Connected Aural Rehabilitation: Past, Present & Future

Terry Chisolm, Ph.D.

Beyond the Audiology Clinic: Innovations & Possibilities in Connected Health

NCRAR

September 18-20, 2013

USF UNIVERSITY OF SOUTH FLORIDA
Tampa, FL
Affiliations

Dept. of Communication Sciences & Disorders

Bay Pines VA Healthcare System
“Those who cannot remember the past are condemned to repeat it” Santayana
“Innovative technological advances have served as a catalyst in stimulating new thinking to address old problems....
“technological limitations have also served as a constraint on our thinking”
(Hearing Journal, Dec. 2013)
Pattern of Technological Development

• Similar to a game of leapfrog
• Innovative technological advance
• Leap forward
• Although more effective, problem not always solved
• Face unexpected hurdles which need to be surmounted

Levitt et al., 2012
Pattern of Technological Development

- New ideas in Rehabilitative Audiology
- New technological advances

Levitt et al., 2012
Pattern of Technological Development

• New ideas in Rehabilitative Audiology
• New technological advances
• Synergy necessary to take the next leap forward

Levitt et al., 2012
Goal of Presentation

Examine changes in our thinking about **Connected Aural Rehabilitation** with each successful leap forward that we have taken.
Goal of Presentation

Plan ahead with new thinking for surmounting the next hurdle that we will face
DEFINING AURAL REHABILITATION
Adult Aural Rehabilitation
(Boothroyd, 2007)
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(Boothroyd, 2007)

• Defined holistically as the reduction of hearing-loss-induced deficits of
  • Function, activity, participation, and quality of life

• Through a combination of
Adult Aural Rehabilitation (Boothroyd, 2007)

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![Sensory management and instruction images]
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• Function, activity, participation, and quality of life

• Through a combination of
AR in the Pre-Electronic Era

• Oral schools for the deaf
  – Speech production training with due emphasis on listening skills
AR in the Pre-Electronic Era

- Oral schools for the deaf
  - Moderate hearing loss could benefit from speech comprehension training using an acoustic horn
AR in the Pre-Electronic Era

• Severe to profound hearing loss
• Acoustic horn provided insufficient amplification for sound to be audible
AR in the Pre-Electronic Era

- Use of **vision** to help develop speech comprehension skills

Nitchie (1903)  
Braun, 1902
AR in the Pre-Electronic Era

- Lip-reading
  - “the eye as a substitute for deaf ears”

Nitchie (1903)

Braun, 1902
AR in the Pre-Electronic Era

- Differed in how much emphasis placed on learning facial patterns of individual sounds before moving on to speech in context

Nitchie (1903)

Braun, 1902
AR in the Pre-Electronic Era

- Implication for Connected AR:
  - Analytic vs. Synthetic approaches

Nitchie (1903)

Braun, 1902
AR in the Pre-Electronic Era

- Lip-reading, treated as a separate form of speech communication
- Rather than an inherent component of normal speech communication

Nitchie (1903)
Braun, 1902
Use of Visual Cues in Speech Communication

- Individuals with normal hearing use visual speech cues in background noise or when acoustic speech signal distorted
  - (e.g., Sumby & Pollack, 1954; Erber 1971; 1975)

- Adults with hearing loss dependent on speech cues in a similar way
AR in the Pre-Electronic Era

- **Implication for Connected AR:**
  - Auditory alone vs. auditory-visual training

Nitchie (1903)

Braun, 1902
AR in the Electronic Era

- Electronic hearing aids
  - Significant improvement in auditory rehabilitation
AR in the Electronic Era

• Electronic hearing aids
  – “Mirroring” the audiogram
  – Worked well with conductive hearing loss or mild SNHL
AR in the Electronic Era

• Moderate and severe hearing loss
  – “Mirroring” the audiogram resulted in over-amplification

• Electronic Hearing Aids
  – Innovative new technology
  – SNHL involved more than simple elevation of auditory thresholds
AR in the Electronic Era

- Implication for Connected AR:
  - Hearing aids alone are not the solution
  - Speech perception training also needed
Speech Perception Training

• Group hearing aids with children at oral skills for the deaf

• National Research Council study (Silverman & Hirsh, 1951)
  – Long term training with a group hearing aid
  – Speech recognition scores improved 30 percentage points
  – After 2 years of training
Speech Perception Training

• Group hearing aids with children at oral skills for the deaf

• Implication for Connected AR:
  – How long of duration do we need for training?
AR and the Transistor

- Development of *complex signal processors* that were small enough to fit in or on the ear
AR and the Transistor

- **Large individual differences** in terms of how individuals with similar audiograms were able to benefit (Levitt et al 1993)
AR and Advanced Methods of Signal Processing

• Lower *cognitive capacity* less able to benefit from *compression hearing aids with short-time constants*
  
  (e.g., Lunner & Sundewall-Thoren, 2007).
AR and Advanced Methods of Signal Processing

• Signal processing to increase audibility of components of speech important for understanding
AR and Advanced Methods of Signal Processing

- While minimizing temporal or other distortions that could reduce intelligibility
AR and Advanced Methods of Signal Processing

- Implication for Connected AR:
  - Need for training programs that can help a person deal with signal processing distortions essential for improving speech intelligibility
AR and Advanced Methods of Signal Processing

• Implication for Connected AR:
  – Training programs include cognitive as well as perceptual components
AR and Cochlear Implants

• Were not supposed to work....
• But they did!
• The innovative new biomedical technology resulted in serious rethinking by hearing scientists
Cochlear Implants = AR and the Digital Era
The Digital Era: Hearing Aids
The Digital Era: Hearing Aids

1980s
- Digital control of analog components

Second generation
- Methods of signal processing, such as innovative adaptive feedback cancellation
The Digital Era: Hearing Aids

1980s
- Digital control of analog components

Early 21st Century
- 1st fully digital hearing aids designed to do what conventional hearing aids did – only better
The Digital Era: Hearing Aids

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- Innovative methods of signal processing, such as adaptive feedback cancellation
The Digital Era: Computer-Based AR: Speech Perception Training Systems

- Early 21st Century
  - 1st fully digital hearing aids designed to do what conventional hearing aids did - only better
  - Second generation
    - methods of signal processing, such as Innovative adaptive feedback cancellation
The Digital Era: Computer-Based AR: Speech Perception Training Systems

1980s – 1990s

- Computer-control of audio-video playback equipment

Second generation

- Methods of signal processing, such as innovative adaptive feedback cancellation
The Digital Era: Computer-Based AR: Speech Perception Training Systems

1980s
- Dynamic Audio Visual Interactive Device (DAVID; NTID)
- Apple II computer
- VCR
- Monitor

Second generation
- methods of
• Young deaf adults at NTID
  – Speech recognition scores of sentences improved 14.6 to 33.5% after 20 training units (Durity 1982)
  – Speechreading scores increased more than 15% (Jacobs, 1982)
• Improvements subsequently declined if after training learned skills not continuously used
• Implication for Connected AR:
  – Consider “booster training” in addition to “initial training”
The Digital Era: Computer-Based AR: Speech Perception Training Systems

**1980s – 1990s**
- Computer control of audio-video playback equipment

**Second generation**
- Computer Assisted Speech Perception & Evaluation (CASPER; Boothroyd, 1987)
- Computer Assisted Tracking Simulation (CATS; Dempsey et al., 1992)
The Digital Era: Computer-Based AR: Speech Perception Training Systems

1980s – 1990s

- Computer control of audio-video playback equipment

Second generation

- Computer Assisted Speech Perception & Evaluation (CASPER; Boothroyd, 1987)
- Computer Assisted Tracking Simulation (CATS; Dempsey et al., 1992)
CASPER

- Adult cochlear implant recipients
- Clinic-based system
- Hearing Alone, Speechreading Alone, Hearing + Speechreading combined
- Vowel & Consonant Analytic training
- Sentence level Synthetic training
CASPER: Rehabilitation of adult cochlear implantees

- **Implant turned on**
- **Time in months**
- **Percent words correct by hearing alone**

<table>
<thead>
<tr>
<th>Time in months</th>
<th>Vowel training</th>
<th>Consonant training</th>
<th>Sentence level training</th>
</tr>
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<tbody>
<tr>
<td>1</td>
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</table>

**Every day communication**

- **Implication for Connected AR:**
  - Providing Extra Time-on task can improve speech recognition performance

(Schematic – for illustration only – Boothroyd)
The Digital Era: Computer-Based AR: Speech Perception Training Systems

1980s – 1990s

- Computer-control of audio-video playback equipment

Implication for Connected AR:
- Significant improvements in speech recognition outcomes
- However,
  - High cost
  - Lacked ease of use
  - Limited by being clinic based

Second generation

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The Digital Era: Computer-Based AR: Speech Perception Training Systems

1980s – 1990s
- Computer-control of audio-video playback equipment

Late 1990s–Current
- Home-based systems using -
  - Desktops
  - Laptops
  - Tablets

Second generation
- Methods of signal processing, such as
  - Innovative adaptive feedback cancellation
So many choices...
Speech Comprehension Training and Auditory and Cognitive Processing in Older Adults

M. Kathleen Pichora-Fuller\textsuperscript{a,b,c} and Harry Levitt\textsuperscript{d}
<table>
<thead>
<tr>
<th>Program Name</th>
<th>Source</th>
<th>Description</th>
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<tbody>
<tr>
<td>Baldi</td>
<td>Psicientic Mind <a href="http://psicienticmind.com/">http://psicienticmind.com/</a></td>
<td>Speechreading training is provided by means of a computer-generated talking head (Baldi) that can generate speech from text. Speed of speech production can be controlled and provides revealing views of Baldi, such as making the skin transparent to show movements of the articulators.</td>
</tr>
<tr>
<td>Computer-Assisted Speech Perception Testing and Training (CASPER)</td>
<td>All programs in the CASPER series can be obtained through the Rehabilitation Engineering and Research Center on Hearing Enhancement of Gallaudet University at <a href="http://www.hearingresearch.org">www.hearingresearch.org</a> or directly from the author at <a href="http://www.arthurboothroyd.com">www.arthurboothroyd.com</a></td>
<td>A series of computer-assisted training and testing programs has been developed using the CASPER system (Boothroyd, 2010). Each of the training programs can be used in the home with or without help from a significant other (PC only). CasperCon: auditory, visual, and auditory-visual training and testing at the level of vowel and consonant contrasts. CasperSent: auditory, visual, and auditory-visual training and testing at the sentence level. AudioCasper: auditory-only training at the story level. Users can vary background noise level, talker speed, and the number of words shown in text form while listening. The goal is to improve both attention to detail and the use of story context.</td>
</tr>
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<td>Computer-Assisted Speech Training (CAST)</td>
<td>Tiger Speech Technology <a href="http://www.tigerspeech.com">www.tigerspeech.com</a></td>
<td>The training software targets important acoustic contrasts among speech stimuli, provides auditory and visual feedback, and incorporates progressive training techniques, thereby maintaining recipients' interest during the auditory training exercises. Tiger Speech Technology offers a range of products based on CAST.</td>
</tr>
<tr>
<td>eARena</td>
<td>Siemens Hearing Instruments <a href="mailto:tpowers@siemens.com">tpowers@siemens.com</a></td>
<td>eARena is an interactive audio-video training program. The program consists of a set of DVDs with &quot;informational videos and a twenty-day curriculum containing listening exercises, 'homework', and daily tips for maximizing the benefits of their personal hearing solution.&quot;</td>
</tr>
<tr>
<td>Listening and Communication Enhancement (LACE)</td>
<td>Neurotone <a href="http://www.neurotone.com">www.neurotone.com</a></td>
<td>This system focuses on auditory training for hearing aid wearers. Interactive adaptive software is used to provide instruction on using a hearing aid, lessons and training to improve listening skills and develop more effective listening strategies, and to address cognitive changes characteristic of the aging process.</td>
</tr>
<tr>
<td>Read My Quips (RMQ)</td>
<td>SenseSynergy [<a href="http://www.sense">www.sense</a> synergy.com](<a href="http://www.sense">http://www.sense</a> synergy.com)</td>
<td>This system focuses on sentence comprehension in noise with contextual cues provided in a video puzzle format. The background noise is adjusted in level adaptively to match the trainer's speechreading ability.</td>
</tr>
<tr>
<td>Seeing and Hearing Speech</td>
<td>Sensimetrics Corporation <a href="http://www.sens.com/">www.sens.com/</a></td>
<td>Multimedia interactive software is used to provide instruction and training in speechreading. Video recordings of a variety of talkers are used, ranging in difficulty from easy to speechread to more difficult.</td>
</tr>
<tr>
<td>Speech Perception Assessment and Training System (SPATS)</td>
<td>Communication Disorders Technology <a href="http://www.comdistec.com">www.comdistec.com</a></td>
<td>The program contains two speech comprehension and training modules: one on the sounds of speech and the other on sentence understanding.</td>
</tr>
</tbody>
</table>

Note: The table lists computer-based auditory training programs for adults that are currently available. The programs are listed in alphabetical order. For each entry, the first column contains the name of the training program; the second column contains the program source and the website for more information and how to obtain the program; and the third column contains a description of the program.
Efficacy of Individual Computer-Based Auditory Training for People with Hearing Loss: A Systematic Review of the Evidence

Helen Henshaw*, Melanie A. Ferguson

NIHR Nottingham Hearing Biomedical Research Unit, Nottingham, United Kingdom
Conclusion

- Our findings demonstrate that published evidence for the efficacy of individual computer-based auditory training for adults with hearing loss is not robust and therefore cannot be reliably used to guide intervention at this time.
- We identify a need for high-quality evidence to further examine the efficacy of computer-based auditory training for people with hearing loss
  - Henshaw & Ferguson (2013)
Our Work with Computer-Based Auditory Training Programs

A Tale of Two Studies

VA Merit Review Grants

The contents do not represent the views of the Department of Veterans Affairs or the United States Government
Our Work with Computer-Based Auditory Training Programs

Thanks to Harvey Abrams
Study #1: Supplementing Hearing Aids with Computerized Auditory Training

VA RR&D Merit Review Grant C6303R (Chisolm & Wilson, Co-PIs)
NCRAR, Portland OR
Gaby Saunders,
Melissa Frederick,
ShienPei Silverman

James H. Quillen VAMC, Mt. Home, TN: Richard Wilson,
Sherri Smith,

VAHC, Bay Pines, FL, U. South Florida: Terry Chisolm,
Rachel McArdle,
All About LACE™:

- Home-based
- Adaptive training
- Progress tracked over time
- Provides motivation via feedback
Comprehension of Degraded Speech

- Speech-in-babble
- Time-compressed speech
- Competing speaker

Enhancement of Cognitive Skills

- Auditory working memory
- Missing word identification using context

Use of Communication Strategies

- Helpful hints
Efficacy of LACE
(Sweetow & Henderson Sabes, 2006)

• Multi-site randomized controlled trial (RCT)
• $n = 65$ (mostly) experienced hearing aid users
• Ages 28-85 years old
Efficacy of LACE
(Sweetow & Henderson Sabes, 2006)

• Randomized to an *Immediate Treatment* or a *Control*, Delayed Treatment Group

• Positive Treatment Outcomes at the Group Level
  • Speech perception tests
  • Cognitive tests
  • Subjective measures of residual hearing difficulties and use of communication strategies
Greater gains were made by Ss with:
- Greater hearing losses
- Poorer baseline scores
- Recognition of Degraded Speech
- Recognition of Speech with a Competing Speaker
- Greater degrees of self-perception of hearing handicap
Need for Continued Research

• Factors which might influence LACE outcomes

• Veteran population
  – Higher pre-fitting expectations for hearing aid use
  – More severe unaided self-report of problems associated with hearing loss
  – Poorer physical and mental health than non-veteran age equivalents (Cox et al, 2005)
Overview of Study

- Large scale ($n = 279$), Parallel Group Randomized Clinical Trial
- Veterans
- New and Experienced Hearing Aid Users
  - All hearing aids < 2 years old
Interventions:

• Hearing Aid Use + Standard-of-care educational counseling
• Hearing Aid Use + LACE Computer training
• Hearing Aid Use + Directed Listening (Placebo)

Directed Listening to Books on computer for equivalent training period
Baseline testing

Random assignment to intervention

Control (standard care)

AT20 LACE-C
20 days, 30 min/day

Directed listening
20 days, 30 min/day

4-6 weeks

Post-intervention testing

6-month follow-up
In addition.....

- **LACE** available in **two different modes of administration**
  - LACE-Computer
  - LACE-DVD
- Differ in recommended duration of training
  - LACE-Computer (20 sessions of training over 4 weeks)
  - LACE-DVD (10 sessions of training over 2 weeks)
    - Olsen et al. (2013) - Positive outcomes with LACE-DVD
- Compare **LACE-Computer (AT20)** to **LACE-DVD (AT10)**
Groups equivalent on demographics, audiometrics, and on all outcome measures.
Outcome Measures Selected to Assess LACE™ Trained Skills

<table>
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<tr>
<th>LACE TASK</th>
<th>Outcome measure</th>
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<td><strong>Speech-in-babble</strong></td>
<td><strong>WIN:</strong> Identify NU-6 words presented in multi-talker babble at 7 SNRs (+24 to 0 dB), compute 50% correct SNR</td>
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<td><strong>Time-compressed speech</strong></td>
<td>NU-6 words 45% and 65% compressed. Presented in quiet. Compute % correct.</td>
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<td><strong>Competing speaker</strong></td>
<td><strong>NU20:</strong> Female voice, NU20 words in carrier phase, sentence masker spoken by single male. Presented at 9 SNRs (+24 to -8 dB). Compute 50% correct SNR</td>
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<td><strong>Auditory working memory</strong></td>
<td><strong>Digit span:</strong> Forwards and backwards.</td>
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<tr>
<td><strong>Missing word identification</strong></td>
<td><strong>R-SPIN-A</strong> sentences presented in multi-talker babble at 10 SNRs (+23 dB to -4 dB). Compute 50% correct SNR</td>
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</table>
| **Subjective ratings**           | **HHIE/A:** Social and Emotional scales  
**APHAB:** Ease of Communication, Reverberation, Background Noise, Aversiveness.                               |
Compliance With Training

• Sweetow & Henderson Sabes (2010)
  – Compliance with LACE training by clinical patients was less than 30%
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<tr>
<th>Intervention</th>
<th>Assessed By</th>
<th>Estimate</th>
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<td>Control</td>
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<tr>
<td>AT10</td>
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<td>AT20</td>
<td>DTL+ Computer Logs</td>
<td>0-100% completed all 20 sessions</td>
</tr>
<tr>
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~ 70% of Ss completed training in each arm
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<th>Outcome Measure</th>
<th>Description</th>
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</thead>
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<td><strong>Speech-in-babble</strong></td>
<td>WIN: Identify 6 words presented in multi-talker babble at 7 SNRs (+24 to 0 dB), compute 50% correct SNR</td>
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<td><strong>Time-compressed speech</strong></td>
<td>NU-6 words 45% and 65% compressed. Presented in quiet. Compute % correct.</td>
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Compressed Speech 65% CR
Compressed Speech 65% CR

![Graph showing percent correct over time for different groups: Baseline, Immediate, 6-Month. The graph compares AT20, AT10, PT, and CONTROL groups.](image-url)
Implication?

LACE Training might provide processing speed benefits under difficult listening conditions
Long-Term Outcomes

Benefits

Not clear that LACE training improves outcomes more than Directed Listening
Comparison to Published Data

• Findings not as robust as previously reported by (Sweetow & Sabes, 2006; Sweetow & Sabes, 2007)
  – Difference in design
    • Delayed Treatment Crossover
    • Between-Groups Design
  – Differences in outcome measures (e.g., QuickSIN vs. WIN)
    • Equivalence of performance established (Wilson, McArdle & Smith, 2007)
    • But some outcome measures the same (e.g., HHIE)
Differences in Participant Groups: Non-Veterans vs. Veterans
Differences in Participant Groups:

<table>
<thead>
<tr>
<th>Factor</th>
<th>Sweetow &amp; Sabes</th>
<th>Present Study</th>
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<tr>
<td>Hearing Aid Experience</td>
<td>85% Bilateral HA users (experienced) + 9 Non Hearing Aid Users</td>
<td>Both New &amp; Experienced Hearing Aid Users – All fit bilaterally</td>
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<td>Hearing Aids</td>
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<tr>
<td>Age</td>
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<tr>
<td>Hearing Loss (PTA)</td>
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Need to Examine Individual Differences in Response to Intervention

Can Predictors be Identified?
Exploratory Forward Stepwise Linear Regression Analyses

• Baseline demographic characteristics
  – Age
  – 3-Frequency PTA (Better Ear)
  – High Frequency PTA (Better Ear)
  – Word recognition in quiet (NU-6; Binaural)
  – Word recognition in noise (Unaided)
  – Education
  – Motivation to improve hearing
Exploratory Forward Stepwise Linear Regression Analyses

- Basic Hearing Aid Characteristics
  - Hearing Aid Experience
  - Length of time of current hearing aid use
  - Aided Audibility Index (Better Ear)
- Baseline performance for the outcome measure
- Treatment Arm
  - Control
  - AT10
  - AT20
  - Placebo
Results

• After trimming for outliers, and transforming categorical variables to similar “groupings”

• Significant models for all Outcomes
  – Not surprising given our $n$

• Account for $\sim 15\text{-}40\%$ of the variance

• For all Outcomes, “Baseline Performance” strongest predictor
  – Similar to Sabes & Sweetow (2007) poorer performers at Baseline showed greatest gains
Results

• For all Outcomes, some aspect of “hearing” (i.e., PTA, HF-PTA, word recognition quiet, word recognition noise) was a significant predictor
  – As hearing loss increased, outcomes improved

• Depending on Outcome, other demographic and/or hearing aid related variables were significant predictors

• **Treatment Arm** significant in 3 models
Compressed Speech 65%  

**AT10, AT20 > improvements than Control/Placebo**

**Diagram Details:**
- **V2CS65...**
- **TxArm...**
- **Ageinyrs...**
- **ComordityIndex...**
- **NU6Quiet#core...**
- **BetterEarHF...**

**Coefficient Estimate**
- Positive
- Negative

**Cs_65_Benefit**
LP – HP Difference (Context Use)

AT10, AT20 > improvements than Control/Placebo
Digit Span Forward (Short Term Memory)

AT, of any type, greater benefit than Control
Summary of 1st Study

- RCT results
  - Little benefit from LACE training

- RCTs have limitations
  - Do not take into account individual differences

- Initial exploratory analyses
  - LACE training may provide benefits to some individuals for:
    - Compressed Speech
    - Context Use
    - Short-term memory tasks
Implication for Connected AR:
One size doesn’t fit all
Who will benefit from which training?
Study #2: Evaluation of Approaches to Auditory Rehabilitation for mTBI

Study funded by VA RR&D grant #: C7054R
(G. Saunders, PI)

and Phonak who provided study equipment
NCRAR, Portland OR
Gaby Saunders, Melissa Frederich, ShienPei Silverman

James A. Haley VA, Tampa, FL, U. South Florida: Terry Chisolm, Paula Myers, Michelle Arnold,
Why are we interested in this?

Data show that:

- About 300,000 Operation Enduring Freedom (OEF)/Operation Iraqi Freedom (OIF) Veterans have some form of traumatic brain injury (TBI)

- About 75% of wounds are due to exposure to a blast(s)

66% of Veterans with deployment-related TBI and blast complained of auditory difficulties. Of these:

- 35-54% have SNHL
- 7% conductive (ruptured TM)
- 20% have ‘normal or almost normal’ thresholds

Saunders & Echt (2012), JRRD, 49(7): 1043-1058 2012
Subjective impacts

- Hearing in background noise
- Following rapid speech
- Following instructions
- Following long conversations
- Tinnitus
- Hyperacusis

i.e. indicative of auditory processing problems
Reported difficulties:

- Hearing in background noise
- Following rapid speech
- Following instructions and long conversations
- Signal-to-noise ratio (SNR)
- Temporal processing
- Working memory
Interventions

**FM system**
- Will be effective at improving SNR, if used correctly
- A prop rather than a ‘fix’; requires an external device

**Auditory Training**
- Potential for sustainable change (a fix) for processing difficulties.
- Requires discipline and time commitment before any benefit may be realized.
Interventions

- Phonak Zoomlink transmitter and binaural iSense receivers

- Brain Fitness Program - computer-based training program developed by Merzenich et al., distributed by Posit Science.
  
  **Designed to train:**
  
  Temporal processing
  
  Auditory working memory

  **40 sessions, 60 min/day**
The Brain Fitness Program: Training Tasks

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

- OEF/OIF Veterans
- Normal or near normal peripheral hearing sensitivity
- Reported blast exposure during deployment
- Self-reported functional hearing difficulties
2-site RCT

Consenting, Screening Baseline Testing

Random assignment to intervention

- Counseling (Control)
- Counseling + Auditory Training
- Counseling + FM System
- Counseling + Auditory Training + FM System

8-12 weeks

Post-intervention testing
## Outcome Measures: Performance

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Results

Data collected from 86 participants.

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<tbody>
<tr>
<td>n</td>
<td>22</td>
<td>15</td>
<td>24</td>
<td>25</td>
</tr>
<tr>
<td>Age</td>
<td>33.1</td>
<td>34.8</td>
<td>33.9</td>
<td>33.7</td>
</tr>
<tr>
<td>4F-PTA</td>
<td>13.4</td>
<td>11.0</td>
<td>12.1</td>
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Gender:
- Male: 22
- Female: 0
- Male: 12
- Female: 3
- Male: 19
- Female: 5
- Male: 22
- Female: 3
Results

Did the participants use the interventions?
Compliance with intervention
Auditory Training

Percentage of Auditory Training Completed

- <25% (60 sessions)
- 25-49% (10-19 sessions)
- 50-74% (20-29 sessions)
- 75-100% (30-40 sessions)

n = 37
Compliance
FM System

• 1 individual did not use FM at all
• 13 wore it hardly ever
• 25 wore it a few times a week
• 7 used it every day

Average use per day = 2.9 hr, range: 0-9
## Analyses of the Preliminary Data

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Speech-in-Noise - HINT

![Bar chart showing benefit in dB SNR for different conditions: FM+AT, FM, AT, and Control. FM+AT shows the highest benefit, followed by FM, AT, and Control, which shows the least benefit.]
Summary of Study #2

Interventions are showing some small but positive outcomes for

- temporal processing
- speech-in-noise
- Reported auditory difficulties
- Reported cognitive processing

• Combination of AT and FM appears to be most effective

• There are individual differences in compliance and in outcome
Implications of Our 2 Studies for Connected AR

• Well-controlled RCTs
  – Add to the evidence-base for auditory training in adults

• Data are not overwhelming
  – But doesn’t hurt and might help

• Are we measuring the right outcomes?

• Should other aspects of AR be included?
Poster Session

Naylor, Thoren, Andersson & Lunner

“A Randomized Controlled Trial of Professional Online Rehabilitation for Adult Hearing Aid Users”
The Digital Era: Computer-Based AR

1980s – 1990s
• Computer-control of audio-video playback equipment

Late 1990s - Current
• Home-based systems using -
  • Desktops
  • Laptops
  • Tablets

Future
The Digital Era: Computer-Based AR

1980s – 1990s
- Computer-control of audio-video playback equipment

Late 1990s-Current
- Home-based systems using -
  - Desktops
  - Laptops
  - Tablets

Future

• ?
Social Networking

Warning: this is disruptive technology
Major Social Media Sites and Uses

• **Facebook**: “I ate.” (social networking)
• **Youtube**: “Look at this eating!” (video)
• **Twitter**: “I need to eat.” (microblog)
• **Linkedin**: “I am good at eating.” (business networking)
• **Foursquare**: “This is where I ate.” (location)
• Fluid and constantly changing based on new technology, websites, etc. All have mobile apps.

Glossary of Social Media Terms:
Hitchhikers Guide to … Social Media?

• everything that’s already in the world when you’re born is just normal;
• anything that gets invented between then and before you turn thirty is incredibly exciting and creative and with any luck you can make a career out of it;
• anything that gets invented after you’re thirty is against the natural order of things and the beginning of the end of civilisation as we know it
• until it’s been around for about ten years when it gradually turns out to be alright really.

Cloud Computing
Cloud Computing for Enhanced Mobile Health Applications

M.T. Nkosi, F. Mekuria SM IEEE
CSIR Modelling and Digital Sciences
Mobile Computing & Security Unit
Meiring Naude Road, Pretoria 0001, South Africa
mnkosi@csir.co.za, fmekuria@csir.co.za

Figure 1: Cloud-Based Mobile Health Security Management

Figure 2: Sensor based Mobile Health Service
• Poster Session
Block & Abrams
• An Evaluation of the Efficacy of a Remotely-Delivered Auditory Training Program
Pattern of Technological Development

• Next leap forward results from
  – Implementation of new ideas in Rehabilitative Audiology
  – New technological advances
  – Synergy of new ideas in both technology and audiology

Levitt et al., 2012
The Ida Institute
“Exploring the Human Dynamics of Hearing”

http://idainstitute.com/
About the Ida Institute

• Funded by the Oticon Foundation
• Established as an independent non-profit organization 2007
• Foster a better understanding of the human dynamics associated with hearing loss
Collaborative Development
Key Value and Method

• Uncovering unmet needs of hearing healthcare professionals for working with their patients
• Creating tools/methods/techniques to meet the unmet needs
• Promotes patient-centered care
Ida World

Seminars

Tools

Workshops

E-learning

Global Community

Academic Panels

Department of Communication Sciences & Disorders
College of Behavioral & Community Sciences
Ida Tools

Patient Motivation

- The Line
- The Box
- The Circle

Engaging Family and Friends

- Communication Rings
- Goal Sharing for Partners (GPS)
- Communication Partner Journey

Self-Development in the Clinical Setting

- Mirror Exercises
- The Reflective Journal
- Dilemma Game
- A Possible Partner Journey
- Living Well with Hearing Loss

Living Well

Pediatric Audiology

- My World
Integration of
Make the “leap” that will lead us further to our goal of assuring **Optimal Outcomes** for all of our Patients with Hearing Loss
Thank you for listening...

chisolm@usf.edu