The Effect of LACE – DVD Training for New and Experienced HA Users

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Disclaimer

Results presented here were required for partial fulfillment of doctoral degree for the primary researcher.

Training program (LACE™ – DVD version) was donated for use in this study by Neurotone.

No financial compensation was provided to researcher or the University of Kentucky
Problem: For adult hearing aid (HA) users, RE-Learning to understand speech (especially in noise) is a difficult task.

Even after extended use, many HA users perceive minimal benefit from them.

Current Protocol:

HA + instruction

No specific training

(Kochkin, 2005)
What else can be done?
(Boothroyd, 2007)

Aural Rehabilitation

Sensory Devices
Counseling
Instruction
Perceptual Training

Auditory Training (AT)
Purpose

Questions & Hypotheses
Purpose

- To examine the behavioral effects of an auditory training program in new and experienced HA users.
- To evaluate the behavioral effects of an auditory training program over time (2 weeks vs 4 weeks)

- **Independent Variable:**
  - The Listening and Communication Enhancement (LACE™) DVD (Sweetow and Sabes, 2006)
Number of Lessons: 10

Content

- Listening Activities:
  - Speech in noise (babble)
  - Competing sentences
  - Rapid speech

- Communication Strategies

Duration of training: 30 minutes

Cost:
Question 1

Is there a difference in comprehension of speech in noise after 2 weeks of training?

Hypothesis 1

Ha: there will be a significant difference in understanding speech in noise after 2 weeks of training compared to baseline for both new and experienced users and between new and experienced users.
Question 2

Is there a difference in comprehension of...

...a) speech in noise
... b) rapid speech
... c) competing speech

after 4 weeks of training
Hypothesis 2

Ha: There will be a statistical difference in comprehension of …

...a) *speech in noise*

...b) *rapid speech*

...c) *competing speech*

*after 4 weeks of training* compared to baseline between groups.
Question 3

Is there a difference in perception of functional hearing ability in daily life after training after 4 weeks of training?

Hypothesis 3

Ha: there will be a significant difference between the perception of functional hearing ability after 4 weeks of training for New and Experienced users who complete training compared to Control.
Question 4

Is there a difference in perception of...

....quality of life after 4 weeks of training?

Hypothesis 4

Ha: there will be a sig diff between the perception of quality of life after 4 weeks of training for New and Experienced users.
Method

Recruitment, Procedures, Measures, Participants
Recruitment

**Target population**
- 50-80 y/o
- mild to severe sensorineural HL

**Inclusion Criteria**
- Bilateral HA users
  - NEW: > 1 month, < 6 months of HA use
  - EXP: > 2 years
- Native speakers of American English
- Adequate vision or vision corrected acuity

**Exclusion Criteria**
- Hx neurological or psychiatric disorder
- Conductive HL

Enrolled: 33
Dropouts: 4
Study Design – Repeated Measures Group Design

- **3 groups of HA users** (Between variable)
  - New HA + Training
  - Exp. HA + Training
  - New HA - Control

- **3 Times of Measurement** (within variable)
  - Baseline
  - 2 week after training
  - 4 week after training

*Exception:*
Control Group
Only @ Baseline and 4 weeks
A Priori Power Analysis

Main Metric = dB SNR

CD be/tw scores = 1.6 dB @ 95% CI (SD = 1.4)

Trying to detect a 1.6 dB SNR change, then for a *p value* < .05 with 80% power --

n= 12 in each group

(Killion, Niquette, Gudmundsen, Revit, & Banerjee, 2004)
General Procedures

Recruitment: email, phone, referral sources (16)

Email/Mail info about study

“Baseline”
Consent
Assessments
HA Verification
Training on DVD operation and set up

Reliability
Interscorcer = .95
Procedural = .99

“2 weeks”
Assessments
HA Verification

“4 weeks”
Assessments
HA Verification
Program given to control group

Contact

Contact
<table>
<thead>
<tr>
<th>Participants</th>
<th>New + Training (n=8)</th>
<th>Exp + Training (n=14)</th>
<th>New – Control (n=7)</th>
</tr>
</thead>
<tbody>
<tr>
<td>M/F</td>
<td>3/5</td>
<td>6/8</td>
<td>6/1</td>
</tr>
<tr>
<td>Age</td>
<td>61 (52-77)</td>
<td>68 (58-79)</td>
<td>64 (54-81)</td>
</tr>
<tr>
<td>Degree of HL *</td>
<td>37 dB HL</td>
<td>49 dB HL</td>
<td>38 dB HL</td>
</tr>
<tr>
<td>(p= .03)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Duration of HL (yrs)</td>
<td>10.3</td>
<td>16.4</td>
<td>11.4</td>
</tr>
<tr>
<td>Education (12=HS,16= BS)</td>
<td>18.1</td>
<td>17.8</td>
<td>15.3</td>
</tr>
</tbody>
</table>
Red = New + Training
Blue = New – Control
Green = Exp + Training
Speech Mapping
(3 freq (500, 1k, 2k) avg deviation dBHL)

ANOVA: NS Differences between groups

<table>
<thead>
<tr>
<th></th>
<th>RE (Baseline)</th>
<th>LE (Baseline)</th>
</tr>
</thead>
<tbody>
<tr>
<td>New + Training</td>
<td>8.10</td>
<td>8.56</td>
</tr>
<tr>
<td>Exp + Training</td>
<td>6.90</td>
<td>8.10</td>
</tr>
<tr>
<td>New - Control</td>
<td>7.97</td>
<td>8.52</td>
</tr>
</tbody>
</table>
Dependent Variables

Quick Speech in Noise (QuickSIN)
- Sentence recognition task in noise
- Scoring in # of decibels that speech is above background noise for listeners to obtain 50% of words in sentences

(Killion et al., 2004)
Dependent Variables

- **Rapid Speech Task**
  - Compressed Speech Test
  - 1 female speaker
  - “Say the word _______”

(Department of Veterans Affairs, 1998)

- **Competing Speaker Task**
  - Synthetic Sentence Identification (SSI)
  - 2 male speakers
    - Davy Crockett Story
    - Nonsense sentences

(Speaks & Jerger, 1965)
Dependent Variables

- **Perceived Communication Function**
  - *Speech, Spatial and Qualities (SSQ) of Hearing Scale*
    - 50 item S/A about functional hearing ability
  
- **Perceived Benefit from Training**
  - *International Outcome Inventory – (IOI-AI)*
    - 7 item S/A about use, benefit, satisfaction activity limitations, participation restrictions, QoL

  (Gatehouse and Noble, 2004)  
  (Noble 2002)
Descriptor Variables

**Working Memory**

Automated Reading Span Test (RSPAN)

- Letters
- Sentences

Purpose: to recall letters presented in order after reading sentences

(Conway, Kane, Bunting, Hambrick, Wilhelm & Engle, 2005)

**Hearing Aid Verification**

Verifit

Purpose: To verify HA function at each assessment
<table>
<thead>
<tr>
<th>Participants (at baseline)</th>
<th>New + Training (n=8)</th>
<th>Exp + Training (n=14)</th>
<th>New – Control (n=7)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speech in Noise (QSIN)</td>
<td>5.78</td>
<td>6.52</td>
<td>6.67</td>
</tr>
<tr>
<td>Working Memory (RSPAN)</td>
<td>44.0</td>
<td>41</td>
<td>43.2</td>
</tr>
<tr>
<td>RE (Verifit) dB HL deviation</td>
<td>8.1</td>
<td>6.9</td>
<td>6.97</td>
</tr>
<tr>
<td>LE (Verifit) dB HL deviation</td>
<td>8.56</td>
<td>8.1</td>
<td>8.52</td>
</tr>
</tbody>
</table>
Results
Q 1: Mean Speech in Noise (dB SNR) (base – 2wk)

<table>
<thead>
<tr>
<th></th>
<th>Baseline</th>
<th>2 wk</th>
<th>Change Score</th>
<th>Effect Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>New + Training</td>
<td>5.78</td>
<td>3.3</td>
<td>-2.48</td>
<td>0.8</td>
</tr>
<tr>
<td>Exp + Training</td>
<td>6.53</td>
<td>5.59</td>
<td>-0.93</td>
<td>0.27</td>
</tr>
</tbody>
</table>
Q 1: Speech in Noise (b – 2wks)

ANOVA: * Sig Main effect for time ($p < .000$)
NS time X cohort ($p = .08$)

Error Bars = 95% CI

New + Training $d = .8$

Exp + Training $d = .27$

New - Control
Q 2a: Mean Speech in Noise (dB SNR) (base – 4 wks)

<table>
<thead>
<tr>
<th>Group</th>
<th>Baseline</th>
<th>4 wk</th>
<th>Change Score</th>
<th>Effect Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>New + Training</td>
<td>5.78</td>
<td>2.8</td>
<td>-2.98</td>
<td>0.99</td>
</tr>
<tr>
<td>Exp + Training</td>
<td>6.53</td>
<td>4.90</td>
<td>-1.62</td>
<td>0.52</td>
</tr>
<tr>
<td>New - Control</td>
<td>6.67</td>
<td>5.70</td>
<td>-0.97</td>
<td>0.27</td>
</tr>
</tbody>
</table>
Q 2a: Speech in Noise (b to 4 wks)

ANOVA: * Sig Main effect for time ($p < .000$)  
NS time X cohort  ($p = .066$)

Error Bars = 95% CI

- **Baseline**
- **4 wk**

**dB SNR**

- New + Training: $d = .99$
- Exp + Training: $d = .52$
- New - Control: $d = .27$

(d= Effect Size)
Q 2a: Speech in Noise

base v 2 v 4 weeks

ANOVA:
* Main effect for time ($p < .000$)
NS time X cohort ($p = .066$)

dB SNR over time

Error Bars = 95% CI

- Blue: Baseline
- Purple: 2 wk
- Gray: 4 wk

New + Training
Exp + Training
New - Control
Training 2 wks vs. 4 wks

ANOVA: *Sig Main Effect of time ($p < .000$)

Error bars = 95% CI

Within Group Effect Sizes for Quick SIN

- Better Performance→ New + Training @ 2 wks
- New + Training @ 4 wks
- Exp + Training @ 2 wks
- Exp + Training @ 4 wks
- New - Control @ 4 wks

Effect Size (Cohen's d)

→Worse Performance  Better Performance→
## Q 2b: Rapid Speech (% correct words)

<table>
<thead>
<tr>
<th>Group</th>
<th>Baseline</th>
<th>2 wk</th>
<th>4 wk</th>
<th>Change Score (b-2wk)</th>
<th>Change Score (b- 4 wk)</th>
</tr>
</thead>
<tbody>
<tr>
<td>New + Training</td>
<td>59</td>
<td>62</td>
<td>67</td>
<td>3.00</td>
<td>8.00</td>
</tr>
<tr>
<td>Exp + Training</td>
<td>60.57</td>
<td>63.29</td>
<td>66.00</td>
<td>2.72</td>
<td>5.43</td>
</tr>
<tr>
<td>New - Control</td>
<td>58.43</td>
<td>65.14</td>
<td></td>
<td>6.71</td>
<td></td>
</tr>
</tbody>
</table>
Q2b: Rapid Speech (% correct words)

ANOVA: * Sig Main effect for time \((p=0.006)\)
NS time X cohort \((p=0.771)\)

Compressed Speech over time

Error Bars = 95% CI

- **Baseline**
- **2 wk**
- **4 wk**

\[ d = \text{Effect Size} \]

New + Training \(d=0.39\)
Exp + Training \(d=0.24\)
New - Control \(d=0.21\)
<table>
<thead>
<tr>
<th></th>
<th>Baseline</th>
<th>2 wk</th>
<th>4 wk</th>
<th>Change Score (b-2wk)</th>
<th>Change Score (b-4wk)</th>
</tr>
</thead>
<tbody>
<tr>
<td>New + Training</td>
<td>57.25</td>
<td>68.13</td>
<td>73.14</td>
<td>10.88</td>
<td>15.89</td>
</tr>
<tr>
<td>Exp + Training</td>
<td>56.14</td>
<td>66.00</td>
<td>66.20</td>
<td>9.86</td>
<td>10.06</td>
</tr>
<tr>
<td>New - Control</td>
<td>57.00</td>
<td>53.29</td>
<td></td>
<td></td>
<td>-3.71</td>
</tr>
</tbody>
</table>
Q 2c: Competing Speech (SSI)

ANOVA: * Sig Main effect of time \((p < .000)\)
NS cohort X time \((p = .066)\)

\[ d = .77 \quad d = .55 \quad d = -.17 \]

\( d = \text{Effect Size} \)
Q 3 Perception: Hearing Speech (SSQ)

ANOVA: * Sig Main effect of time ($p = .001$)
NS cohort X time ($p = .202$)

Error Bars = 95% CI

- New + Training: $d = 1.0$
- Exp + Training: $d = .36$
- New - Control: $d = .25$
Q3 Perception: Quality of Hearing (SSQ)

ANOVA: * Sig Main effect of time ($p = .006$)
NS cohort X time ($p = .491$)

Error Bars = 95% CI

**Relative Value**

- **New + Training**: $d = .63$
- **Exp + Training**: $d = .24$
- **New - Control**: $d = .28$
Q 4. Mean IOI-AI Scores for New and Exp Groups w/ Training

* Independent t tests ($p = .02$)

Error Bars = 95% CI

Relative Score

- Use
- Benefit
- Res Activ
- Satis
- Res Part
- Impact
- QoL

New + Training
Exp + Training
Discussion
Limitations

- Compliance with home training paradigm
  - Some technical problems
- Experimenter bias
- Did not evaluate control group at 2 wk time point
- Sig difference between degree of HL and groups
Clinical Implications

- Encouraging new HA users to do training soon after fitting with HA.
- May need to recommend longer training periods for experienced HA users.
- May be some limitations in terms of benefit from training based on degree of hearing loss.
Future Research Directions

- Who actually benefits?
  - Differential effects observed from persons with greater hearing loss

- When to start training?
  - Differential effects between new users and experienced users

- Training in other populations
Tipping Point (Gladwell)

- The Law of the Few
- The Stickiness Factor
- Power of Context
Acknowledgements

- Participants
- Neurotone Inc.
- Dissertation Committee
- Department of Rehabilitation Sciences and College of Health Sciences at the University of Kentucky
Comments / Concerns / Questions
References


Department of Veterans Affairs. 1998. Tonal and speech materials for auditory perceptual assessment (2.0). Mountain Home, TN VA Medical Center


References


References


References

References


Modulators of Benefit

- Degree of HL
- Cognition
- Compliance
- Benefit from Training
- Length of HA use
- Duration of HL
- Age
## Working Memory: RSPAN

<table>
<thead>
<tr>
<th>RSPAN score</th>
<th>New + Training (n=6)</th>
<th>Exp + Training (n=13)</th>
<th>New – Control (n=6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>M</td>
<td>44.0</td>
<td>41</td>
<td>43.2</td>
</tr>
<tr>
<td>SD</td>
<td>16.03</td>
<td>19.25</td>
<td>16.16</td>
</tr>
<tr>
<td>% correct</td>
<td>58%</td>
<td>55%</td>
<td>58%</td>
</tr>
</tbody>
</table>
Q 5 Results from Regression Analysis

Predictors of Benefit

\[ y = -1.239x + 89.41 \]

\[ R^2 = 0.323 \]
Speech Mapping
(3 freq deviation dBHL)

ANOVA: NS Differences between groups

<table>
<thead>
<tr>
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<th>RE (4 week)</th>
<th>LE (Baseline)</th>
<th>LE (4 week)</th>
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</thead>
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<tr>
<td>New + Training</td>
<td>8.10</td>
<td>8.00</td>
<td>8.56</td>
<td>7.01</td>
</tr>
<tr>
<td>Exp + Training</td>
<td>6.90</td>
<td>6.46</td>
<td>8.10</td>
<td>7.82</td>
</tr>
<tr>
<td>New - Control</td>
<td>7.97</td>
<td>9.10</td>
<td>8.52</td>
<td>6.26</td>
</tr>
</tbody>
</table>
Hearing Aid Verification
Within Group Effect Sizes for Quick SIN

Effect Size (Cohen's d)

Better Performance →

New + Training @ 2 wks
New + Training @ 4 wks
Exp + Training @ 2 wks
Exp + Training @ 4 wks
New - Control @ 4 wks

←Worse Performance

Effect Size (Cohen's d)