Clinical Application of Acceptable Noise Level

Melinda Freyaldenhoven Bryan, Ph.D., CCC-A
melinda@latech.edu
A Little about Me

Graduated from the University of Tennessee in 2006


Moved to Louisiana Tech University in Sept 2006.

Associate Professor/Program Director, AuD
What is ANL?

Acceptable Noise Level

A procedure to quantify the amount of background noise a listener is willing to accept while listening to speech.


Why Needed?
Measuring & Calculating ANL

What you need...

- Sound-treated room
- Loudspeaker (one)
- Stimuli...
- Instructions...
Procedure takes about 2-3 minutes
Stimuli

- Primary discourse – Arizona Travelogue
- Noise – 12-talker babble
The ANL Procedure

- Most Comfortable Level (MCL)
- Background Noise Level (BNL)

When the button are hit, tester adjusts the level of the story/noise.
Instructions for MCL

You will listen to a story through a loudspeaker. After a few moments, select the loudness of the story that is most comfortable for you, as if listening to a radio/watching TV.

1. First, turn the loudness up until it is too loud…
2. Then turn the loudness down until it is too soft…
3. Finally, select the loudness level that is most comfortable for you.
You will listen to the same story with background noise of several people talking at the same time. After you have listened to this for a few moments select the level of background noise that is the MOST you would be willing to accept or “put-up-with” without becoming tense and tired while following the story.

1. First, turn the noise up until you cannot follow/hear the story…
2. Then, turn the noise down until the story becomes very clear...
3. Finally, adjust the noise (up and down) to the MAXIMUM noise level that you would be willing to “put-up-with” for a long time while following the story.

1. Adjust the noise to the MOST you would be willing to put up with and still follow the story for a long period of time.
2. Do NOT add the words comfortable, tolerant(tolerance), understand…
Calculation of ANL

ANL is calculated by subtracting BNL from MCL.

\[ \text{ANL} = \text{MCL} - \text{BNL} \]

<table>
<thead>
<tr>
<th>Listener 1</th>
<th>Listener 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>MCL 60</td>
<td>MCL 60</td>
</tr>
<tr>
<td>BNL -50</td>
<td>BNL -58</td>
</tr>
<tr>
<td>ANL 10</td>
<td>ANL 2</td>
</tr>
</tbody>
</table>
Comparison of ANLs

Low ANL
- greater acceptance of background noise
- < 6 dB

Mid ANL
- Nabelek et al. (2006)
- 10 dB

High ANL
- less acceptance of background noise
- > 14 dB
ANL Characteristics

ANL is not related to...

- Age (Nabelek et al, 1991; Crowley & Nabelek, 2006; Freyaldenhoven & Smiley, 2006)
- Hearing Sensitivity (Nabelek et al, 1991)
- Gender (Rogers et al, 2004)
- Preference for Background Sounds (Freyaldenhoven, Smiley et al, 2006)
- Speech in Noise Performance (Nabelek et al., 2004)

ANL is...

- Reliable (Freyaldenhoven, Smiley et al, 2006; Nabelek et al, 2004)
- Consistent over a 3-month period (Freyaldenhoven, Smiley et al, 2006; Nabelek et al, 2006)
ANL Characteristics Cont.

ANL...

- Does not change w/ use of hearing aids
  (Nabelek et al, 2006)

- ANL is related to pattern of hearing-aid use
  (Nabelek et al, 2006)
Pattern of Hearing-Aid Use Questionnaire

How do you use your hearing aids? (Circle 1, 2, or 3)

1. I wear my hearing aids whenever I need them.  
   Approximately how many hours per day ______________

2. I only wear my hearing aids occasionally (when I need them).  
   Approximately how many hours per day ______________
   Briefly describe the situations ______________

3. I do NOT use my hearing aids.  
   Why do you NOT wear them ______________
ANL & Hearing-Aid Use

Nabelek et al., 2006
ANL can predict success with hearing aids with 85% accuracy (Nabelek et al., 2006)
Likelihood to Succeed & ANL

Edwards, EUHA 2010
## Accuracy of the Prediction

<table>
<thead>
<tr>
<th>User-type</th>
<th>Predicted by Model</th>
<th>Observed</th>
<th>% Correct</th>
</tr>
</thead>
<tbody>
<tr>
<td>Successful</td>
<td>60</td>
<td>69</td>
<td>87.0</td>
</tr>
<tr>
<td>Unsuccessful</td>
<td>102</td>
<td>122</td>
<td>83.6</td>
</tr>
</tbody>
</table>

*Overall: 84.8*

(Nabelek et al, 2006)
Other HA Characteristics & ANL

- ANL did **not** change w/ use of monaural versus binaural amplification  
  (Freyaldenhoven, Plyler, et al, 2006)

- ANLs **improved** w/ the use of directional microphones.  
  (Freyaldenhoven, Nabelek et al, 2005)

- ANL improved w/ the use of asymmetric directional microphones compared to omnidirectional microphone fittings.  
  (Kim et al, 2009)

- ANLs **improved** w/ the use of noise reduction algorithms  
  (Mueller et al, 2006)
ANL & Noise Reduction

Goal: Understand the benefits of DNR on individual ANLs
- 36 participants with hearing loss
- miniBTEs
- DNR on and off
- Measured ANLs
ANL & Noise Reduction

Eddins & Colleagues - EUHA 2014
ANL & Noise Reduction

ANL - benefit from noise reduction

- High ANL
- Avg ANL
- Low ANL

Eddins & Colleagues - EUHA 2014
Other HA Characteristics & ANL

- **ANL did not change** when venting and/or low-frequency gain compensation were employed  
  (Freyaldenhoven, Plyler, et al., 2006)

- **ANL could be affected by increased high-frequency bandwidth/information**  
  (Plyler et al., 2007; Johnson et al., 2009)

- **ANL may change** with the use of WDRC vs. output limiting  
  (Boynton et al., 2011)
Large Scale (Multi-Language) ANL Project
ANL Improvement with Technology

Aided ANL Improvement (Experienced Users)

ANL Improvement (First-time Users After 4 weeks)
Other Characteristics & ANL

- Improved in normal hearing listeners w/ ADHD after medication was administered (Freyaldenhoven, Thelin, et al., 2005)

- Rehabilitation/Counseling
- Tinnitus Rehabilitation?
- Auditory Training?
Take Home Message...

Questions: Melinda@latech.edu
References


