NEW

Minimum Speech Test Battery (MSTB)

For Adult Cochlear Implant Users 2011
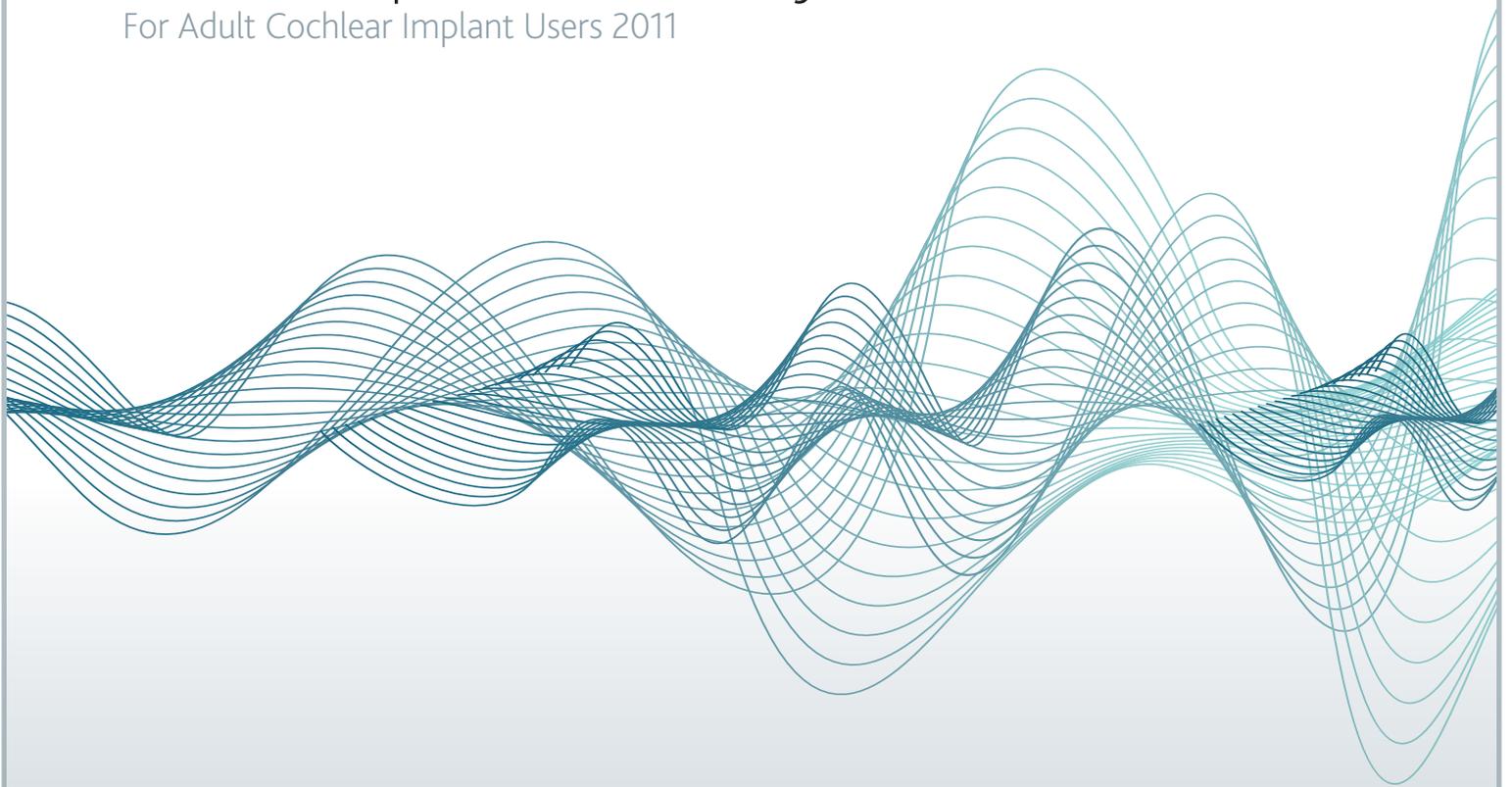
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ACKNOWLEDGEMENTS

INTRODUCTION

In 1996, a committee comprised of representatives from the American Academy of Audiology (AAA), the American Academy of Otolaryngology-Head and Neck Surgery (AAO-HNS), and cochlear implant manufacturers convened to identify a set of materials to be used clinically and in research studies to assess the performance of adults with cochlear implants. The committee recommended the Consonant-Nucleus-Consonant (CNC) test (Peterson & Lehiste, 1962) to assess open-set word recognition and materials from the Hearing in Noise Test (HINT) (Nilsson, Soli, & Sullivan, 1994) to assess open-set sentence recognition in quiet and in speech-spectrum noise. These tests comprised the original Minimum Speech Test Battery for Adult Cochlear Implant Users (MSTB). High quality compact disc recordings of the tests were generated and distributed to cochlear implant centers (Nilsson, McCaw & Soli, 1996).

Since the introduction of the MSTB, advances in technology, improvements in outcomes, and changes in candidacy criteria have resulted in ceiling effects on the HINT sentences when presented in quiet. To illustrate, Gifford et al. (2008) reported that as many as 71% of implanted adult subjects scored 85% or higher on the HINT in quiet. Consequently, the current trend is to assess performance in adults with CNC words and more difficult sentence materials such as the AzBio sentences (Spahr & Dorman, 2004) and Bamford-Kowal-Bamford Speech-in-Noise (BKB-SIN) test (Etymōtic Research, 2005) (Fabry et al., 2009; Gifford et al., 2010). The AzBio sentences are more difficult than the HINT sentences because they are spoken by different talkers in a conversational style with limited contextual cues that the listener can use to predict or "fill in" unintelligible words. The sentences are presented at a fixed level in quiet or in 10-talker babble at a fixed signal-to-noise ratio. The BKB-SIN test is challenging for cochlear implant listeners because a modified adaptive approach is employed wherein sentences are presented at a fixed level and four-talker babble is presented at increasingly more difficult signal-to-noise ratios (SNRs)

Therefore, based upon current practice and clinical needs, the MSTB has been revised to include the CNC word test and subsets of the AzBio and BKB-SIN tests.

Components of the New MSTB Package

The MSTB consists of a high quality compact disk (CD) recording of CNC words and subsets of the AzBio and BKB-SIN tests. The AzBio sentences have been recorded with the target sentences and noise (multi-talker babble) on separate channels. This recording format allows the speech and noise to be presented from separate loudspeakers in the sound field at different (fixed) presentation levels.

The MSTB materials consist of:
- Audio CD with tests in the following order:
  - AzBio sentences (8 lists of 20 sentences) on Channel 1 or left channel with continuous, 10-talker babble on Channel 2 or right channel (Tracks 1 through 8).
  - CNC word test (10 lists of 50 words) (Channel 1, Tracks 9 through 18).
  - Standard BKB-SIN test (10 list pairs with 8 or10 sentences per list; 16 or 20 sentences per list-pair) on Channel 2 or right channel (Tracks 9 through 18).
  - Sound-field calibration noise (Track 19 on Channel 1 and 2) and a 1 kHz VU calibration tone (Track 20 on Channel 1 and 2).
- This User Manual.

- Score sheets for each test, which can be downloaded from Auditory Potential, LLC at www.auditorypotential.com.

Recommended Protocol

The following tests are recommended at the preoperative and postoperative evaluations:

- One 20-sentence list of AzBio sentences presented in quiet.
- One 20-sentence list of AzBio sentences presented in noise.
- One 50-word list of CNC words.
- One 16-sentence list-pair (8 sentences per list) of the BKB-SIN preoperatively; one 20-sentence list-pair (10 sentences per list) of the BKB-SIN postoperatively[1].

Postimplantation assessments are recommended at three, six, and 12 months following device activation, and annually thereafter. Each test takes about 5-7 minutes to complete (Fabry et al., 2009). If there is insufficient time to administer all tests, then the AzBio sentences in quiet and in noise should be administered, followed by CNC words.

The recommended presentation level is 60 dBA which is comparable to the level of conversational speech. The recommended SNR for the AzBio sentences in noise is +10 or +5 dB, depending on the speech understanding abilities of the listener.

NOTE: Please refer to the package insert of each device for the speech tests and criteria that have been approved by the FDA for determining adult cochlear implant candidacy. This information also can be obtained directly from the device manufacturer.

ROOM SETUP AND CALIBRATION

Setup

Testing requires a sound-isolated room with a loudspeaker and chair, a compact disc player, and an audiometer. The sound room, audiometer, and loudspeaker(s) must be calibrated before administration of any tests. Accurate calibration ensures that test results can be compared across testing laboratories and clinics.

Sound Room

The testing should be conducted in a sound-isolated room with minimal reverberation. The reflective surfaces of the room walls, windows, and doors reflect sound and create new sound sources that are delayed versions of the original signals. Those delayed sounds can reduce speech intelligibility and therefore must be minimized.

The sound room must be large enough for a chair to be placed in the center of the room and for the loudspeaker to be one meter from a reference point at the center of the listener's head. The minimum room size required is 1.83 x 1.83 meters or 6 x 6 feet.

The chair should be placed in the center of the room, preferably facing a corner away from any window or door. Then, one loudspeaker should be positioned at the level of a typical listener's head directly in front of the chair (approximately 86 centimeters or 39 inches from the floor) (0

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[1] The 20-sentence lists include SNRs down to -6dB, rather than 0dB, and therefore provide headroom to accommodate the expected pre- to postoperative improvement in speech perception.

azimuth). The speaker should be located one meter from a position corresponding to the center of the listener's head, as shown in Figure 1. With this arrangement, both the speech and noise signals for the AzBio test, when administered in noise, will be presented from the same loudspeaker. This arrangement typically will be used to assess performance with hearing aids (preoperatively) or a unilateral cochlear implant (postoperatively). At least one additional loudspeaker is required to assess bilateral or bimodal performance with speech and noise presented from separate loudspeakers. Calibration and administration instructions for bimodal and bilateral testing will be provided in a future addendum to the manual.
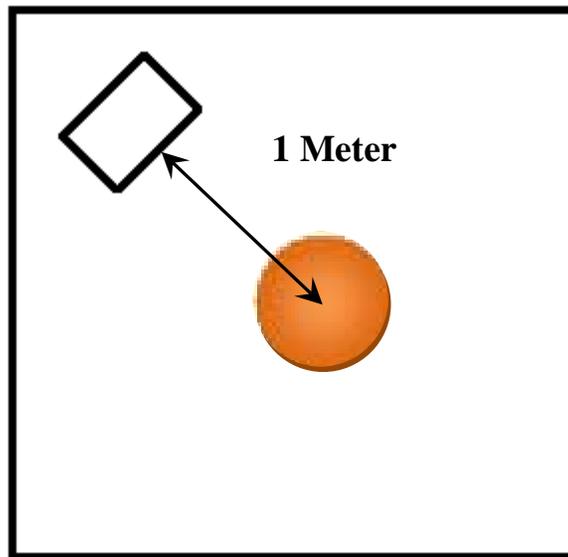
Figure 1. Sound-field test set up.

Calibration

The stimuli on the MSTB CD have been recorded so that the calibration procedure, described below, can be used to set the levels of **all** of the speech materials on the CD when presented from the same speaker. Calibration is a two-step process. First, the 1000-Hz tone is used to calibrate the level at the *input* to the audiometer, then the noise is used to calibrate the *output* from the loudspeakers in the sound field. Both calibration steps must be performed to ensure that the test stimuli are presented at the desired level. It is considered good clinical practice and assumed that a sound-level meter is available for speech perception testing in the sound field. Ideally, calibration of sound field presentation levels should occur at each test session, at a minimum daily.

Audiometer Calibration

FOR TESTS PRESENTED IN QUIET AND IN NOISE

The output from the audiometer is calibrated using the VU meter on *each* audiometer channel. For the AzBio test, the speech will be presented from **Channel 1** and the noise, if used, from **Channel 2** of the audiometer. For the CNC test, the speech will be presented from **Channel 1** only. For the BKB-SIN test , the speech and noise will be presented from **Channel 2** only.

1. Connect the output from the **left** channel of the CD player to the input of **Channel 1** on the audiometer
2. Connect the output from the **right** channel of the CD player to the input of **Channel 2** on the audiometer.
3. Turn on the CD player and audiometer.
4. Insert the CD into the CD player.
5. SKIP to Track 20 on the CD for the 1000-Hz calibration tone. Press PLAY on the CD player.
6. Adjust the VU meter of the audiometer to zero on **Channel 1**. Press STOP on the CD player.
7. Repeat Step #5 and adjust the VU meter of the audiometer to zero on **Channel 2**. Press STOP on the CD player.

Calibration of Sound Field Loudspeakers

FOR THE AzBIO AND CNC TESTS PRESENTED IN QUIET
1. Place the calibration microphone on a stand so that the microphone is at the position corresponding to the center of a typical listener's head when he or she is seated on a chair (approximately 86 centimeters or 39 inches from the floor).
2. Turn on the audiometer.
3. Connect the audiometer **Channel 1** output to the desired speaker and route the signal to **Channel 1** on the audiometer.
4. Turn on the CD player.
5. Insert the CD into the CD player.
6. SKIP to Track 19 on the CD which contains a calibration noise. Press PLAY on the CD player.
7. Adjust the HL dial on **Channel 1** until the calibration microphone measures 60 dBA. Make note of the HL dial setting because this setting will be used to set the level of the speech signals played through **Channel 1.**

FOR THE AzBIO SENTENCES IN NOISE (10-Talker Babble)
1. Place the calibration microphone on a stand at the position corresponding to the center of a typical listener's head when he or she seated in a chair (approximately 86 centimeters or 39 inches from the floor).
2. Turn on the audiometer.
3. **Turn Channel 1 off.**
4. Connect the audiometer Channel 1 and calibrate the output to the desired speaker, as described immediately above, in Steps 1 through 5, for testing in quiet.
5. Connect the audiometer **Channel 2** output to the desired speaker and route the signal to **Channel 2** on the audiometer.
6. Turn on the CD player.

7. Insert the CD into the CD player.
8. SKIP to Track 19 on the CD which contains the calibration noise. Press PLAY on the CD Player.
9. Adjust the HL dial on **Channel 2** until the calibration microphone reads the desired presentation level (e.g., 55 dBA for +5 dB SNR or 50 dBA for +10 dB SNR). Make note of the HL dial setting because this setting will be used to set the level of noise played through Channel 2.
10. Turn Channel 1 back on prior to testing (i.e., both Channels should be on for testing).

FOR THE BKB-SIN TEST
1. Place the calibration microphone on a stand at the position corresponding to the center of a typical listener's head when he or she is seated on a chair (approximately 86 centimeters or 39 inches from the floor).
2. Turn on the audiometer.
3. Connect the audiometer **Channel 2** output to the desired speaker.
4. Turn on the CD player.
5. Insert the CD into the CD player.
6. SKIP to Track 19 on the CD which contains the calibration noise. Press PLAY on the CD Player.
7. Adjust the HL dial on **Channel 2** until the calibration microphone reads 60 dBA. Make note of the HL dial setting because this setting will be used to set the starting level of noise played through **Channel 2.**

Note: Once you begin the test, the level of the noise will change automatically.

TEST ADMINISTRATION

AzBio Sentences

Introduction
The AzBio sentences are spoken by multiple male and female talkers using a conversational rather than deliberate speaking style. In addition, the sentences have limited contextual cues that make it difficult for a listener to "fill in" unintelligible words. The lists were equated for intelligibility by presenting the sentences to normal-hearing listeners through a 5-channel cochlear implant simulator (Spahr & Dorman, 2004).

Test Materials
The subset of AzBio sentences on the MSTB consist of 8 lists of 20 sentences that range in length from 4 to 12 words. Each list of 20 sentences consists of 10 sentences spoken by two male talkers and 10 sentences spoken by two female talkers (5 sentences per talker). Continuous 10-talker babble is recorded on Channel 2 for assessment of performance in noise.

Test Procedures
Setup
1. Turn on the audiometer and CD player.
2. Insert the CD into the CD player.
3. Seat the listener in the chair facing the loudspeaker through which the sentences will be played. Instruct the listener to maintain an upright head position and not to lean forward or to turn his/her head.

4. Instruct the listener with the following written or oral instructions:

   This is a test of your ability to understand speech. You will hear a man or a woman reading a list of sentences. Your task is to repeat all of the words in each sentence. Please repeat everything that you hear, even if it is only part of a word or part of the sentence. It is all right to guess. I will stop after each sentence to allow you to repeat what you heard. I will play each sentence only once.

Test Protocol in Quiet
1. **Turn off Channel 2.**
2. Adjust **Channel 1** to the HL setting that corresponds to 60 dBA from the loudspeaker.
3. Direct **Channel 1** output to the desired speaker.
4. SKIP to the CD track containing the desired sentence list.
5. PLAY the sentence. Press PAUSE to allow time for a response.
6. On the score sheet, circle the words repeated correctly in the sentence. Record the number of words correctly repeated in each sentence in the column marked *Score*.
7. Repeat Steps 5 and 6 for subsequent sentences until the entire list of 20 sentences has been presented.

Test Protocol in 10-Talker Babble
1. Instruct the listener with the following written or oral instructions:

   This is a test of your ability to understand speech in a noisy situation. You will hear a man or a woman reading a list of sentences in a background of noise that sounds like many people talking in a crowded room. Your task is to repeat all of the words in each sentence. Please repeat everything that you hear, even if it is only part of a word or part of the sentence. It is all right to guess. I will stop after each sentence to allow you to repeat what you heard. I will play each sentence only once.

2. Follow steps 1 through 3 above to direct the sentences to Channel 1, if not completed already.
3. **Turn off Channel 1.**
4. **Turn on Channel 2.**
5. Adjust **Channel 2** to the HL setting that corresponds to the desired level of noise (e.g., 55 dBA for a + 5 dB SNR or 50 dBA for a +10 dB SNR).
6. **Turn Channel 1 back on.**
7. Direct Channel 1 and 2 outputs to the desired speaker.
8. Repeat **Steps 4-7** immediately above, under Test Protocol in Quiet.

Calculation of Sentence Recognition Scores
1. Count the number of words correct for each sentence. Total the number of words correct for all of the sentences in the list, and divide by the total number of words in the list. The number of words per list is given on the score sheets.
2. For each list, multiply by 100 the ratio of words correct divided by the total words to obtain the score in percent correct.
3. The following example demonstrates these calculations:

AzBio Sentence Test
List 1
MSTB CD – Track 01
(Channel 1 = Speech, Channel 2 = Noise)

Sentence	Text	Poss	Score
1	I could hear another conversation through the cordless phone.	9	3
2	She relied on him for transportation.	6	4
3	He was an ordinary person who did extraordinary things.	9	7
4	How long has this been going on?	7	7
5	His class was on Saturday.	5	5
6	She was entitled to a bit of luxury occasionally.	9	8
7	The vacation was cancelled on account of weather.	8	6
8	The salon is not open on Mondays.	7	3
9	She had a way to justify any of her wrongdoing.	10	6
10	I feel sorry for my brother.	6	6
11	On numerous occasions they left early.	6	4
12	In private she let her hair down.	7	5
13	A mother always has something better to do.	8	4
14	You should be used to taking money from ladies.	9	7
15	Who would lie about cancer for attention?	7	5
16	Hang the air freshener from your rearview mirror.	8	6
17	You can use your computer to make greeting cards.	9	6
18	I guess you know what you're doing.	7	7
19	You must live in a gingerbread house!	7	4
20	The cat was born with six toes.	7	7

Words Correct	110
Words Possible	151
Percent Correct	72.8

CNC Word Test

Introduction

The CNC word test consists of lists of monosyllabic words with equal phonemic distribution across lists. Each list exhibits approximately the same phonemic distribution as the English language (Lehiste & Peterson, 1959). The original CNC lists were revised to eliminate relatively rare words and proper nouns (Peterson & Lehiste, 1962). The resulting ten lists of 50 words contain monosyllabic words with a frequency of occurrence of greater than four per million as calculated in the Thorndike and Lorge word frequency tables (Thorndike & Lorge, 1944).

Test Materials

The CNC test consists of 500 test words organized into 50-word lists. Each word is preceded by the carrier word "Ready." There are three practice words at the beginning of each list. On the CD, the words within each list are separated by approximately two seconds of silence. The CNC recording on the new MSTB CD is the same as the original MSTB CD.

Test Procedures

Setup
1. Turn on the audiometer and CD player.
2. Insert the CD into the CD player.
3. Seat the listener in the chair facing the loudspeaker through which the words will be played. Instruct the listener to maintain an upright head position and not to lean forward or to turn his or her head.
4. Instruct the listener with the following written or oral instructions:

   This is a test of your ability to understand speech. You will hear a man say the word "READY" followed by a test word. Your task is to repeat each test word you hear the man say. I will stop after each word to allow you to repeat what you heard. Please repeat anything you hear, even if it is only part of a word. It is all right to guess. I will play each word only once.

Test Protocol
1. **Turn off Channel 2.**
2. Adjust **Channel 1** to the HL setting that corresponds to 60 dBA from the loudspeaker.
3. Direct **Channel 1** output to the desired speaker.
4. SKIP to the CD track containing the desired word list.
5. PLAY the first carrier and practice word, then press PAUSE to allow time for a response.
6. PLAY the second and third practice items, allowing time for the listener to respond.
7. PLAY the next carrier and test word, then press PAUSE.
8. Record the response on the score sheet. If the word was repeated correctly, make an "X" in the *Phonemes Correct* column, under the column labeled '3' (for three phonemes correct) in the fourth column. If the word was repeated incorrectly, record the number of phonemes correct in first, second or third columns, under the columns '0', '1', or '2'. There are three phonemes per word. If preferred, record the whole-word response under 'Whole Word Response (Optional)' and calculate the number of phonemes correct at the end of the test.
9. Repeat steps 7 and 8 (PLAY the next word, PAUSE to allow the listener to respond if necessary, record the number of phonemes repeated correctly) until the entire list has been presented.

Calculation of Word and Phoneme Scores in Percent Correct
1. Total the 'X's for each column under '# Correct Phonemes.'
2. Record these totals in the worksheet section in the bottom right of the score sheet and calculate the total number of phonemes correct.
3. Enter the total number of phonemes calculated as the 'Grand Total'; this is the total number of phonemes correct (in the example shown, 114/150).
4. Enter the number of words with 3 phonemes correct at the bottom of the sheet; this is the number of whole words correct (in the example shown, 20/50).

The following example demonstrates these calculations.

Monosyllabic Word Test Key (CNC, List 1)
MSTB CD
Track 09 (Channel 1)

Score all words for a beginning consonant sound, a nucleus (vowel) sound and an ending consonant sound. (Total phoneme count per word = 3. Phonemes must be in the appropriate order.)

Practice Items   1. DUCK   2. BOMB   3. JUNE

	Test Items	Whole Word Response (Optional)	# Correct Phonemes 0	1	2	3		Test Items	Whole Word Response (Optional)	# Correct Phonemes 0	1	2	3
1.	GOOSE	_____				☒	26.	WRECK	*wretch*			☒	
2.	NAME	_____				☒	27.	ROUT	*loud*		☒		
3.	SHORE	*chore*			☒		28.	BOAT	*bow*			☒	
4.	BEAN	*bin*			☒		29.	RIPE	*lie*		☒		
5.	MERGE	_____				☒	30.	WHEEL	*feel*			☒	
6.	DITCH	_____				☒	31.	DEAD	_____				☒
7.	SUN	*some*			☒		32.	SOB	_____				☒
8.	TOUGH	_____				☒	33.	MESS	_____				☒
9.	SEIZE	*size*			☒		34.	WISH	*witch*			☒	
10.	LEASE	*least*			☒		35.	CHORE	_____				☒
11.	HOME	_____				☒	36.	WOOD	_____				☒
12.	JAR	_____				☒	37.	KING	_____				☒
13.	PAD	_____				☒	38.	TOAD	*tow*			☒	
14.	FALL	*sale*		☒			39.	CHECK	_____				☒
15.	VAN	*fan*			☒		40.	LOOP	_____				☒
16.	JUG	*jump*			☒		41.	LAG	*nag*			☒	
17.	YEARN	*earn*			☒		42.	SALVE	*sang*			☒	
18.	MAKE	*mate*			☒		43.	DIME	*time*			☒	
19.	GALE	_____				☒	44.	HULL	_____				☒
20.	TOOTH	*toot*			☒		45.	THIN	*fun*		☒		
21.	PATCH	_____				☒	46.	SHIRT	_____				☒
22.	BOIL	*foil*			☒		47.	ROSE	*hose*			☒	
23.	HATE	*gate*			☒		48.	FIT	*sit*			☒	
24.	PICK	*sick*			☒		49.	KITE	_____				☒
25.	KNIFE	*nice*			☒		50.	CAPE	*kate*			☒	

Sum of boxes checked for: 0   4   25   20
                                   0   1   2   3

Grand Total:

            1 Phoneme Correct: 4   X 1 =   4

            2 Phonemes Correct: 25   X 2 = 50

            3 Phonemes Correct: 20   X 3 = 60

 # Words with 3 Phonemes Correct = 20 / 50 Words   **Grand Total: 114 / 150 Phonemes**

         (.20 x 100 = 40% or 2 x 20 = 40%)   **(.76 x 100 = 76%)**

BKB-SIN Test

Introduction

The BKB-SIN test was developed to be a quick and easy procedure to assess speech understanding in noise in cochlear implant listeners and other individuals with hearing impairment. The test uses the Bamford-Kowal-Bench sentences, which were derived from language samples elicited from young hearing-impaired children (Bench and Bamford, 1979; Bench, Kowal and Bamford, 1979). The sentences are spoken by a male talker in four-talker babble (Auditec of St. Louis, 1971) at prerecorded signal-to-noise ratios that decrease in 3-dB steps. Results are reported as the SNR in dB at which the subject understands 50% of the key words in the sentences (SNR-50).

The BKB-SIN was designed to compare the SNR at which an individual with hearing impairment understand 50% of sentences to the SNR at which a normal-hearing person can understand 50% of sentences. The difference in dB SNR compared to normative data is termed the "SNR loss." The SNR loss indicates the degree of difficulty experienced when listening to speech in noise, which is not predictable from the pure-tone audiogram (e.g., Lyregaard, 1982; Killion and Niquette, 2000).

Test Materials

The subset of BKB-SIN sentences on the new MSTB consists of 10 list-pairs. Each List-Pair consists of two lists of 8 or 10 sentences each that have been equated for intelligibility. *Both* lists of the pair (A & B) must be administered for valid results. The first sentence in each list has four key words, and the remaining sentences each have three key words. A verbal "ready" cue precedes each sentence. The key words in each sentence are scored as correct or incorrect. The sentences are prerecorded at SNRs that decrease in 3-dB steps. Lists 9 through 13 (Channel 2) on the MSTB CD have 8 sentences in each list, with one sentence at each SNR of: +21, +18, +15, +12, +9, +6, +3, and 0 dB. Lists 1 through 5 (Channel 2) on the MSTB CD have 10 sentences in each list, with one sentence at each SNR of: +21, +18, +15, +12, +9, + 6, +3, 0, -3, and -6 dB. Each list in the pair is individually scored, and the results of the two lists are averaged to obtain the List-Pair score.

Test Procedures

Setup
1. Turn on the audiometer and CD player.
2. Insert the CD into the CD player.
3. Seat the listener in the chair facing the loudspeaker through which the sentences and noise will be played. Instruct the listener to maintain an upright head position and not to lean forward or to turn his/her head.
4. Instruct the listener with the following written or oral instructions:

   Imagine you are at a party. There will be a man talking and several other talkers in the background. The man will say "Ready" and then will say a sentence. Repeat the sentence the man says. The man's voice is easy to hear at first because his voice is louder than the others. The background talkers will gradually become louder, making it difficult to understand the man's voice, but please guess and repeat as much of each sentence as you can. I will play each sentence only once.

Test Protocol
1. **Turn off Channel 1.**
2. Adjust **Channel 2** to the HL setting that corresponds to 60 dBA.
2. Direct **Channel 2** output to the desired speaker.
3. SKIP to the CD track containing the desired sentence list.
4. PLAY the first sentence. Press PAUSE to allow time for a response, only if necessary. It is preferable to administer the test in a continuous manner.
5. On the score sheet, circle the *key* words repeated correctly (key words are underlined on the score sheets).
6. Write the number of correct words for each sentence on the line provided.

Note: The level of the noise will change (increase) as the test progresses through the list.

Scoring
1. Add the number of correct words for each list, placing the sum in the space provided on the score sheet. Subtract the total from 23.5 to obtain the SNR–50 (signal-to-noise ratio for 50% correct).
2. Score each list, then average the two scores for the List-Pair using the space provided on the score sheet.

LIST PAIR 2

List 2A

	Key Words	# Correct	SNR
1. The cat is sitting on the bed.	4	4	+21 dB
2. They had a lovely day.	3	3	+18 dB
3. The thin dog was hungry.	3	2	+15 dB
4. They are watching the train.	3	1	+12 dB
5. The dog played with a stick.	3	2	+9 dB
6. The farmer keeps a bull.	3	0	+6 dB
7. The lady wore a coat.	3	1	+3 dB
8. The boy is running away.	3	0	0 dB
9. The room is getting cold.	3	0	-3 dB
10. The wife helped her husband.	3	0	-6 dB

Total Key Words Correct __13__

SNR–50 = (23.5) - (# Correct) = __10.5__ dB

List 2B

	Key Words	# Correct	SNR
1. The lady went to the store.	4	4	+21 dB
2. A tree fell on the house.	3	3	+18 dB
3. The fruit came in a box.	3	3	+15 dB
4. The husband brought some flowers.	3	3	+12 dB
5. A man told the police.	3	2	+9 dB
6. Potatoes grow in the ground.	3	1	+6 dB
7. The big dog was dangerous.	3	0	+3 dB
8. The strawberry jam was sweet.	3	0	0 dB
9. The boy has black hair/ tie.	3	0	-3 dB
10. The mother heard the baby.	3	0	-6 dB

Total Key Words Correct __16__

SNR–50 = (23.5) - (# Correct) = __7.5__ dB

10.5 + 7.5 = 18

18 / 2 = 9

Average SNR–50, Lists 2A and 2B = __9__ dB

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