321	-0.54211	13.6	11.7	-1.5	-6.0
83	話唔埋	waa6m4maai4	0.18714	-0.48953	12.2	10.6	0.4	-4.1
84	維他命	wai4taa1ming6	-0.25121	-0.55912	14.0	12.1	-0.4	-4.9
85	盡可能	zeon6ho2nang4	0.21529	-0.73570	18.4	15.9	0.3	-4.2

#	Character	Romanization	a[a]	b[b]	Slope at 50% [c]	Slope 20-80%[d]	Threshold[e]	ΔdB[f]
86	自動化	zi6dung6faa3	0.77514	-0.54021	13.5	11.7	1.4	-3.1
87	自信心	zi6seon3sam1	0.92151	-0.46122	11.5	10.0	2.0	-2.5
88	足球賽	zuk1kau4coi3	-0.91248	-0.56572	14.1	12.2	-1.6	-6.1
89	總經理	zung2ging1lei5	-0.33264	-0.80012	20.0	17.3	-0.4	-4.9
90	總公司	zung2gung1si1	0.78086	-0.86651	21.7	18.8	0.9	-3.6
		Average	0.14815	-0.57478	14.4	12.4	0.3	-4.2
		Minimum	-2.30794	-0.98546	7.0	6.1	-4.0	-8.5
		Maximum	2.01314	-0.28074	24.6	21.3	5.7	1.2
		Range	4.32108	0.70472	17.6	15.3	9.7	9.7
		Standard Deviation	0.88640	0.13085	3.3	2.8	1.7	1.7

[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 the threshold of a word to the mean PTA of the subjects (4.5 dB HL)

Table 4

Mean Performance for 28 Selected Cantonese Male Trisyllabic SRT words

#	Character	Romanization	a[a]	b[b]	Slope at 50%[c]	Slope 20-80%[d]	Threshold[e]	ΔdB[f]
1	畢業生	bat1jip6sang1	4.11970	-0.78252	19.6	16.9	5.3	0.8
2	並唔係	bing3m4hai6	3.39174	-0.50811	12.7	11.0	6.7	2.2
3	出版社	ceot1baan2se5	4.47935	-0.67371	16.8	14.6	6.6	2.1
4	對唔住	deoi3m4zyu6	1.08758	-0.69423	17.4	15.0	1.6	-2.9
5	電視機	din6si6gei1	4.70590	-0.58308	14.6	12.6	8.1	3.6
6	分公司	fan1gung1si1	3.86446	-0.63808	16.0	13.8	6.1	1.6
7	火車站	fo2ce1zaam6	2.54992	-0.64192	16.0	13.9	4.0	-0.5
8	副產品	fu3caan2ban2	3.20050	-0.55534	13.9	12.0	5.8	1.3
9	記唔到	gei3m4dou3	4.72809	-0.55679	13.9	12.0	8.5	4.0
10	工程師	gung1cing4si1	5.40212	-0.69783	17.4	15.1	7.7	3.2
11	下半年	haa6bun3nin4	2.93462	-0.48315	12.1	10.5	6.1	1.6
12	可能性	ho2nang4sing3	3.16043	-0.47265	11.8	10.2	6.7	2.2
13	幼兒園	jau3ji4jyun4	2.51526	-0.41277	10.3	8.9	6.1	1.6
14	有意思	jau5ji3si1	4.31989	-0.61234	15.3	13.3	7.1	2.6
15	郁啲就	juk1di1zau6	3.43405	-0.41984	10.5	9.1	8.2	3.7
16	用唔著	jung6m4zoek3	4.43111	-0.57800	14.4	12.5	7.7	3.2
17	吸塵器	kap1can4hei3	3.29864	-0.55316	13.8	12.0	6.0	1.5
18	嚟得切	lei4dak1cit3	3.16043	-0.47265	11.8	10.2	6.7	2.2
19	嚟唔切	lei4m4cit3	5.73817	-0.71374	17.8	15.4	8.0	3.5
20	唔單止	m4daan1zi2	3.52447	-0.52841	13.2	11.4	6.7	2.2
21	唔緊要	m4gan2jiu3	4.39565	-0.54358	13.6	11.8	8.1	3.6
22	唔捨得	m4se2dak1	3.92639	-0.58969	14.7	12.8	6.7	2.2
23	唔在乎	m4zoi6fu4	3.09026	-0.54561	13.6	11.8	5.7	1.2
24	生活費	saang1wut6fai3	4.25281	-0.57757	14.4	12.5	7.4	2.9
25	上個月	soeng6go3jyut6	2.42225	-0.59546	14.9	12.9	4.1	-0.4
26	睇唔慣	tai2m4gwaan3	1.68136	-0.46213	11.6	10.0	3.6	-0.9
27	自信心	zi6seon3sam1	3.32998	-0.49866	12.5	10.8	6.7	2.2
28	總公司	zung2gung1si1	4.84996	-0.61723	15.4	13.4	7.9	3.4
		Average	3.64268	-0.57172	14.5	12.6	6.4	1.9
		Minimum	1.08758	-0.78252	10.3	8.9	1.6	-2.9
		Maximum	5.73817	-0.41277	19.6	16.9	8.5	4.0
		Range	4.65059	0.36975	9.2	8.0	6.9	6.9
		Standard Deviation	1.06220	0.09056	2.3	2.0	1.6	1.6

[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 the threshold of a word to the mean PTA of the subjects (4.5 dB HL)

Table 5

Mean Performance for 28 Selected Cantonese Female Trisyllabic SRT words

#	Character	Romanization	a[a]	b[b]	Slope at 50% [c]	Slope 20-80%[d]	Threshold[e]	ΔdB[f]
1	畢業生	bat1jip6sang1	1.05078	-0.69263	17.3	15.0	1.5	-3.0
2	並唔係	bing3m4hai6	2.01314	-0.90969	22.7	19.7	2.2	-2.3
3	出版社	ceot1baan2se5	0.92893	-0.70835	17.7	15.3	1.3	-3.2
4	對唔住	deoi3m4zyu6	1.29076	-0.80114	20.0	17.3	1.6	-2.9
5	電視機	din6si6gei1	1.37646	-0.58078	14.5	12.6	2.4	-2.1
6	分公司	fan1gung1si1	0.41165	-0.44802	11.2	9.7	0.9	-3.6
7	火車站	fo2ce1zaam6	0.52687	-0.46557	11.6	10.1	1.1	-3.4
8	副產品	fu3caan2ban2	0.80900	-0.48675	12.2	10.5	1.7	-2.8
9	記唔到	gei3m4dou3	0.99484	-0.57087	14.3	12.4	1.7	-2.8
10	工程師	gung1cing4si1	0.44786	-0.43504	10.9	9.4	1.0	-3.5
11	下半年	haa6bun3nin4	0.51719	-0.41207	10.3	8.9	1.3	-3.2
12	可能性	ho2nang4sing3	0.59618	-0.65900	16.5	14.3	0.9	-3.6
13	幼兒園	jau3ji4jyun4	0.39226	-0.56004	14.0	12.1	0.7	-3.8
14	有意思	jau5ji3si1	0.89710	-0.54570	13.6	11.8	1.6	-2.9
15	郁啲就	juk1di1zau6	1.64215	-0.56443	14.1	12.2	2.9	-1.6
16	用唔著	jung6m4zoek3	0.98714	-0.46969	11.7	10.2	2.1	-2.4
17	吸塵器	kap1can4hei3	0.53682	-0.47515	11.9	10.3	1.1	-3.4
18	嚟得切	lei4dak1cit3	0.96251	-0.73481	18.4	15.9	1.3	-3.2
19	嚟唔切	lei4m4cit3	1.04619	-0.60273	15.1	13.0	1.7	-2.8
20	唔單止	m4daan1zi2	0.44381	-0.55133	13.8	11.9	0.8	-3.7
21	唔緊要	m4gan2jiu3	1.96095	-0.74264	18.6	16.1	2.6	-1.9
22	唔捨得	m4se2dak1	0.61758	-0.50154	12.5	10.9	1.2	-3.3
23	唔在乎	m4zoi6fu4	0.69320	-0.51977	13.0	11.2	1.3	-3.2
24	生活費	saang1wut6fai3	0.45168	-0.75546	18.9	16.3	0.6	-3.9
25	上個月	soeng6go3jyut6	0.85356	-0.59907	15.0	13.0	1.4	-3.1
26	睇唔慣	tai2m4gwaan3	0.56189	-0.62017	15.5	13.4	0.9	-3.6
27	自信心	zi6seon3sam1	0.92151	-0.46122	11.5	10.0	2.0	-2.5
28	總公司	zung2gung1si1	0.78086	-0.86651	21.7	18.8	0.9	-3.6
		Average	0.88260	-0.59786	14.9	12.9	1.5	-3.0
		Minimum	0.39226	-0.90969	10.3	8.9	0.6	-3.9
		Maximum	2.01314	-0.41207	22.7	19.7	2.9	-1.6
		Range	1.62088	0.49762	12.4	10.8	2.3	2.3
		Standard Deviation	0.44028	0.13445	3.4	2.9	0.6	0.6

[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 the threshold of a word to the mean PTA of the subjects (4.5 dB HL)

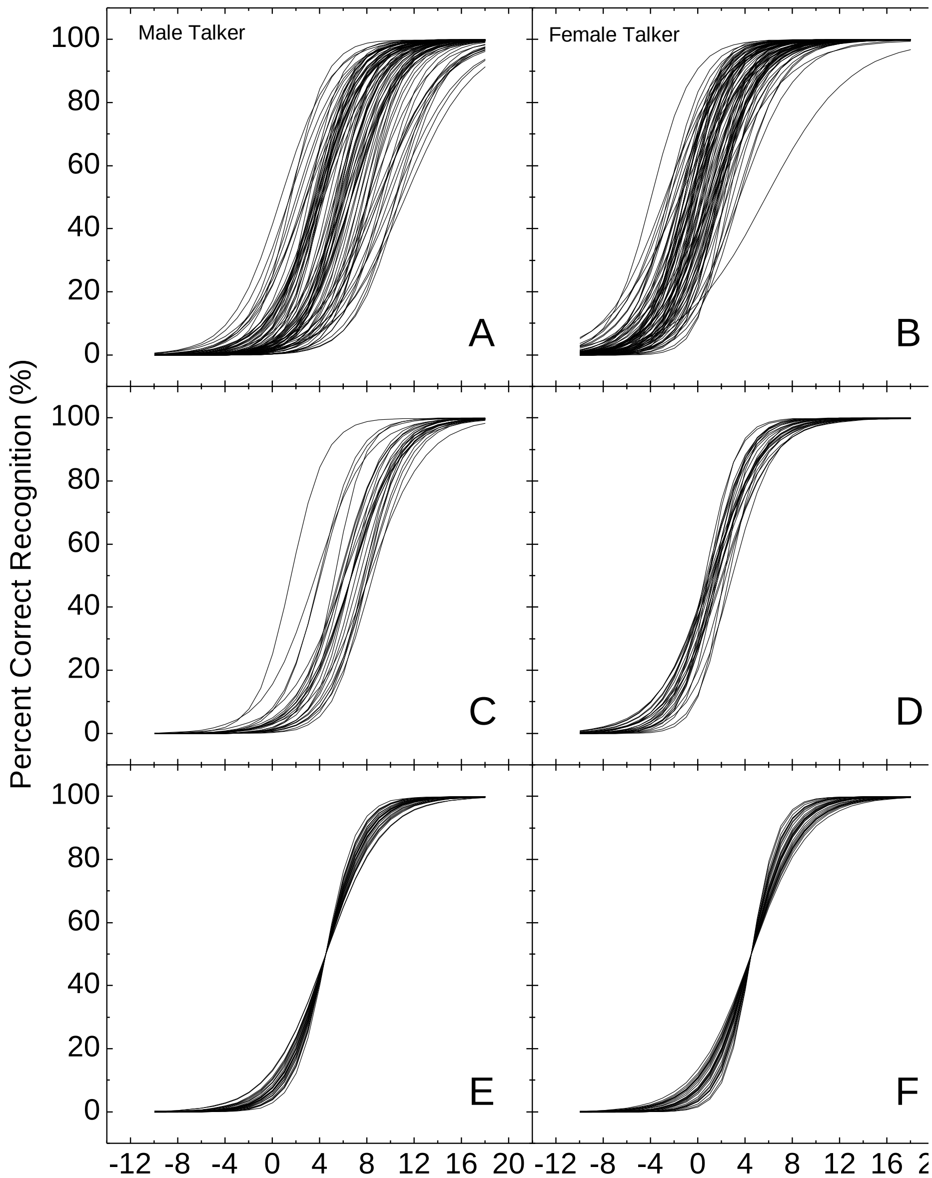

Figure 1. Psychometric functions for Cantonese trisyllabic words for male talker (left panels) and female talker (right panels) recordings. All 90 unadjusted words (top panels A-B), 28 selected unadjusted words (middle panels C-D), and 28 selected adjusted words (bottom panels E-F). The 28 selected adjusted words were digitally adjusted to have 50% thresholds equal to the mean PTA (4.5 dB HL) for the 20 normally hearing subjects.

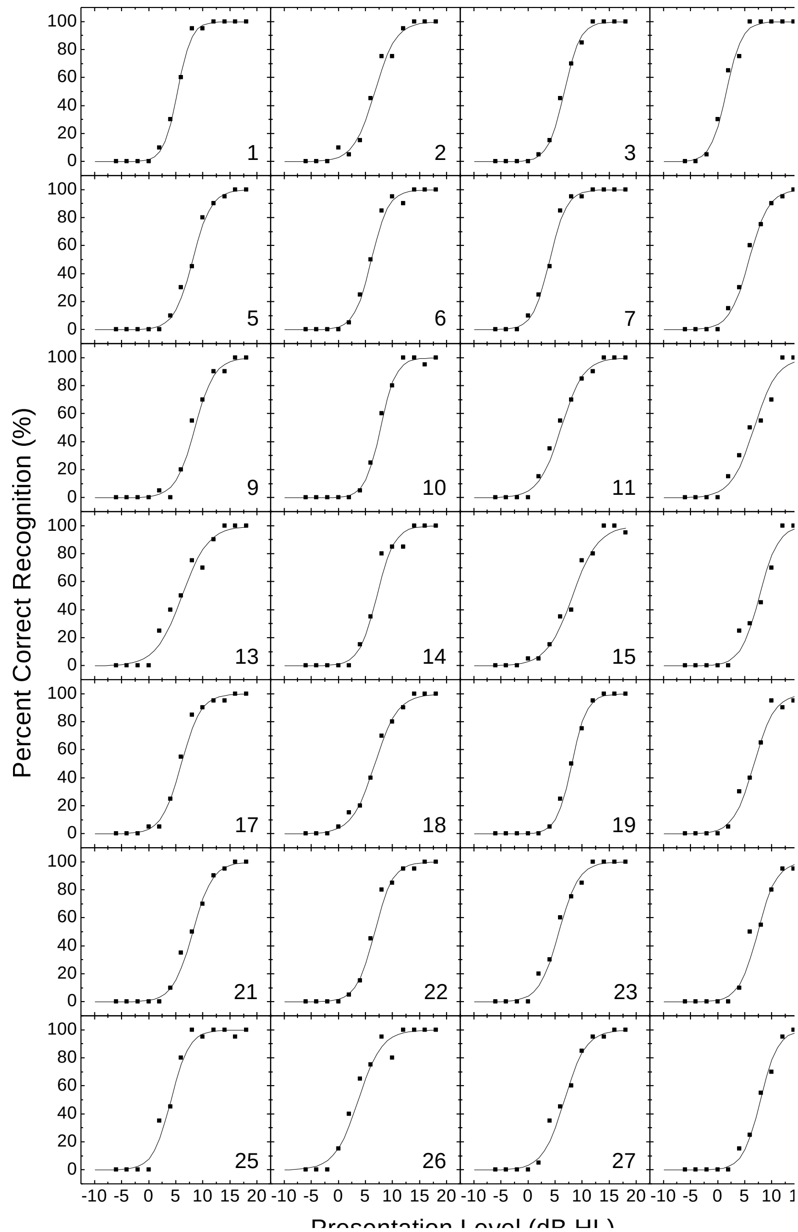

Figure 2. Psychometric functions for the 28 selected unadjusted Cantonese trisyllabic words spoken by a male talker. The functions were calculated using logistic regression; the symbols represent mean percentage of correct recognition calculated from the raw data for 20 normally hearing subjects.

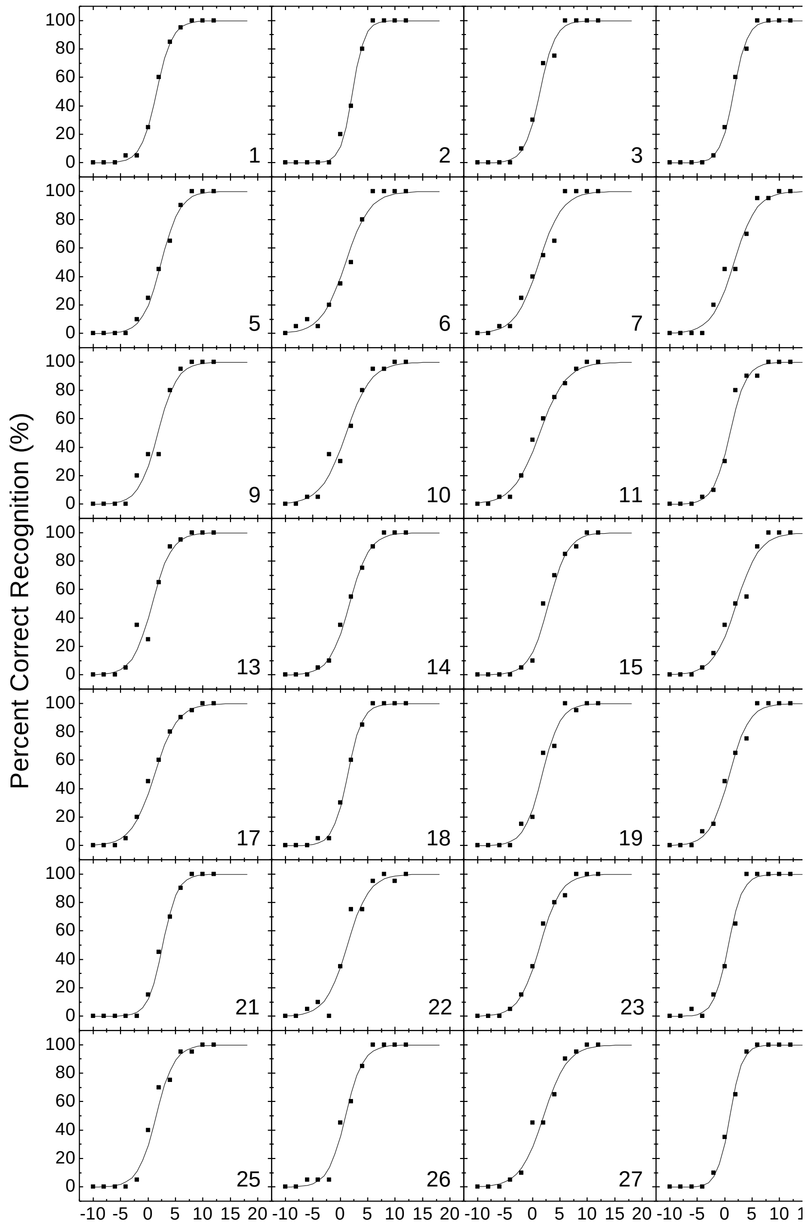

Figure 3. Psychometric functions for the 28 selected unadjusted Cantonese trisyllabic words spoken by a female talker. The functions were calculated using logistic regression; the symbols represent mean percentage of correct recognition calculated from the raw data for 20 normally hearing subjects.

50% threshold of each word was equal to the mean PTA of the subjects (4.5 dB HL). The necessary adjustments for each of the 28 selected words for the male and female talker recordings are presented in Table 4 and Table 5. The bottom panels of Figure 1 contain predicted psychometric functions for the 28 selected words after intensity adjustment to equate 50% thresholds for the male talker (E) and female talker (F). Figure 4 shows the mean psychometric functions for the selected 28 words for both male and female talker, demonstrating the slightly steeper mean slope for the female talker recordings (14.9 %/dB) compared to the male talker recordings (14.5 %/dB).

Discussion

The current investigation aimed to digitally record, evaluate, and psychometrically equate SRT materials so audiologists in the United States familiar with Cantonese can use these materials to obtain accurate results in the testing of individuals whose native language is Cantonese. This purpose was accomplished and a list of 28 trisyllabic words was developed that are relatively homogeneous in performance with respect to audibility and psychometric function slope. These words were recorded by a male and a female native Cantonese talker. A CD with digital recordings of the selected adjusted words was then created and included with this project.

The homogeneity of the 28 trisyllabic words is much greater with respect to audibility and psychometric function slope after intensity adjustment than the original unadjusted trisyllabic words. This difference can be seen in the different panels of Figure 1**.** The mean slopes from 20 to 80% for the 28 trisyllabic words consisted of a range of 8.9 %/dB to 16.9 %/dB (*M* = 12.6 %/dB) for the male talker and a range of 8.9 %/dB to 19.7 %/dB (*M* = 12.9 %/dB) for the female talker. The mean slopes from

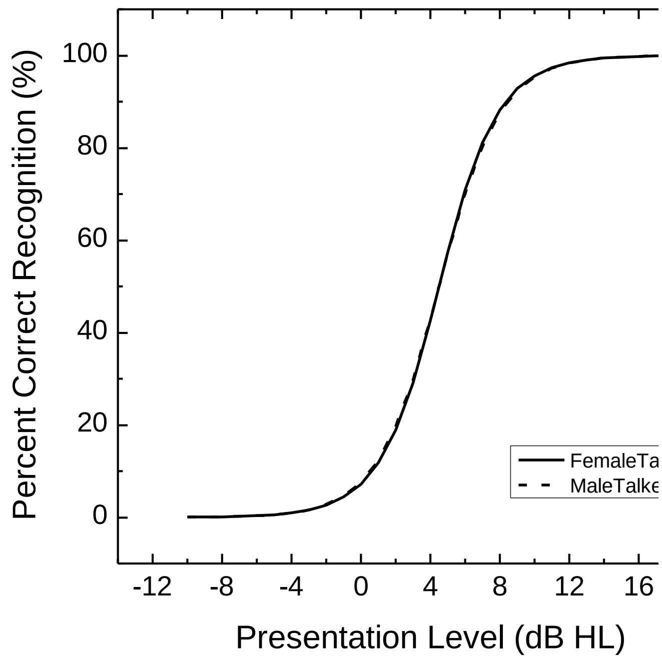

Figure 4. Mean psychometric functions for 28 selected Cantonese male and female talker trisyllabic words after intensity adjustment to equate 50% threshold performance to the mean PTA (4.5 dB HL) for the 20 normally hearing subjects.

20 to 80% for the trisyllabic psychometric functions for both the male and female talkers are in close correspondence to the means reported for SRT materials in other languages.

Typically, the mean slopes for the spondaic words used in English SRT testing have been reported to be between 7.2%/dB and 10%/dB (Hudgins et al., 1947; Hirsh et al., 1952). However, there have been some instances where the mean has been reported as high as 12 %/dB (Beattie, Svihovec, & Edgerton, 1975; Ramkissoon, 2001). Materials that have been created in other languages also have comparable mean slopes to those presented in the present study. Christensen (1995) reported that the means slopes of the Spanish SRT materials were 11.1 %/dB for a male talker and 9.7 %/dB for a female talker**.** The mean slopes for Polish SRT materials created by Harris et al. (2004) were reported to be 10.1%/dB and 9.8%/dB for a male and female talker respectively. Italian SRT materials reported a mean slope of 7.3%/dB for a male talker (Greer, 1997). Finally, in research involving Mandarin trisyllabic SRT word lists, the mean slopes were reported to be 11.3%/dB for the male talker and 12.1%/dB for the female talker (Nissen et al., 2005).

The development of speech audiometry materials is a time consuming undertaking; however, the benefits of standardized speech audiometry materials far outweigh the cost of time spent identifying, recording, and evaluating the materials. Standardized materials disseminated on a CD can be used across many different clinical settings and allows audiologists to selected test stimuli from a longer list and also randomize the presentation of stimuli by use of a computer (Nissen et al., 2005).

Although the development of these materials is progress in the field, there are other important factors that remain a necessity to study further in the area of Cantonese speech audiometry. For example, it is unclear whether or not these words would reproduce the same results if tested again. Therefore, an important next step would be to determine the test-retest reliability of the selected stimuli. If tested again, the group results should be highly correlated with no significant difference present in order for the test to be considered a reliable measure (Gelfand, 1998).

In addition to testing the reliability of these materials, it is also important to extend the testing from normally hearing individuals to individuals with hearing impairments. McArdle and Wilson (2006) conducted a study that examined the performance of individuals with normal hearing and with sensorineural hearing loss on the 18 Quick Speech in Noise (QuickSIN) test lists. They found that although the 18 QuickSIN lists were homogenous when tested on individuals with normal hearing, there were four lists that had a considerable degree of variability and were not homogenous when tested on individuals with sensorineural hearing loss. Since the materials created in the present study will eventually be used to examine the communication abilities of individuals with hearing impairments, Jerger (2006) indicated that in order to establish an accurate test, it is necessary to use the test materials on the population for which it is intended. Therefore, further testing on individuals with a hearing impairment whose primary language is Cantonese should be conducted.

One of the affects of a hearing impairment is the ability of an individual to hear speech in the presence of background noise. The current investigation was done in a sound suite without any presentation of noise during testing. However, an important further measure would be to test the Cantonese trisyllabic word list on normally hearing and hearing impaired individuals in the presence of background noise as these measures would be helpful in determining the appropriate amplification measures used in remediation (Wagener & Brand, 2005).

Another area of interest would be to create a list that would be appropriate for the testing of children. Similar to the modifications needed for speech audiometry materials for individuals who speak a foreign language, modifications also need to be made for children as their vocabularies are not as developed and the words that may be familiar to the adult population would not be suitable for children. A Spanish speech audiometry test involving a picture-pointing task was developed for the testing of children (Comstock & Martin, 1984). If a task like this was created in Cantonese, it would have a two-fold purpose. First, the hearing abilities of children as they relate to communication could be tested. Second, because the child's response is judged correct or incorrect based on the child pointing to the picture that corresponds with the test stimuli rather than the repetition of a word, the test could be administered by an audiologist whose native language is not Cantonese.

Finally, other areas that could warrant further study include, but are not limited to, the evaluation of the differences seen in performance for individuals tested with male versus female talkers and also examining the effect of word list length on listener performance.

Conclusion

In summary, this study resulted in the development of digitally recorded male and female talker recordings of 28 trisyllabic words that are relatively homogeneous in relation to audibility and psychometric function slope. The threshold variability for the trisyllabic words was significantly reduced after intensity adjustments made for the individual words as part of this study. The 28 trisyllabic words can be used to measure

SRT in individuals whose native language is Cantonese and can be found on a CD of digitally recorded materials. The description of the materials contained on the CD can be found in Appendix B.

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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 Communication Disorders at Brigham Young University, Provo, Utah. The faculty directors of this research is Richard W. Harris, Ph.D. and Shawn L. Nissen, Ph.D. Students in the Communication Disorders 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 to three 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 complete your participation in this research project you will be paid the amount of $________ for your participation.

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 or Dr. Shawn L. Nissen, 138 TLRB, Brigham Young University, Provo, UT 84602, phone (801) 422-5056. If you have any questions regarding your rights as a participant in a research project you may contact Dr. Renea Beckstrand, Chair of the Institutional Review Board, 422 SWKT, Brigham Young University, Provo, UT 84602; phone (801) 422-3873, email: renea_beckstrand@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

APPROVED EXPIRES
OCT 1 6 2006 - SEP 2 0 2007

Appendix B

BYU Cantonese CD Contents

Track 1	1 kHz calibration tone.
Track 2	Trisyllabic words for use in measuring the SRT in alphabetical order for familiarization purposes.
Track 3	Trisyllabic words for use in measuring the SRT in random order, repeated in blocks.
Track 4	Word recognition List 1 – 50 bisyllabic words in random order.
Track 5	Word recognition List 2 – 50 bisyllabic words in random order.
Track 6	Word recognition List 3 – 50 bisyllabic words in random order.
Track 7	Word recognition List 4 – 50 bisyllabic words in random order.
Track 8	Word recognition List 1A – 25 bisyllabic words in random order.
Track 9	Word recognition List 1B – 25 bisyllabic words in random order.
Track 10	Word recognition List 2A – 25 bisyllabic words in random order.
Track 11	Word recognition List 2B – 25 bisyllabic words in random order.
Track 12	Word recognition List 3A – 25 bisyllabic words in random order.
Track 13	Word recognition List 3B – 25 bisyllabic words in random order.
Track 14	Word recognition List 4A – 25 bisyllabic words in random order.
Track 15	Word recognition List 4B – 25 bisyllabic words in random order.

Track 16

您將聽到一系列音量大小變化的單詞. 當您一聽到單詞時，請重複一遍. 如果您不確定您聽到的單詞是什麼，請盡量猜.

Instructions for speech reception threshold-verbal response: “You are going to hear a series of words that may vary in volume. Please repeat each word as soon as you hear it. If you are not sure of the word that you heard, you may guess.”

Track 17

您將聽到一系列音量大小不變的單詞. 當您聽到單詞時，請重複一遍. 如果您不確定您聽到的單詞是什麼，請盡量猜.

Instructions for word recognition-verbal response: “You are going to hear a series of words that will be given at a constant volume. Please repeat each word as soon as you hear it. If you are not sure of the word that you heard, you may guess.”

Track 18

這一部分您會在一耳聽到噪音，在另外一耳聽到單詞. 請忽略噪音並重複您聽到的單詞.

Instructions for speech audiometry-masking in nontest ear-verbal response: “During this part of the test you will hear a noise in one ear and words in the other. Ignore the noise and repeat each word when you hear it.”

Track 19

您將聽到一系列音量大小不變的單詞. 當您聽到單詞時，請把它寫下來. 如果不確定您聽到的單詞是什麼， 請盡量猜.

Instructions for speech audiometry-written response: “You are going to hear a series of words that will be given at a constant volume. Please write each word as soon as you hear it. If you are not sure of the word you heard, you may guess.”

Track 20

這一部分您會在一耳聽到噪音，在另一耳聽到一個單詞. 請忽略噪音並寫下您聽到的單詞.

Instructions for speech audiometry-masking in nontest ear-written response: “During this part of the test you will hear noise in one ear and words in the other. Ignore the noise and write each word when you hear it.”

Track 21

您将聽到一系列音調高低變化的哨音. 只要您聽到哨音，請馬上舉手. 當哨音停止時，請將手放下. 如果您覺得聽到哨音, 即使不確定，還是要舉手.

Instructions for pure-tone audiometry-hand raising: “You are going to hear a series of sounds which will vary in pitch. When you hear the tone, immediately raise your hand. Put your hand down as soon as the sound goes off. Raise your hand if you think you hear the tone, even if you are not sure.”

Track 22

這一部分您會在一耳聽到哨音，在另一耳聽到噪音. 請忽略噪音，聽到哨音後馬上舉手.

Instructions for pure-tone audiometry-masking in nontest ear-hand raising: “During this part of the test you will hear noise in one ear and tones in the other. Ignore the noise and raise your hand when you hear the tone.”

Track 23

您將聽到一系列音調高低變化的哨音. 當您一聽到哨音，請馬上按鈕. 當哨音停止時，請停止按鈕. 如果您覺得聽到哨音, 即使不確定，還是要按鈕.

Instructions for pure-tone audiometry-button pressing: “You are going to hear a series of tones which will vary in pitch. When you hear a sound, immediately press the button. Stop pushing the button when the tone goes off. Push the button if you think you hear the sound, even if you are not sure.”

Track 24

這一部分您會在一耳聽到哨音，在另一耳聽到噪音. 請忽略噪音,
並且當您一聽到哨音時，請馬上按鈕
Instructions for pure-tone audiometry-masking in nontest ear-button pressing: “During this part of the test you will hear noise in one ear and tones in the other. Ignore the noise and press the button when you hear a tone.”

Track 25

這個部分是測試您在聽到一系列音量大小不變的單詞時的聽力水平. 每當您聽到一個單詞時, 請重複一遍. 如果您不確定這個單詞是什麼, 請盡量猜. 如果您不明白那個單詞, 也無法猜出它, 請安静地等下一個單詞
Instructions for word recognition-verbal response: “The purpose of this test is to determine how well you can understand words when they are presented at a constant listening level. Each time you hear a word, just repeat it. If you are unsure of what the word was you may have to guess. If you did not understand the word, and you are not able to guess, please remain silent and wait for the next word.”

Track 26

這個部分您會在一耳聽到噪音，在另一耳聽到單詞. 請忽略噪音，並只注意聽單詞. 每當您聽到單詞時，請重複那個單詞一遍. 如果您不確定所聽到的單詞是什麼，請盡量猜. 如果您不明白那個單詞, 也無法猜出它，
請安静地等下一個單詞.
Instructions for speech audiometry-masking in nontest ear-verbal response: “During this part of the test you will hear a noise in one ear and words in the other. Do your best to ignore the noise and listen only to the words. Each time you hear a word, please repeat it. If you are unsure of what the word was you may have to guess. If you did not understand the word, and you are not able to guess, please remain silent and wait for the next word.”

Track 27

這個部分是測試你在聽到一些音量大小不變的單詞時的聽力水平. 每當聽到一個單詞時，請您在我們给您的紙上寫下那個單詞. 如果您不確定所聽到的單詞是什麼，請盡量猜. 如果您不明白那個單詞, 也無法猜出它，
便請在空格裡劃一條線. 劃完後請您安静地等下一個單詞.
Instructions for word recognition-written response: “The purpose of this test is to determine how well you can understand words when they are presented at a constant listening level. Each time you hear a word, please write it down on the paper provided. If you are unsure of what the word was you may have to guess. If you did not understand the word, and you are not able to guess, please draw a line in the space provided and wait for the next word.”