Evaluation of Approaches to Auditory Rehabilitation for mTBI

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14020
DEPARTMENT OF
VETERANS AFFAIRS
COMPENSATION &
PENSION / AUDIOLOGY

Study Rationale

- Conducted an informal email survey of 220 VA audiologists
  - How often do you encounter OEF/OIF veterans complaining of hearing difficulties who have normal or almost normal hearing thresholds?
  - What rehabilitation do you provide for these individuals?
- In less than one week, 88 audiologists responded, representing about 82 different sites

Study Rationale

	Never	Less than 1 per month	1 – 3 per month	4 or more per month
# of responses	2	5	47	35
% of responses	2	6	53	39

What are audiologists currently doing?

- **There is no standard of care**

- 33% currently provide FM systems
- 26% currently provide auditory training
- 30% were unsure about what to do

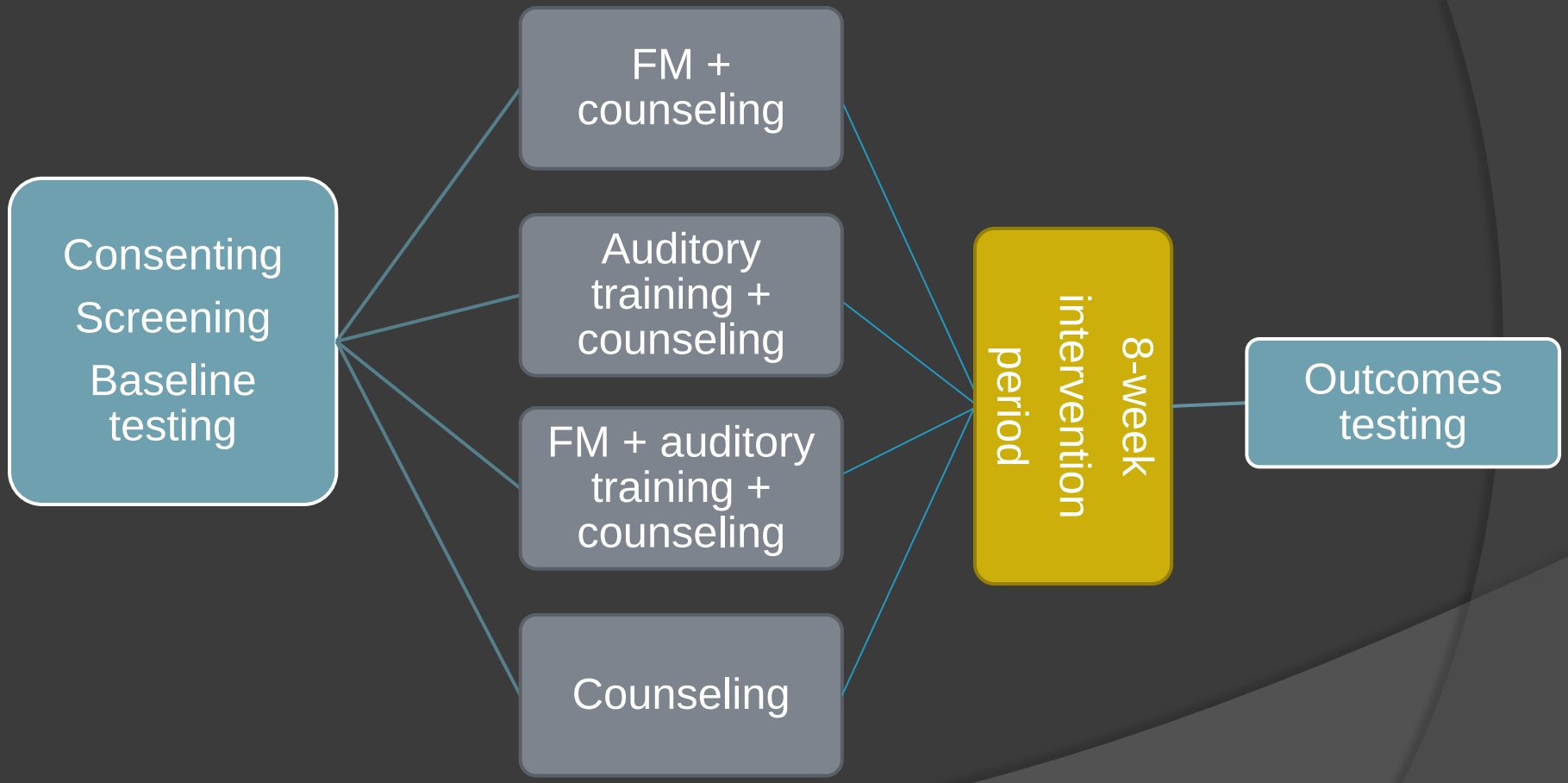
Need to validate current practices

Gabrielle Saunders, Theresa Chisholm, Harvey Abrams, Paula Myers

Evaluation of Approaches to Auditory Rehabilitation for mTBI

Newly funded study

Multi-site, randomized controlled trial at Tampa VA and Portland VA



Participants

- 132 OIF/OEF veterans (68 Tampa, 62 Portland)
- *Self-reported functional hearing difficulties*
- Normal/near normal peripheral hearing sensitivity
- Reported blast exposure during service
- Meet American Congress of Rehab Medicine criteria for mTBI
  - Diminished or altered consciousness < 30 minutes
  - Post-traumatic amnesia < 24 hours post-injury

Session 1

- Informed consent
- Audiometric History & Evaluation
- Administration of:
  - MMSE
  - SKILL card
  - FHQ
  - Infectious Diseases Questionnaire
  - LiSN-S-baseline auditory segregation skills
  - SSQ-baseline auditory disability for Speech, Spatial hearing and Quality of sounds

Criteria for Inclusion

- Audiometric
  - No hearing threshold greater than 40 dBHL at frequencies of: 500, 1000, 2000, 3000, 4000
  - No threshold greater than 25 dBHL at three of the five frequencies noted above
  - Symmetrical pure ton thresholds with a left-right difference that does not exceed 15 dBHL at all frequencies 500-4000 Hz
  - No conductive hearing loss
- FHQ
  - Score of 19 or more

Baseline Variable

- **Listening in Spatialized Noise-Sentences Test** (NAL, distributed by Phonak)
- Assess auditory segregation skills in persons with suspected APD. Tests ability to understand speech in noise when noise comes in different directions.
- Requires computer, sound card, SennHeiser headphones, LISN-S software

Speech, Spatial & Qualities of Hearing Scale (SSQ) Gatehouse, S. Noble W.

- Measure range of hearing disabilities across several domains:
- Attention to hearing speech in competing contexts, directional, distance, segregate sounds and to attend to simultaneous speech streams
- Qualities of hearing experience-ease of listening, naturalness, clarity, identify different speakers, music, instruments and everyday sounds

Session 2

- Complete Tests:
  - **PPT-**measure/compare actual & perceived speech understanding in noise
  - **ATTR**-within-channel/across-channel gap detection thresholds
  - **Digit Span -**auditory working memory
  - **Time Compressed Speech Test** -speech recognition for speeded speech
  - **Stroop Test-** cognitive flexibility & resistance to interference from outside stimuli
  - **Woodcock Johnson Story Recall-** working memory for auditory info in narrative context
- *Administer training for intervention arm*

Performance-Perceptual Test

- Measure speech understanding in noise and accuracy of perceived hearing difficulty
- Evaluates objective and subjective ability to understand speech in noise using same test materials, adaptive testing format and unit of msmt (dB S/N) for both using HINT

(Saunders, Forsline & Fausti 2004)

Adaptive Tests of Temporal Resolution (Lister, Roberts)

- Measure random gap detection among persons to gain insight into auditory temporal processing ability
- Uses adaptive paradigm to calculate the gap discrimination threshold
- NBN Within-Channel Gap Detection and NBN Across-Channel Falling Gap Detection

Digit Span

- Digit Forward--Repeat as many numbers as you can in the order in which heard them
- Digit Backward-Say the numbers backwards in the order in which you heard them

Time Compressed Speech Test

- Repeat sentence by female speaker at different rates

Stroop Color and Word Test

- Word Page-read down the columns out loud the words as quickly as you can
- Color Page-read down the columns out loud the colors as quickly as you can
- Color-Word Page-Name the color of the ink the words are printed in, ignoring the word that is printed for each item

- *Naming the color hues takes more time than the reading of the color names*

Woodcock Johnson III Test 3 Story Recall

- Assesses meaningful memory for auditory information in narrative context.
- Subject recalls as many details of story he/she can remember (responses recorded and scored offline)

Forms of Intervention

- Group 1
  - Personal FM system use + minimal informational counseling for 8 weeks
- Group 2
  - Auditory training with the Brain Fitness program + minimal informational counseling for 8 weeks
- Group 3
  - FM + auditory training with Brain Fitness program + minimal informational counseling combined for 8 weeks
- Group 4
  - Control group who will receive minimal informational counseling alone

Rationale for the interventions

- FM system
  - Successful for children with auditory processing problems
  - Available with no/minimal gain
  - Improve SNR, leaving more resources for higher level processing

- Auditory training
  - Reported success with Fast ForWord and LACE


Hearing is one thing.
Listening is another.
LACE helps your brain
ARE YOU
LISTENING?
High or Low?
Volume
Pause/Exit
Guide
THE EAR—ORGANS OF HEARING AND BALANCE

Auditory Training Program

- Brain Fitness Program by Posit Science

- Six Exercises
  - **High-Low**-processing speed
  - **Match It** -sound precision
  - **Tell Us Apart** -discriminating sounds
  - **Sound Replay** -sound sequencing
  - Listen and Do -working memory
  - **Storyteller**- narrative memory

High or Low?

Challenge
Tips
Points

Challenge
In High or Low? your challenge is to shorten the gap between the two sounds you hear.

The numbers on the meter show the length of the gap between the sounds in milliseconds. Lower numbers are shorter gaps – and harder ones!

Three correct answers in a row shorten the gap between the sounds.

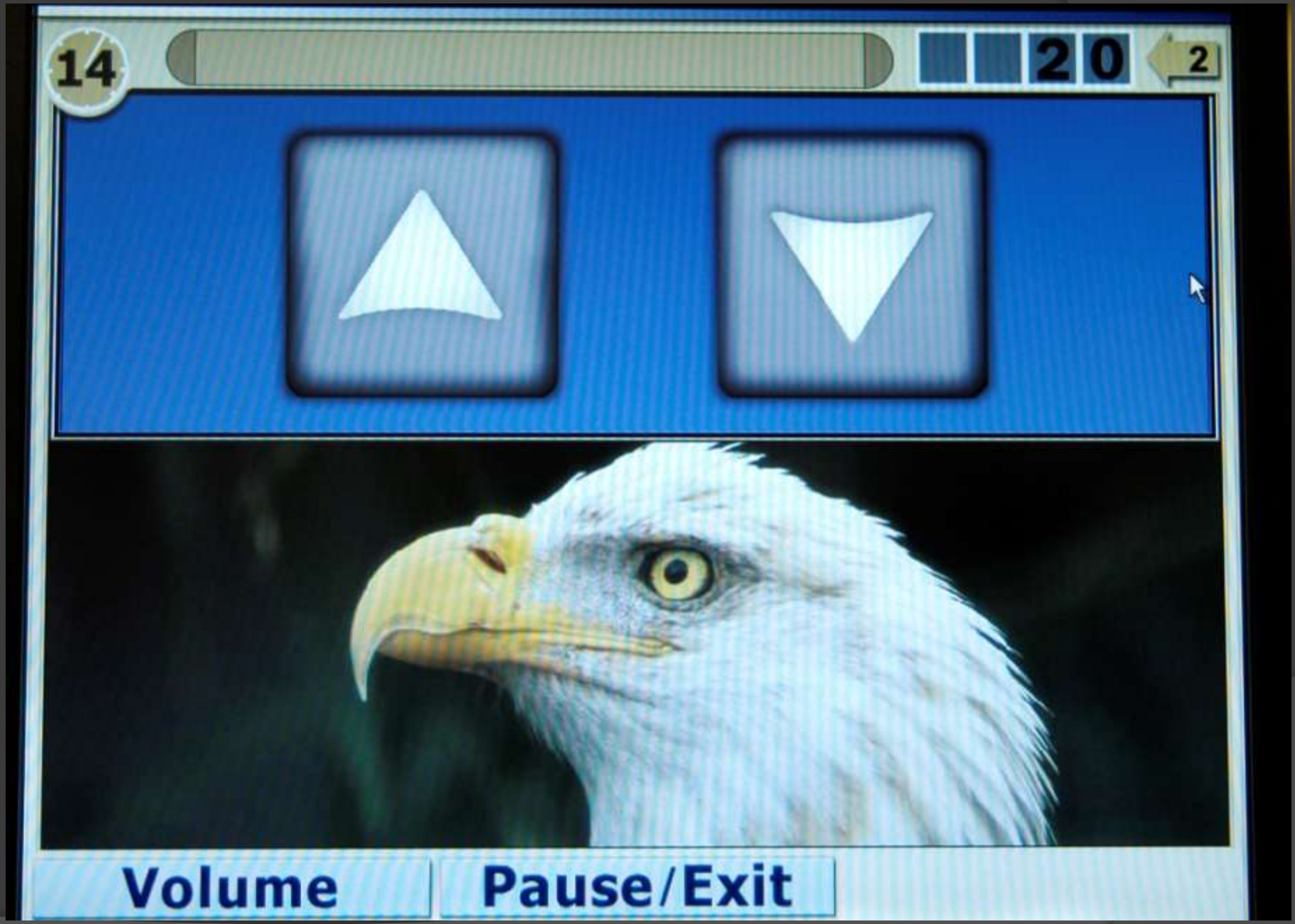
One incorrect answer lengthens the gap.

TODAY'S GOAL

Concentrate on paying careful attention to the sounds to do the best you can.

Start the exercise

Volume | Pause/Exit | Guide


14
20
2
Volume
Pause/Exit

High or Low?

- Progress
  - History
  - Analysis
  - Details
- Points
- Benefits
- Videos

Progress

The progress steps in High or Low? are related to the length of the gap between the two sounds. Each time you pass a milestone in gap length, you take a step forward.

400 ms gap	50 ms gap
200 ms gap	40 ms gap
120 ms gap	30 ms gap
70 ms gap	

Challenge Meter Connection

When you pass a milestone in gap length and turn an arrow green, the Challenge Meter closes that section and opens the next one. That means you've taken one step forward in progress.

Go to next exercise

Volume | Pause/Exit | Guide

High or Low?

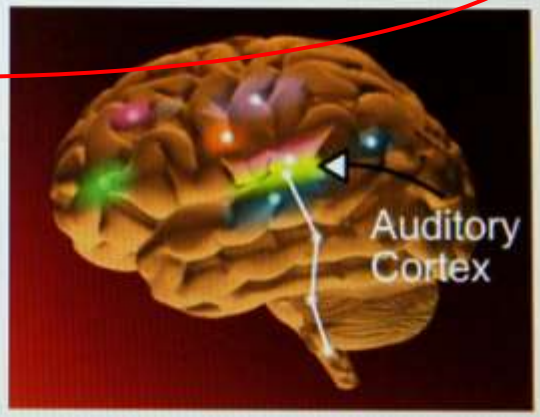
- Progress
- Points
- Benefits
  - Processing Speed
  - Pitch Distinction
  - Discriminating Sounds
- Videos

Processing Speed

Exercise Benefits

High or Low? is designed to improve processing speed. The up and down sounds in the exercise target the auditory cortex—the part of the brain responsible for the smallest details of speech.

The goal is to strengthen the auditory cortex's ability to interpret sound details accurately, even when speech is very rapid.



Click the buttons at left to read more about the exercise's scientific design.

Go to next exercise

Volume | Pause/Exit | Guide

High or Low?

Progress

Points

Benefits

Processing Speed

Pitch Distinctio

Discriminating Sounds

Videos

Pitch Distinction

Did you know that neurons in your brain are specialized to respond to different sound frequencies? In order to improve the brain's reception and memory of what it hears, you need to exercise a broad array of these neurons.

In the Exercise

Different Frequencies

The sounds in High or Low? cover the range of frequencies commonly heard in human speech. They begin at three different frequencies: 500, 1000, and 2000 Hertz.

In the World

Listening Better

Participants in the program often notice their hearing becoming clearer. Examples include that bird calls seem more complex and sharper, or that music is fuller.

Go to next exercise

Volume | Pause/Exit | Guide

High or Low?

- Progress
- Points
- Benefits
  - Processing Speed
  - Pitch Distinction
  - Discriminating Sounds
- Videos

Discriminating Sounds

You probably don't notice, but spoken language is made up of subsounds. Refining your ability to hear these subsounds precisely is key to improving how well your brain can interpret what you hear.

In the Exercise

Sweeps

The up and down "sweeps" in High or Low? mimic subsounds that are common in many English consonants and vowels. To the brain, one sweeping subsound is an important difference between a /g/ sound and a /d/ sound, a /b/ sound and a /p/ sound, and many other pairs.

In the World

Understanding and Comprehension

The ability to discriminate sounds better can help people pick up more of what other people say to them. For example, they might find it easier to understand someone that mumbles or talks very quickly. (*Dad* no longer sounds like *pad*, *gad* or *bad*!)

Go to next exercise

Volume | Pause/Exit | Guide

Match It!

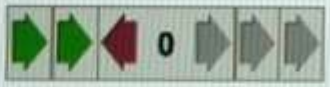
Challenge
Tips
Points

Challenge

In Match It! your challenge is to clear grids of sounds within a certain number of clicks. If you are successful, the grids get larger.

Each section of the meter represents a grid size: 8, 16, 24 or 30 buttons. The open section (where you can see the arrows) shows the grid size you are working on.

The meter shows the number of clicks you have to clear the grid. Clear it in fewer clicks to turn the arrow green and move to the next set.



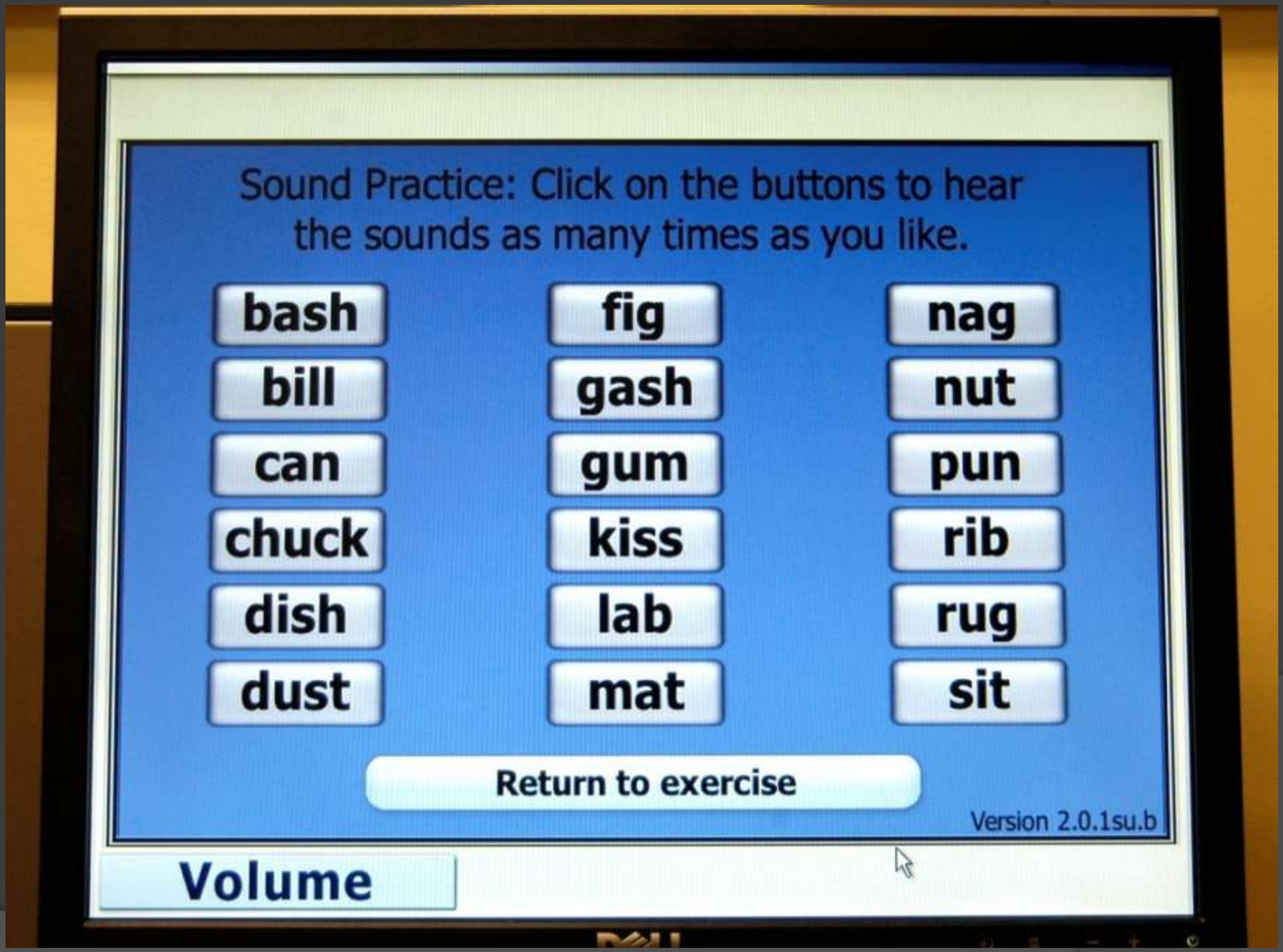
If the number of clicks drops to 0, the arrow turns red. To advance to the next grid size, you have to turn all five arrows green.

TODAY'S GOAL

Try to clear the next grid in less than 74 clicks.

Start the exercise

Volume | Pause/Exit | Guide


Sound Practice: Click on the buttons to hear the sounds as many times as you like.
bash
bill
can
chuck
dish
dust
fig
gash
gum
kiss
lab
mat
nag
nut
pun
rib
rug
sit
Return to exercise
Version 2.0.1su.b
Volume

Sound Replay

- Progress
  - History
  - Analysis
  - Details
- Points
- Benefits
- Videos

Progress

In Sound Replay, there are five different sets of syllables. You earn a forward progress step each time you pass one of these sets.

Syllable Sets	Examples
Phonemes	baa, do, gi, pu, te, ka
Syllables - different vowels	fig, nut, can, bill, pun, nag
Short i syllables	big, bit, dig, dip, kick, kid
Short u syllables	bud, cup, dug, pug, tub, dud
Short a syllables	back, bat, cat, pat, gab, tag

Challenge Meter Connection

In the Challenge Meter, you'll see that there are five arrows broken out for the number of syllables you're working on. These arrows represent the five syllable sets. Each time you turn an arrow green, it means you've taken one step forward in progress.

Go to next exercise

Volume | Pause/Exit | Guide

Sound Replay

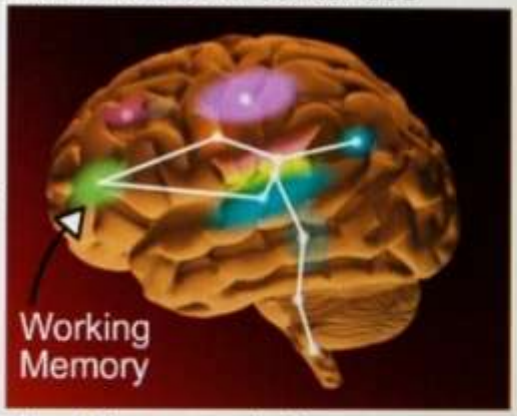
- Progress
- Points
- Benefits
  - Sound Sequencing
  - Processing Speed
  - Sound Precision
- Videos

Sound Sequencing

Exercise Benefits

Sound Replay aims to build your brain's ability to keep information you hear in order. This ability is crucial on many levels—it's even what enables you to remember what you hear long enough to sequence the sounds into words and sentences that have meaning.

The part of the brain responsible for this type of short-term memory is located in the forebrain, near the front of the head.



Click the buttons at left to read more about the exercise's scientific design.

Go to next exercise

Volume | Pause/Exit | Guide

Sound Replay

- Progress
- Points
- Benefits
  - Sound Sequencing
  - Processing Speed
  - Sound Precision
- Videos

Processing Speed

Sound Replay aims to increase your processing speed (the speed at which your brain can take in sounds accurately). The goal is to improve your ability to identify words—either when you're listening to someone else or are talking yourself.

In the Exercise

Faster Speech

Every eight sessions, the speech processing level changes. The sounds become faster, pushing your brain to work faster to catch each subtlety.

In the World

Finding the Right Words

When the brain becomes more efficient at processing sound, it doesn't have to struggle as much to come up with the right words. This can help people feel more confident and well-spoken in conversations with others.

Go to next exercise

Volume | Pause/Exit | Guide

Sound Replay

- Progress
- Points
- Benefits
  - Sound Sequencing
  - Processing Speed
  - Sound Precision
- Videos

Sound Precision

The syllables that you see in Sound Replay are very common in English. They have been processed to help your brain sharpen its ability to tell such important sounds apart with precision.

In the Exercise

Processed Speech

In addition to slowing down speech, the processed speech in Sound Replay exaggerates important changes and differences in the word sounds. The goal is to etch strong pathways in the brain for each individual sound. This should help your brain differentiate similar words like *bad* and *bag* without a problem.

In the World

Understanding and Comprehension

Past participants have noticed that they find it easier to follow conversations, even in restaurants or other noisy places. Many have commented that children have become easier to understand, too.

Go to next exercise

Volume | Pause/Exit | Guide


15
2
3
4
5
8
4
JAVA
CAFE
Fruit Market
BARBER SHOP
EDDIE'S ICE CREAM
Volume
Main Menu
Guide

Story Teller

- Progress
- Points
- Benefits
  - Narrative Memory
  - Working Memory
  - Attentional Focus
- Videos

Narrative Memory

Exercise Benefits

Story Teller is designed to improve your memory for narratives you hear.

To fully understand a narrative, several parts of the brain must work together—from the auditory cortex through the speech reception and working memory centers.

Click the buttons at left to read more about the exercise's scientific design.

Go to today's summary

Volume | Pause/Exit | Guide

Story Teller

- Progress
- Points
- Benefits
  - Narrative Memory
  - Working Memory
  - Attentional Focus
- Videos

Working Memory

Story Teller is designed to expand the length of your working memory—the short-term memory that allows you to act on what you hear.

In the Exercise

Story Segments

Story Teller begins with one story segment, and moves up to two, three, or even four. The purpose is to improve your ability to keep more details in working memory over longer periods of time.

In the World

Brighter Mood

Some people have noticed that their mood has improved along with their memory.

Go to today's summary

Volume | Pause/Exit | Guide

Story Teller

- Progress
- Points
- Benefits
  - Narrative Memory
  - Working Memory
  - Attentional Focus
- Videos

Attentional Focus

Story Teller, like all the program exercises, is designed to improve your attentional focus. It does so because when you are focusing attentively, the brain releases an important chemical for learning and remembering called acetylcholine.

In the Exercise

Details

To answer the Story Teller questions correctly, you have to remember minor story details. Listening for such details requires careful attention.

In the World

More Connected

Some people report that better focus helps them feel more connected to the people around them. For instance, they might find that after talking with a new friend, they remember the conversation details well enough to ask follow-up questions later.

Go to today's summary

Volume | Pause/Exit | Guide

Summary

- Summary
- High or Low?
- Tell Us Apart
- Match It!
- Sound Replay
- Listen and Do
- Story Teller

Exercise	Total Score	Progress Steps (in difficulty)
High or Low? Processing Speed	111596	
Tell Us Apart Discriminating Sounds	1805	
Match It! Sound Precision	2208	
Sound Replay Sound Sequencing	2744	
Listen and Do Working Memory	1407	
Story Teller Narrative Memory	300	

You are on session: **19** You have **21** sessions left

19

Main Menu | Progress Screens

Session 3

- Administration of:
  - **SSQ-C** -Examines reported auditory disability for speech, spatial hearing, and quality of sounds
  - **PIADS**-impact of intervention on Competence, Self-Esteem & Adaptability domains
  - Cognitive Self Report Questionnaire (**CSRQ**)-impact of interventions on self-reported cognitive difficulties
  - **PPT**
  - ***ATTR***
  - **Digit Span**
  - **Time Compressed Speech Test**
  - ***Stroop Test***
  - **Woodcock Johnson Story Recall**
  - **Exit Interview**

Outcome Measures

- Objective measures
- Self-report measures

Psychosocial Impact of Assistive Devices Scale-PIADS

- Three scales:
  - Adaptability
  - Competence
  - Self-esteem

  - 26 items evaluate effects of assistive device on functional independence, QOL
  - Each word describes how FM (or AT) might affect you. For each phrase check the best box to show the extent the FM (or AT) affects you.

Psychosocial Impact of Assistive Devices Scale (PIADS) Self Report

	Decreased		No Change			Increased	
	-3	-2	-1	0	1	2	3
Competence							
Independence							
Happiness							
Adequacy							
Confusion							
Efficiency							
Self-esteem							

Other Subjective Outcome Questionnaires

- SSQ-C
  - Examines reported auditory disability for speech, spatial hearing, and quality of sounds
- CSRQ
  - Assesses the impact of interventions on self-reported cognitive difficulties

Objective Outcome Performance Measures

- Performance-Perceptual Test (PPT)
  - Measures speech understanding in noise and accuracy of perceived hearing ability
- Adaptive Tests of Temporal Resolution (ATTR)
  - Measures random gap detection
- Digit Span
- Time Compressed Speech Test
- Stroop Color and Word Test
- Woodcock Johnson Story Recall
  - Measures meaningful memory for auditory information

Come back in a year or so and we'll have some data!