THE PERFORMANCE OF SOUTH AFRICAN ENGLISH FIRST AND SECOND ADULT SPEAKERS ON A "LOW LINGUISTICALLY LOADED"CENTRAL AUDITORY PROCESSING TEST PROTOCOL

Safia Saleh*, Nicole G. Campbell* and Wayne J. Wilson‡

* Department of Communication Pathology, University of Pretoria, Pretoria, South Africa
‡Division of Audiology, School of Health and Rehabilitation Sciences, University of Queensland, Brisbane, Australia

ABSTRACT

The lack of standardized tests of central auditory processing disorder (CAPD) in South Africa (SA) led to the formation of a SA CAPD Taskforce, and the interim development of a"low linguistically loaded"CAPD test protocol using test recordings from the 'Tonal and Speech Materials for Auditory Perceptual Assessment Disc 2.0'. This study inferentially compared the performance of 16 SA English first, and 16 SA English second, language adult speakers on this test protocol, and descriptively compared their performances to previously published American normative data. Comparisons between the SA English first and second language speakers showed a poorer right ear performance ($p < .05$) by the second language speakers on the two-pair dichotic digits test only. Equivalent performances ($p < .05$) were observed on the left ear performance on the two pair dichotic digits test, and the frequency patterns test, the duration patterns test, the low-pass filtered speech test, the 45% time compressed speech test, the speech masking level difference test, and the consonant vowel consonant (CVC) binaural fusion test. Comparisons between the SA English and the American normative data showed many large differences (up to 37.1% with respect to predicted pass criteria as calculated by mean-2SD cutoffs), with the SA English speakers performing both better and worse depending on the test involved. As a result, the American normative data was not considered appropriate for immediate use as normative data in SA. Instead, the preliminary data provided in this study was recommended as interim normative data for both SA English first and second language adult speakers, until larger scale SA normative data can be obtained.

INTRODUCTION

There are three significant problems encountered when assessing central auditory processing disorder (CAPD) in South Africa (SA). First, there is a lack of a universally accepted definition of central auditory processing and CAPD. Secondly, there is no CAPD test protocol specific to SA conditions, particularly with respect to SA's eleven official languages. Thirdly, there is an absence of SA specific normative data for many CAPD tests. This paper addresses the latter two of these problems.

DEFINING CAPD

Despite more than twenty years of research, and the efforts of two taskforces mandated by the American Speech, Language and Hearing Association (ASHA), there remains no universally accepted definition of central auditory processing or CAPD (ASHA, 1996; Jerger & Musiek, 2000; Musiek & Rintelmann, 1999; Schow, Seikel, Chermak & Berent, 2000). For the purposes of this paper, we adopted the most commonly referenced of the recent definitions, that of ASHA (1996). ASHA (1996, p. 43) defines auditory processing as the a"auditory mechanisms and processes responsible for the following behavioural phenomena: sound localization and lateralisation, auditory discrimination, auditory pattern recognition, temporal aspects of audition, including temporal resolution, temporal masking, temporal integration and temporal ordering, auditory performance decrements with competing acoustic signals and auditory performance decrements with degraded acoustic signals" .They then defined CAPD as" an observed deficiency in one or more of the above-listed behaviours".

SELECTING A CAPD TEST PROTOCOL FOR SA

In SA the problems surrounding the definition of auditory processing and CAPD are further confounded by the absence of a CAPD test protocol that is specific to local conditions. In response to this absence, the Professional Board for Speech, Language and Hearing Professions, of the Health Professions Council of South Africa, approved the formation of a SA CAPD Taskforce on 8 February 2000 (South Africa Central Auditory Processing Taskforce, 2000, 2001).

The first task of the SA CAPD Taskforce was to select an appropriate CAPD test protocol from those currently described in the literature. The protocol chosen was that of Bellis and colleagues (Bellis, 1996; Bellis & Ferre, 1999; Chermak & Musiek, 1997), as it was designed to assess different levels and processes of the central auditory nervous system. Instead of recommending specific single tests, the Bellis (1996) protocol recommended that a CAPD test protocol should include, at a minimum, tests from the following CAPD test categories: two dichotic speech tests (one high linguistically loaded and one low linguistically loaded), one monaural low redundancy speech test, one temporal patterning test, and one binaural interaction test. Bellis' recent update of this protocol (Bellis, 2003) was not considered as it

collection had begun.

The next task of the SA CAPD Taskforce was to select appropriate CAPD test recordings from those currently available. The recordings chosen were those contained in the 'Tonal and Speech Materials for Auditory Perceptual Assessment Disc 2.0' (Wilson & Strouse, 1998), as these were widely used internationally, were easy to access, were of high quality, and the Disc 1.0 version of this CD (Wilson & Strouse, 1992) had been used by Bellis (1996, 2003). These recordings also represented a range of tests that assessed different central auditory processes whilst controlling for recording conditions, stimulus parameters, stimulus generation, and test protocols. By using this CD only, it was hoped that future collection of normative data, test standardization, and comparisons of test results within and between different clinics in SA would be better facilitated (Noffsinger, Wilson & Musiek, 1994).

One of the last tasks of the SA CAPD Taskforce was to modify the chosen CAPD protocol (Bellis, 1996; Bellis & Ferre, 1999; Chermak & Musiek, 1997) and test materials (Wilson & Strouse, 1998) for the SA context. Of immediate concern were SA's 11 official languages: it was quickly realized that the creation of 11 separate protocols was beyond the short-term capabilities of the taskforce. As an interim measure, it was decided create a" low linguistically loaded" CAPD test protocol that could be used to assess any SA subject capable of understanding and speaking basic English. This " low linguistically loaded" protocol was as per the original Bellis (1996) protocol, with the exception that the linguistically loaded dichotic speech test was removed, and the remaining tests all had to have a reduced linguistic load (i.e., they could only contain non-speech stimuli, simple speech stimuli such as digits or simple words, and/or speech stimuli that allowed for pre-test familiarization).

THE NEED FOR NORMATIVE CAPD DATA SPECIFIC TO SA

It is well known that the valid application of any clinical protocol cannot proceed without first obtaining normative data specific to the subject, stimulus and recording parameters being used (Bellis, 1996). The most referenced preliminary normative data currently published for the Bellis CAPD protocol (Bellis, 1996, 2003; Bellis & Ferre, 1999; Chermak & Musiek, 1997) and the 'Tonal and Speech Materials for Auditory Perceptual Assessment Disc 2.0' (Wilson & Strouse, 1998), however, were obtained from adult and child subjects in the United States of America [low- and high-pass filtered words (Bellis, 1996, 2003; Bornstein, Wilson & Cambron, 1994); frequency (pitch) and duration pattern tests (Bellis, 1996, 2003; Musiek, Baran & Pinheiro, 1990; Musiek, Geurkink & Hanover, 1982); dichotic digits, sentences and nonsense syllables (Bellis, 1996, 2003; Musiek, 1983a,b; Noffsinger, Martinez & Wilson, 1994); time compressed words with and without reverberation (Bellis, 1996, 2003; Wilson, Preece, Salamon, Sperry & Bornstein, 1994); speech masking level difference (Wilson, Zizz & Sperry, 1994); segmented alternated CVC words (Wilson, 1994); dichotic musical chords (Noffsinger, Martinez, Friedrich & Wilson, 1994)]. Thus, the last task of the SA CAPD Taskforce was to identify the need to obtain SA specific normative data for the Taskforces proposed interim" low linguistically loaded"CAPD test protocol.

METHODOLOGY

AIMS

Following on from the SA CAPD Taskforce's proposed " low linguistically loaded" interim CAPD test protocol, and the resulting need for SA specific normative data, this study used a comparative research design (Leedy & Ormrod, 2001) to:

- Obtain preliminary normative data from SA English first and second language adult speakers, on seven tests of CAPD suitable for use in the proposed test protocol.
- Determine if the performances of the SA English first language adult speakers differed from those of the SA English second language adult speakers.
- Determine if the performances of the SA English speakers differed from the previously reported American normative data.

SUBJECTS

Thirty-two adult subjects were conveniently sampled from the student and staff population of a university and hospital where the primary researcher was based. Permission was obtained from the rector of the university and the superintendent of the hospital to place notices that outlined the aim of the study, the test procedures, as well as a request for volunteers to participate in the study on the bulletin boards of the university and the hospital. The sample size was determined by the minimum sample size required for utilizing the Means Procedure of the SAS program (SAS Institute Inc., 1999) and the time limitations of the study.

All subjects were aged between 18 and 40 years, had SA English as their first or second language, had a Grade 10 or higher level of educational, had no known medical history of adverse neurological or medical conditions which could affect performance on CAPD tests, and had normal pure tone thresholds, acoustic immittance results and speech reception thresholds to English spondaic words (American English recording) (Hall & Mueller, 1997; Martin & Clark, 2000). All criteria, except for the pure tone, acoustic immittance and speech reception thresholds, were confirmed by subject report.

The subjects were divided into two groups, namely SA English first language speakers of Indian descent, and SA English second language speakers of African descent. These ethnic groups were used as they represented the majority population at the university and hospital where the primary researcher worked. First and second language classifications were based on the first language learnt at school, and the use of each language in general day-to-day living. The SA English first language speaker group consisted of 5 males and 11 females whose average age was 25.8 ± 5.0 years (range 21 to 39 years). Two of these subjects had grade 12 education, while 14 had university education. Only one of these subjects had

consisted of 8 males and 8 females whose average age was 25.3 ± 5.7 years (range 18 to 36 years). Two of these subjects had grade 10 education, while 5 had grade 12, and 9 had university education. Five of these subjects had any medical histories of note [three reported childhood otitis media, and two were receiving medication (one for migraine and one for hypertension)]. The first languages of the SA English second language speakers were Tswana (n=7), Zulu (n=5), Northern Sotho (n=3), Ndebele (n=1).

MATERIALS AND APPARATUS

A subject information sheet and letter of consent were used to explain the purpose and nature of the study. A biographical questionnaire, a Welch-Allyn 3.5 V HAL Otoset otoscope, an audiometer (Interacoustic AC30 audiometer with Telephonic TDH-50 earphones), an acoustic immittance meter (GSI 28A middle ear analyzer), a compact disk player (single disc Philips portable AX1000), and the CID W-1 list of spondees (presented live voice), were used to ensure the subjects had no history or peripheral hearing deficits that could adversely affect the CAPD testing. The same audiometer and compact disk player, and the 'Tonal and Speech Materials for Auditory Perceptual Assessment Disc 2.0' (Wilson & Strouse, 1998), were used to obtain the CAPD test data.

Of all the tests available on the 'Tonal and Speech Materials for Auditory Perceptual Assessment Disc 2.0' (Wilson & Strouse, 1998), only the following seven tests were used: the two pair dichotic digits test (a low linguistically loaded dichotic speech test), the low-pass filtered speech test and the 45% time compressed speech test (both monaural low redundancy tests), the frequency and the duration patterns tests (both temporal patterning tests), and the speech masking level difference and CVC binaural fusion tests (both binaural interaction tests). These were chosen to give clinicians some flexibility when choosing only one low linguistically loaded dichotic speech test, one monaural low redundancy test, one temporal patterning test, and one binaural interaction test, for use in the "low linguistically loaded" CAPD test protocol as recommended by the SA CAPD Taskforce (South Africa Central Auditory Processing Taskforce, 2000, 2001).

All testing was conducted in a sound-treated test booth and all audiometric equipment and test environments complied with the SANS specifications.

PROCEDURES

On arrival for testing, each subject completed the informed consent and pre-test questionnaire forms, and underwent otoscopic, pure tone, speech reception and acoustic immittance testing. Subjects who met the selection criteria were then tested on the selected CAPD tests from the 'Tonal and Speech Materials for Auditory Perceptual Assessment Disc 2.0' (Wilson & Strouse, 1998). Both the order of test presentation, and the order of ear testing (where appropriate), were randomized.

Dichotic Speech Tests: Two Pair Dichotic Digits Test

This two pair dichotic speech test contained 25, two-pair dichotic digit stimuli (1, 2, 3, 4, 5, 6, 8, 9, and 10) with a 5 second interval between each. The stimuli were simultaneously presented to both ears at 50 dBSL relative to the spondee threshold of the better ear (Bellis, 1996) (the left channel was routed to the left ear and the right channel was routed to the right ear). Following each stimulus, the subjects were required to repeat all four digits, regardless of ear or order. The first five stimuli (20 digits) were used as practice, and the remaining 20 stimuli (80 digits) were scored at 2.5% for each digit correctly repeated (regardless of ear or order), for each ear separately (40 digits per ear).

Temporal Patterning tests: Frequency Patterns Test and Duration Patterns Test

The frequency patterns test contained 30 frequency-pattern sequences (six patterns by five randomizations). The low frequency tone was 880 Hz and the high-frequency tone was 1122 Hz. Both tones were 150 ms long with 10 ms rise-fall times (cosine squared). Each sequence had an interstimulus interval of 200 ms and an interpattern interval of 6 s. The same 30 stimuli were presented separately to each ear at 50 dBSL relative to the 1000 Hz threshold of the ear being tested (Bellis, 1996). Following each stimulus, the subjects were required to verbally report the pattern they had heard (e.g. high, high, low). For each ear, the first five sequences were used as practice, and the remaining 25 presentations were scored at 4% for each sequence correctly reported.

The duration patterns test contained 30 duration-pattern sequences (six patterns by five randomizations). The tones were 1000 Hz with 10 ms rise-fall times (cosine squared). The long tone was 500 ms, the short tone was 250 ms. Each sequence had an interstimulus interval of 300 ms, and an interpattern interval of 6 s. The same 30 stimuli were presented separately to each ear at 50 dBSL relative to the 1000 Hz threshold of the ear being tested (Bellis, 1996). Following each stimulus, the subjects were required to verbally report the pattern they had heard (e.g. long, long, short). For each ear, the first five sequences were used as practice, and the remaining 25 scored at 4% for each sequence correctly reported.

Monaural Low Redundancy Speech Tests: Low-Pass Filtered Speech Test and 45% Time Compressed Speech Test

The low-pass filtered speech test contained 50 monosyllabic words from List 3 of the Northwestern University Auditory Test No. 6 (N.U. No. 6) spoken by a female, all low-pass filtered with a 1500 Hz cutoff at 115 dB/octave. The first 25 stimuli were presented to one ear, and the remaining 25 to the other ear, at 50 dBSL relative to the spondee threshold of the ear being tested (Bellis, 1996). Following each stimulus, the subjects were required to verbally report the word they heard. For each ear, the first five words presented were used as practice, and the remaining 20 scored at 5% for each word correctly reported.

The 45% time compressed speech test contained 50 carrier phrase and word stimuli from the N.U. No. 6 pool of 200 words that were compressed 45%, i.e., 45% of the carrier phrase and word had been removed (designated List 5 because it contained a composite of words from the original four N.U. No. 6

and the remaining 25 to the other ear, at 50 dBSL relative to the spondee threshold of the ear being tested (Bellis, 1996). Following each stimulus, the subjects were required to verbally report the word they heard. For each ear, the first five words presented were used as practice, and the remaining 20 scored at 5% for each word correctly reported.

Binaural Fusion Test 1: Speech Masking Level Difference Test

The speech masking level difference test contained spondaic words embedded in bursts of broadband noise in the $S\pi$ no paradigm, i.e., the spondaic words were 180° out-of-phase on the two channels and the bursts of broadband noise in-phase on the two channels. The 10 spondaic words that were used repetitively were from the Technisonic Studio recording of the W-1 lists (Hirsh et al., 1952) and were selected based on earlier masking-level difference data (Wilson, Shanks & Koebsell, 1982). The words started 500 ms into the 2000 ms noise bursts that had 20 ms rise-fall times. Four words were recorded at each of 16 signal-to-noise ratios in 2 dB decrements from 0 dB to -30 dB. The interstimulus interval was 5 s. Each subject was familiarized with the stimuli, and the stimuli were presented to both ears simultaneously, first in the diotic condition, then in the dichotic condition, at 50 dBSL relative to the spondee threshold of the ear being tested (Bellis, 1996). Following each stimulus, the subjects were required to verbally report the word they heard. The stimuli were presented until the subject responded incorrectly to all four spondee words in two sequential signal-to-noise ratios. The masking level difference was calculated using the series of formulae outlined in Bellis (1996, 2003).

Binaural Fusion Test 2: CVC Binaural Fusion Test

The CVC binaural fusion test contained 50 monosyllabic words from List 4 of the Northwestern University Auditory Test No. 6 (N.U. No. 6) spoken by a female. The words on the left channel (1) were high-pass filtered (2100 Hz cutoff; 115 dB/octave rejection), whereas the words on the right channel (2) were low-pass filtered (1500 Hz cutoff; 115 dB/octave). The high-pass filtered words were presented to the left ear, while the low-pass filtered words were simultaneously presented to the right ear, at 50 dBSL relative to the spondee threshold of the better ear (Bellis, 1996). Following each stimulus, the subjects were required to verbally report the word they heard. The first five words presented were used as practice, and the remaining were 45 scored at 2.2% for each word correctly reported.

DATA COLLECTION AND ANALYSIS

The subjects' responses were recorded manually and scored off-line. Means and standard deviations were used to describe their performances on each CAPD test, and two-tailed Mann-Whitney *U* tests (Diamantopoulos & Schlegelmitch, 2000) at the 5% level were used to identify differences between their performances on each CAPD test.

To compare the performances of the SA English first and second language speakers to the previously published American normative data, only descriptive comparisons were used. Inferential statistics were not attempted as the American normative data did not exactly match this study's sample size, subject/stimulus/recording parameters, and data collection and analysis techniques (although they were similar) with only same mean-2SD cut-off values, and no access to raw data.

The American normative data used for the purposes of comparison were those cited in Bellis (1996, 2003) and the 'Tonal and Speech Materials for Auditory Perceptual Assessment Disc 2.0' booklet (Wilson & Strouse, 1998). These datasets were chosen because they were obtained using protocols very similar to those used in the present study.

RESULTS

Table 1 shows the results obtained for the SA English first and second language adult speakers, and the related American normative data, on the CAPD tests assessed. Compared to the American normative data [using the mean-2SD values for ease of comparison and clinical emphasis (Bellis, 1996)], the SA English adult speakers performed:

- Worse by as much as 37.1% for the frequency pattern test, 23.6% for the two-pair dichotic digit test, and 18.6% for the duration pattern test.
- Better by as much as 14.6% for the low pass filtered speech test, 14.3% for the 45% time compressed speech test, and 9.6% for the binaural fusion test.
- Considered equivalent only for the speech masking level difference test (SA English first language adult speakers were up to 0.8 dB better).

Table 2 shows the results of the Mann Whitney U analyses of the differences in performances between the SA English first language and second language speaking groups on the CAPD tests assessed. Significant differences ($p < .05$) were observed for right ear performance on the two pair dichotic digits test only.

DISCUSSION

SA ENGLISH FIRST VERSUS SA ENGLISH SECOND LANGUAGE SPEAKERS

The significantly worse ($p < .05$) performance by the SA English second language speakers on the two-pair dichotic digits test, right ear only (although the left ear also approximated this trend at $p = .07$), suggested that this test carried relatively greater linguistic bias. Thus for the English second language speakers in this study, the negative effect of the dichotic stimuli was greater than the positive effect of using digits instead of words or sentences. Such an interpretation would be partially consistent with the absence of linguistic effects seen in the remainder of the CAPD tests (despite some of these tests using words instead of digits), and with similar reports of linguistic bias in the dichotic staggered spondaic word test (Keith, Katbamna, Tawfik & Smolak, 1987).

Of the remaining CAPD tests, the absence of linguistic effects was expected for some, i.e., the "linguistic free" frequency and duration pattern tests, but not for others, i.e., the "low linguistic loaded" low-pass filtered speech test, 45% time compressed speech

Table 1. CAPD test results for the adult, SA English first (n=16) and second (n=16) language speakers. All SA English speaker data was obtained at 50 dBSL relative to either 1000 Hz or spondee threshold.

CAPD TEST		SA English first language speakers Right ear	Left ear	SA English second language speakers Right ear	Left ear	American normative data Right ear	Left ear
Dichotic digits (%)	Range	85-100	70-100	75-95	70-90	NA	NA
	X±SD	91.6±4.4	85.0±7.7	86.7±6.3	80.3±5.9	97.8±2.9[1]	96.5±1.7[1]
	x-2SD	82.8	69.5	74.1	68.5	92.0[1]	93.1[1]
						90.0[2]	90.0[2]
Freq. patterns (%)	Range	56-92	56-96	52-82	48-88	64-100[3]	70-100[3]
	x±SD	68.5±8.9	69.3±11.0	68.3±11.1	64.8±11.0	94.1±9.5[3]	93.0±8.7[3]
	x-2SD	50.8	47.3	46.1	42.9	75.1[3]	75.6[3]
						80[2]	80[2]
Duration patterns (%)	Range	64-100	64-100	60-100	56-100	63-100[4]	67-100[4]
	x±SD	83.8±10.5	84.3±9.7	78.3±12.5	77.3±13.2	88.3±10.5[4]	88.7±9.6[4]
	x-2SD	62.8	64.8	53.3	50.9	67.3[4]	69.5[4]
						73.0[2]	73.0[2]
Low-pass filtered speech (%)	Range	60-90	60-90	65-90	60-90	NA	
	x±SD	77.5±6.8	75.3±7.4	76.9±6.8	77.2±8.0	67.0±8.9[5]	
	x-2SD	63.8	60.5	63.3	61.3	NA	
45% time comp. speech (%)	Range	95-100	85-100	90-100	85-100	NA	
	x±SD	98.8±2.2	96.9±4.4	96.9±4.0	95.7±4.8	93.4±6.7[6]	
	x-2SD	94.3	88.0	88.8	86.1	80.0[6]	
						85.0[2]	
CVC binaural fusion (%)	Range	97-100		93-100		NA	
	x±SD	99.4±1.2		98.3±2.5		95.2±3.9[7]	
	x-2SD	97.0		93.3		87.4[7]	
Speech MLD (dB)	Range	5-9		5-12		3.5-11.5[8]	
	x±SD	7.1±1.3		7.6±2.1		7.8± 2.1[8]	
	x-2SD	4.4		3.4		3.6[8]	

x = arithmetic mean of the sample, SD = standard deviation, NA = not available.

[1]Musiek (1983a,b), 50 dBSL relative to spondee threshold, n=45 normal hearing adult subjects, aged 19-35 years, wide range of vocational backgrounds.

[2]Bellis (1996, 2003), 50 dBSL relative to spondee threshold, normal hearing subjects, aged 12 years to adult, no further details given.

[3]Musiek, Geurkink, & Hanover (1982), 50 dBSL relative to the spondee threshold, n=31 normal hearing subjects, aged 26.7 ± 6.8 years, range 15-46 years, wide range of vocational backgrounds.

[4]Musiek, Baran, & Pinheiro (1990), 50 dBSL relative to the spondee threshold, n=50, normal hearing subjects, 8 males and 42 females, mean age 22.4, age range 19-39 years.

[5]Bornstein, Wilson, & Cambron (1994), 55 dBHL, n=20 normal hearing adult subjects out of a pool of 120 subjects, aged 23±3.1 years, range: 17-32 years, 21 males, 99 females, 107 self-identified right handers.

[6]Wilson, Preece, Salamon, Sperry, & Bornstein (1994), 55 dBHL, n=20 normal hearing adult subjects out of a pool of 120 subjects, aged 23±3.1 years, range: 17-32 years, 21 males, 99 females, 107 self-identified right handers.

[7]Wilson (1994), 55 dBHL, n=20 normal hearing adult subjects out of a pool of 120 subjects, aged 23±3.1 years, range: 17-32 years, 21 males, 99 females, 107 self-identified right handers.

[8]Wilson, Zizz, & Sperry (1994), 45 dBHL, n=60 normal hearing adult subject out of a pool of 120 subjects, aged 23±3.1 years, range: 17-32 years, 21 males, 99 females, 107 self-identified right handers.

Table 2. Mann-Whitney U test results (p values) for comparisons in CAPD test performances between SA English first (n=16) and second (n=16) language speakers.

CAPD TEST	Right ear	Left ear
Dichotic digits	.03*	.07
Frequency patterns	.94	.34
Duration patterns	.17	.08
Low-pass filtered speech	.70	.39
45% time compressed speech	.18	.47
CVC binaural fusion	.15	
Speech MLD	.47	

* Significant difference ($p < .05$)

expectations were in light of previous reports of English second language speakers experiencing greater speech perception difficulties in adverse listening environments (Crandell & Smaldino, 1996; Keith et al., 1987). It is therefore possible that the "low linguistic load"nature of these remaining CAPD tests was sufficient to negate any linguistic differences present between the SA English first and second language speakers.

SA ENGLISH VERSUS AMERICAN ENGLISH SPEAKERS

With the exception of the speech masking level difference test, large differences were observed between the performances of the SA English speakers and the previously published American normative data (up to 37% between mean 2SD values). These differences suggested that the American norms could not be directly used in SA (given that the American data was originally chosen because it had been obtained using protocols very similar to those used in the present study). Whilst the obvious SA/American language mismatch was a likely factor in these differences (Bellis, 1996; Crandell & Smaldino, 1996; Keith et al., 1987), minor differences in sample size, subject/stimulus/recording parameters, and data collection and analysis techniques could also account for the differences obtained (these factors may also explain some of the observed differences between the American data). A full explanation as to why the SA subjects performed worse than the American data on some tests, but better on others, will however require further research.

CONCLUSIONS

Preliminary normative data was obtained for SA English first and second language adult speakers on seven tests of CAPD selected from the 'Tonal and Speech Materials for Auditory Perceptual Assessment Disc 2.0' (Wilson & Strouse, 1998). Each test was chosen because of its suitability for use in the "low linguistically loaded"test protocol proposed by the SA CAPD Taskforce.

The SA English first and second language adult speakers performed similarly to each other on all tests except the two-pair dichotic digits test (right ear only), but differently to previously reported American normative data on all tests except the speech masking level difference test. As a result, the American normative data was not considered appropriate for immediate use in SA. Instead, the SA data provided in this study was recommended for use as preliminary normative data for both SA English first and second language adult speakers, until larger scale SA normative data can be obtained.

Limitations of this study are noted and the results cannot be generalized beyond the subject, stimulus and recording parameters used.

Note: The 'Tonal and Speech Materials for Auditory Perceptual Assessment Disc 2.0' (Wilson, & Strouse, 1998) is available from Professor Richard Wilson PhD, Audiology (126), VA Medical Centre, Mountain Home, Tennessee 37684, ph +1 423 926 1171 ext 7553, fax +1 423 232 6903, email Richard.Wilson2@med.va.gov or wilson.richard@mtn-home.va.gov. Professor Wilson does not charge a formal price for the CD, as it was produced by USA Veterans Affairs. He requests that you send a "donation (postal order)" of US$50-100 to his research fund - the East Tennessee State University (ETSU) Foundation.

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Locke, J.L. (1983). Clinical Psychology: The explanation and treatment of speech sound disorders. *J. Speech Hear Disord., 48,* 339-341.

Penrod, J.P. (1985). Speech discrimination testing. In J. Katz *(Ed.), Handbook of clinical audiology* (3rd ed.). Baltimore: Williams & Wilkins.

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