Hearing Loss and Emotions

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Disclosures

- **Lori Rakita, Au.D.**

- Lori Rakita is a research audiologist at Phonak. Lori has managed a significant program of research including extensive technical assessments to participant testing to improve the application, evidence basis and clinical support of Phonak products. Lori received her Bachelor of Science in Psychology from the University of Wisconsin- Madison and Doctorate of Audiology from Washington University, St. Louis.

- *Financial-Phonak employee who receives a salary for employment*
- *Nonfinancial-No relevant nonfinancial relationships exists*

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Learner Objectives

- Participants will understand currently existing data on the topic of emotions and hearing loss
- Participants will be able to better counsel patients and their families on the impact of hearing loss and emotions
- Participants will learn research tests used to assess emotional constructs

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"Emotions"

Perceptions of the emotional World

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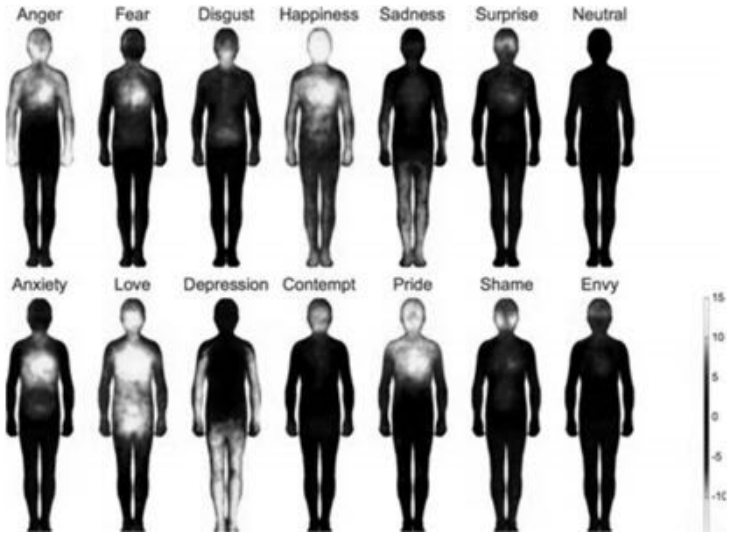
Who Cares?



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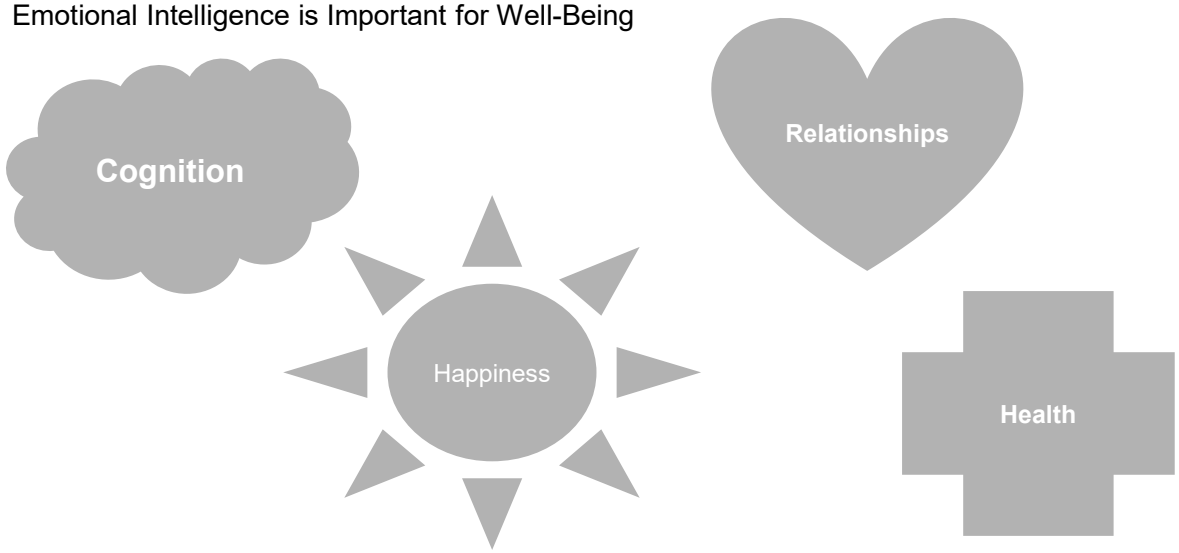
Emotional Intelligence is Important for Well-Being



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Hearing Loss

Isolation increases risk of depression and cardiovascular disease

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“Domains” of Emotional Intelligence

Recognition

Emotional “Range”

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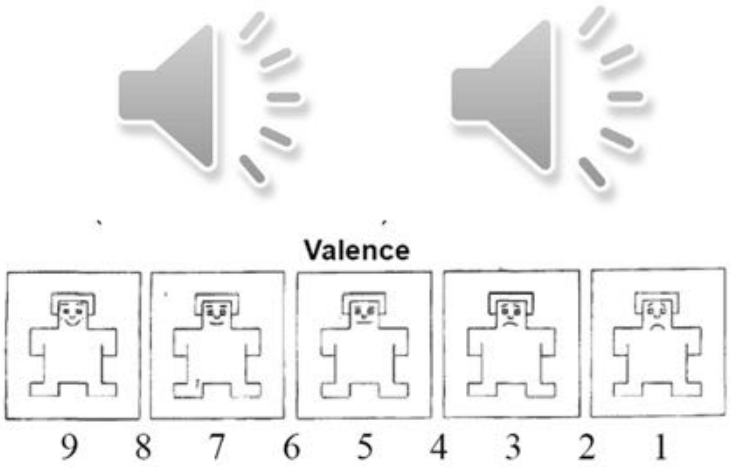
How Hearing Loss and Age Affect Emotional Responses to Nonspeech Sounds

Picou. Journal of Speech, Language, and Hearing Research, October 2016, Vol. 59, 1233-1246.
doi:10.1044/2016_JSLHR-H-15-0231

International Affective Digitized Sounds (IADS)



- Bradley, M. M., & Lang, P. J. (1999). International affective digitized sounds (IADS): Stimuli, instruction manual and affective ratings (Tech. Rep. No. B-2). Gainesville, FL: The Center for Research in Psychophysiology, University of Florida

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Research Purpose

Arousal

Valence

Dominance

What are the effects of acquired hearing loss and age on emotional ratings?

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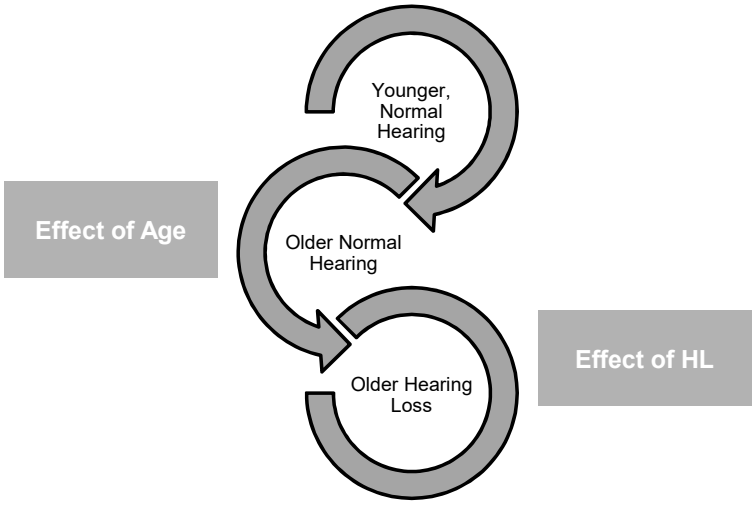
Methods



Outcome Measure:

IADS

Presented at a soft/loud level

Group A: 35 and 65 dB SPL

Group B: 50 and 80 dB SPL

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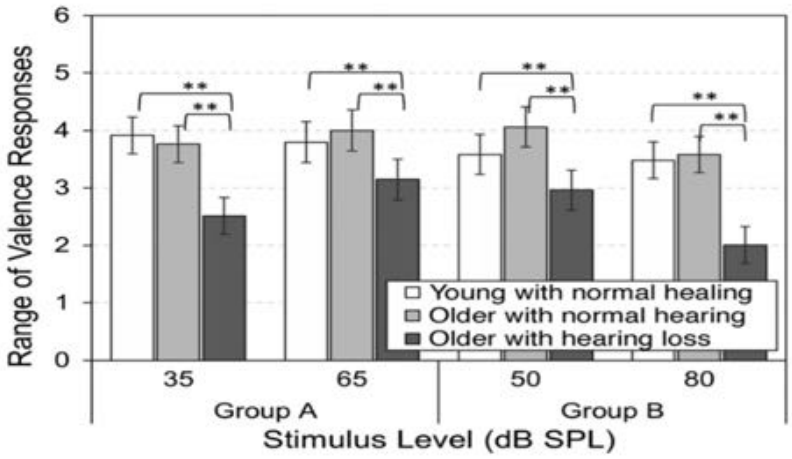
Results



Findings:

- Older listeners with hearing loss, lower ratings than peers with normal hearing
- Listeners with HL exhibited a reduced range of valence in responses

Picou. Journal of Speech, Language, and Hearing Research, October 2016, Vol. 59, 1233-1246.
doi:10.1044/2016_JSLHR-H-15-0231

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The relationship between emotional responses to sound and social function

Erin Picou, Gabrielle Buono 2017. Vanderbilt University Medical Center.

Research Questions

If listeners do not perceive pleasant sounds as pleasant, are they less likely to engage socially?

Is there a relationship between lab measures of emotional responses to sound and social connectedness?

International Affective Digitized Sounds (IADS)

Perceived Disconnectedness and Social Isolation Scales

Hospital Anxiety and Depression Scale

Results

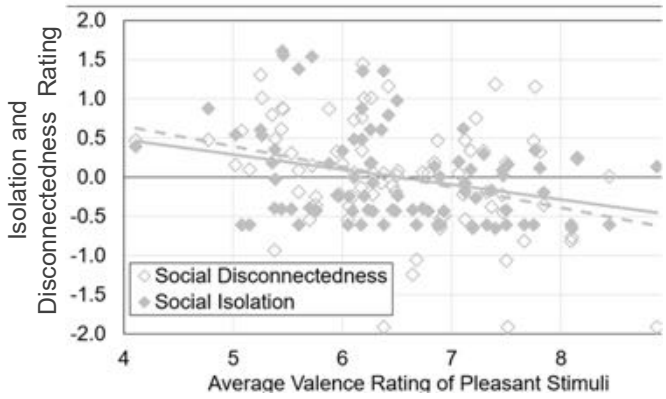

Figure 4. Significant relationships between disconnectedness or isolation and average rating of valence for pleasant stimuli ($p < 0.01$; $n = 83$).

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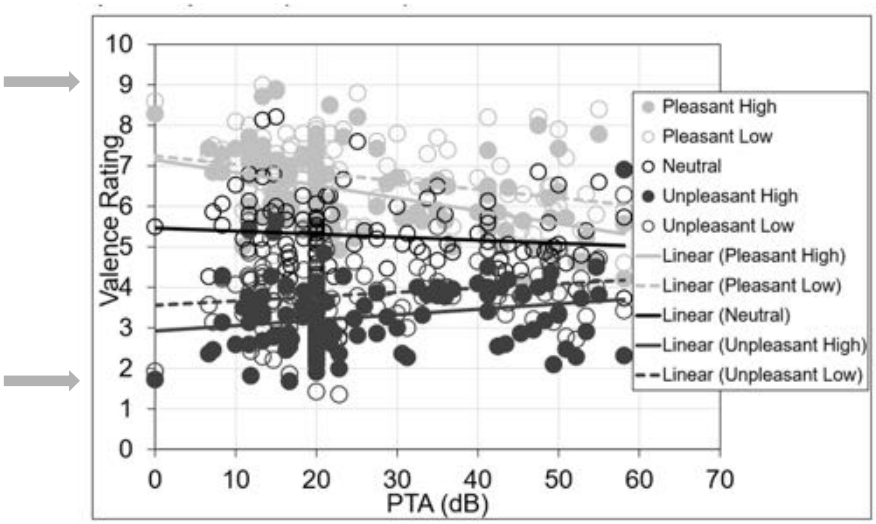
Erin Picou, Gabrielle Buono 2017. Vanderbilt University Medical Center.

Reduced "Valence" Range



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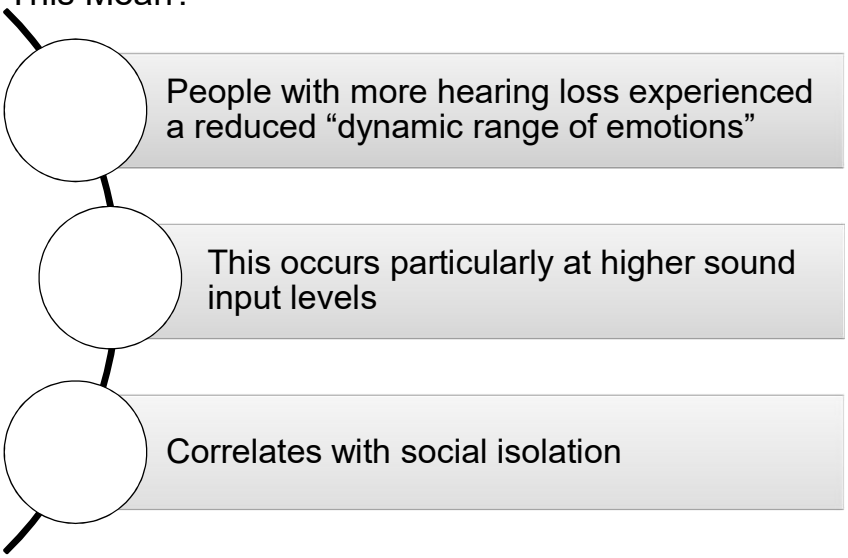
Erin Picou, Gabrielle Buono 2017. Vanderbilt University Medical Center.

What Does This Mean?



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Role of Hearing Aids?

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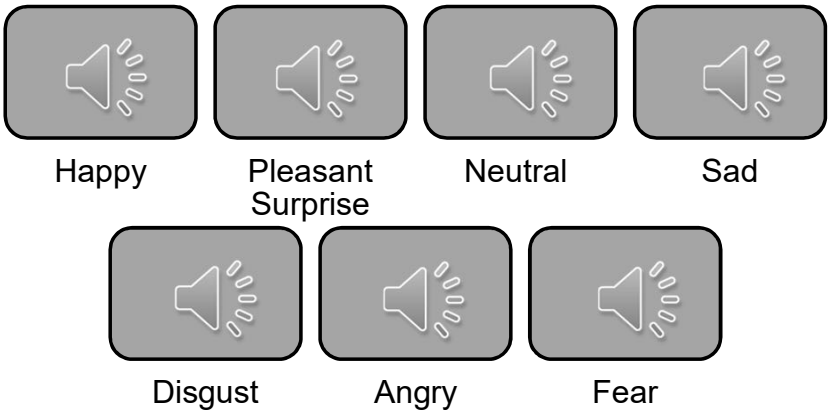
Perception of Emotional Speech by Listeners with Hearing Aids

Goy, G., Pichora-Fuller, M. K., Singh, G., Russo, F. (2016). Perception of Emotional Speech by Listeners with Hearing Aids. *Journal of the Canadian Acoustical Association,* 44 (3), 182-183.

Toronto Emotions Speech Set (TESS)

7 emotions (x 7 times x 3 conditions) = 147 trials

+ 49 practice trials



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Confusions made by HL listeners, when unaided…

HA, unaided		RESPONSE								
		angry	disgust	fear	happy	neutral	ps	sad		
TRUE	angry	28	11	4	6	40	10	0		100
	disgust	5	25	5	10	41	13	1		100
	fear	3	3	28	25	10	30	1		100
	happy	2	7	6	30	32	20	3		100
	neutral	8	14	16	1	37	1	23		100
	ps	1	3	1	44	5	45	0		100
	sad	0	10	15	0	19	1	55		100
		47	73	75	117	184	120	84		

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Perception of Emotional Speech by Listeners with Hearing Aids

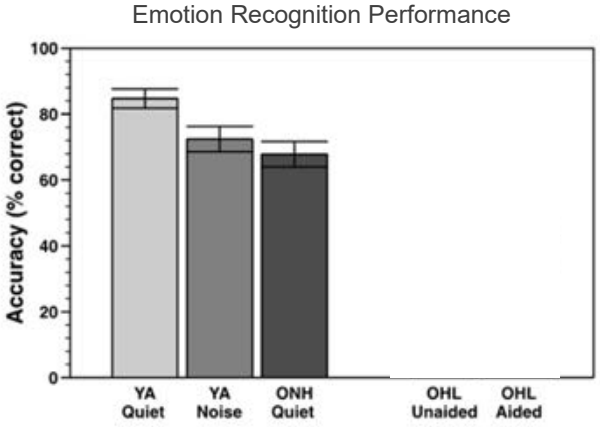
Questions asked by Goy et. al (2016):

1. How well do older adults with hearing loss recognize emotional affect?
2. Are hearing aids beneficial?

Task:

Toronto Emotional Speech Set (TESS)

"*Say the word learn"*



Goy, G., Pichora-Fuller, M. K., Singh, G., Russo, F. (2016). Perception of Emotional Speech by Listeners with Hearing Aids. *Journal of the Canadian Acoustical Association,* 44 (3), 182-183.

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Research question

Comparing within original recordings:

- What acoustic properties are different between emotions?
- What acoustic properties are listeners using to identify emotion in speech?

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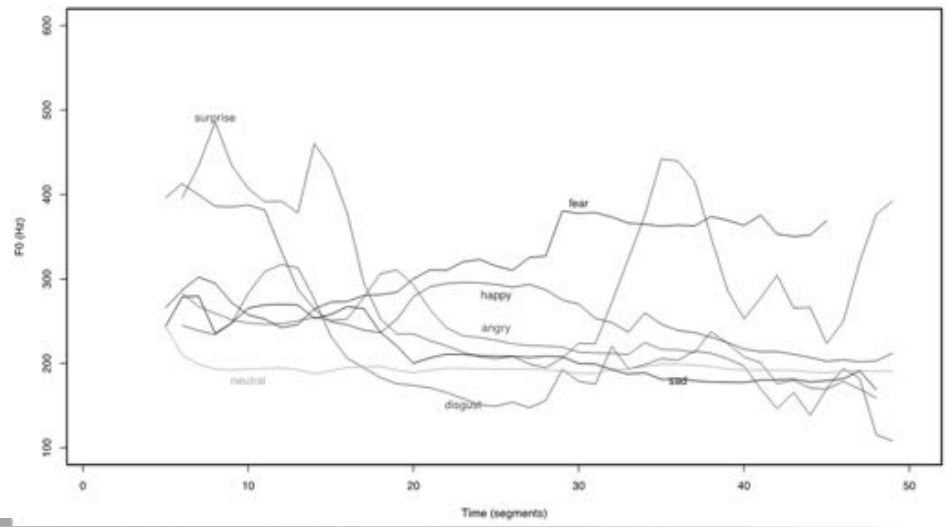
Comparing emotions (original recordings)



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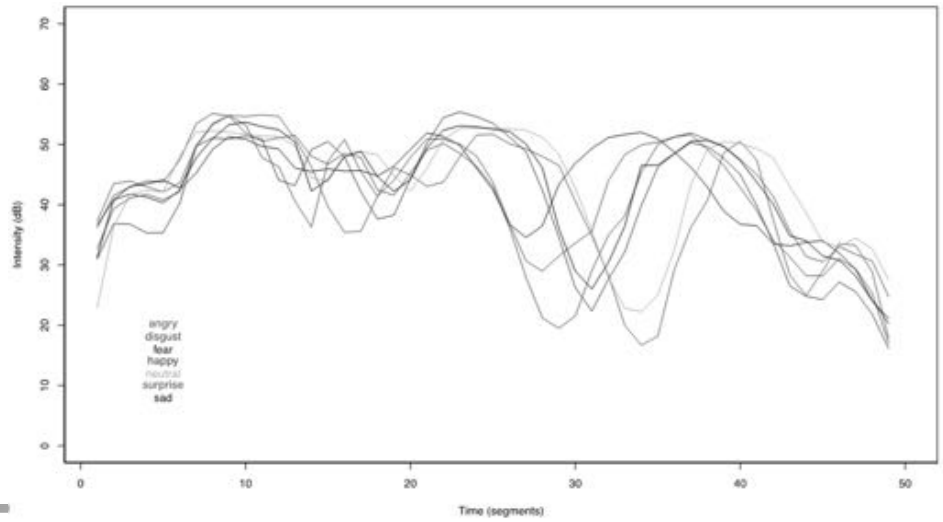
Comparing emotions (original recordings)



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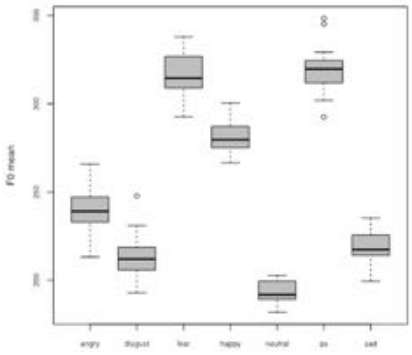
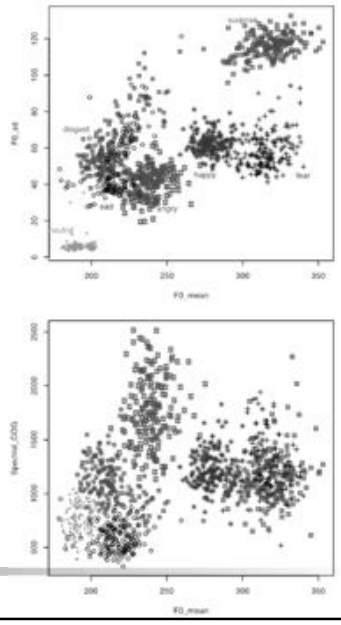
Combination of acoustic properties





Linear discriminant analysis:

Three measures of F0 mean, F0 SD and Spectral centre-of-gravity can correctly classify 96% of 1176 emotional speech tokens.

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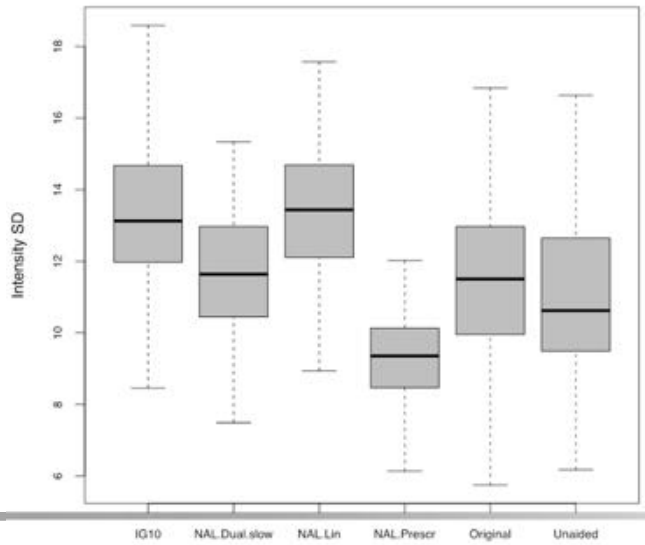
Hearing aid processing



- Less intensity variation with NAL fast amplitude compression

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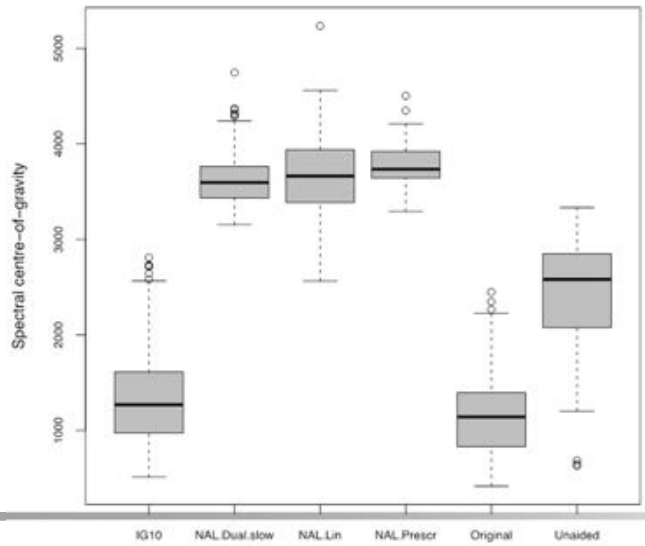
Hearing aid processing



- More high frequency energy with NAL fitting

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Remaining Questions

Understanding the role of hearing aids in emotion recognition

- Question of audibility → Personal hearing aids
- Emotion recognition as a cognitive vs. peripheral issue
- Mixed effect of hearing aids?

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The Effect of Hearing Aids on Emotion Recognition

Phonak Audiology Research Center. 2016

Research Question

Do we get a different result than Goy et. al (2016) with hearing aid fittings that are verified?

Can we do anything to the hearing aid processing to make emotion recognition better?

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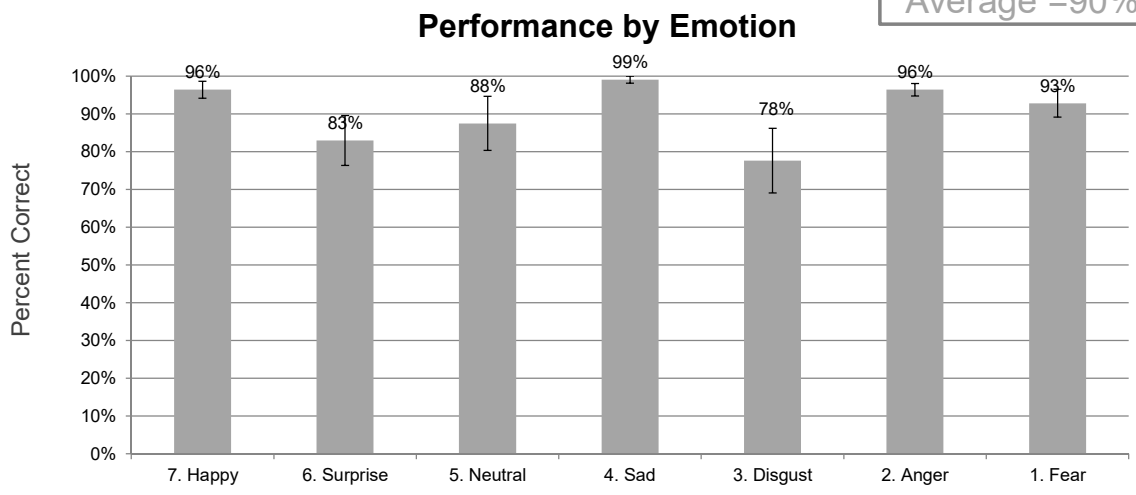
Normal Hearing Group

Average =90%



- Best performance: Sad
- Worst performance: Disgust

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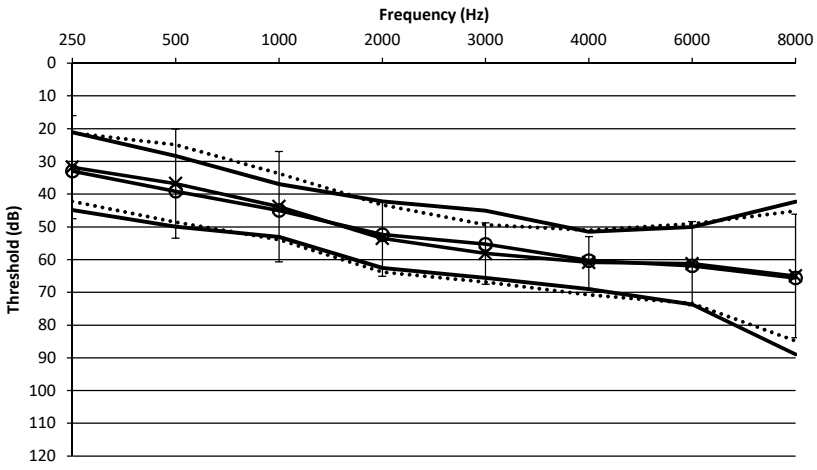
2 Experimental Group

Moderate Hearing Loss

Moderate Hearing Loss Group

- N = 17
- Average Age = 67



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Performance x Emotion

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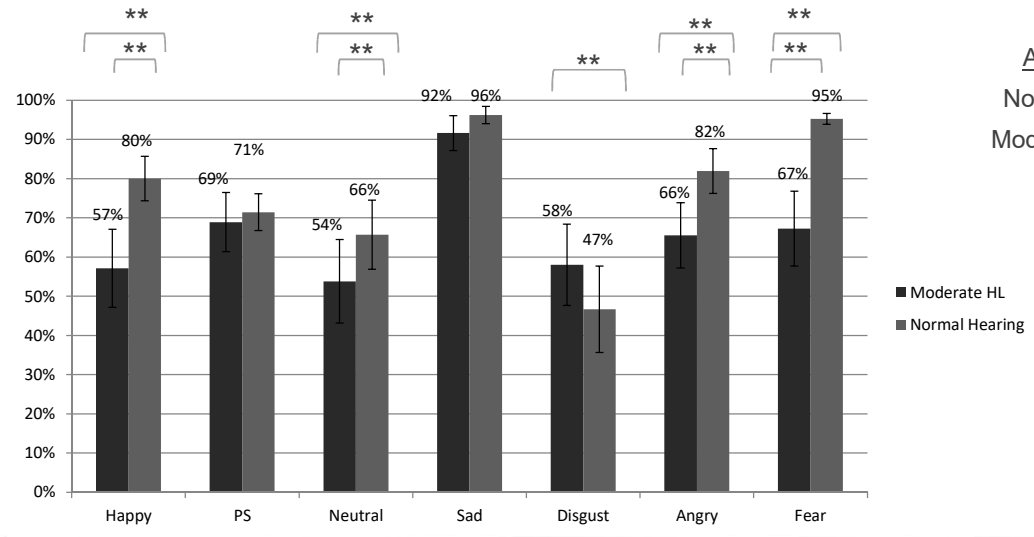
Unaided Comparisons (Moderate/Normal averaged across all conditions)



Averages

Normal: 86%

Moderate: 67%

** = p < 0.01

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What Mistakes do Normal Hearing Listeners Make?

Presented Emotion

Participant Response	7. Happy	6. Surprise	5. Neutral	4. Sad	3. Disgust	2. Anger	1. Fear
7. Happy	78%	6%	0%	0%	10%	0%	0%
6. Surprise	14%	76%	0%	0%	10%	0%	2%
5. Neutral	8%	10%	71%	0%	26%	8%	3%
4. Sad	0%	0%	20%	98%	1%	0%	1%
3. Disgust	0%	8%	8%	2%	50%	12%	0%
2. Anger	0%	0%	0%	0%	3%	80%	0%
1. Fear	0%	0%	0%	0%	0%	0%	93%

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What Mistakes do Moderate Hearing Loss Listeners Make?

Correct Answer

Participant Response	7. Happy	6. Surprise	5. Neutral	4. Sad	3. Disgust	2. Anger	1. Fear
7. Happy	59%	13%	0%	0%	1%	0%	8%
6. Surprise	13%	63%	0%	0%	4%	0%	8%
5. Neutral	13%	8%	59%	5%	30%	10%	6%
4. Sad	6%	7%	30%	91%	4%	1%	2%
3. Disgust	4%	8%	7%	3%	57%	14%	1%
2. Anger	4%	0%	1%	0%	2%	75%	9%
1. Fear	0%	1%	3%	1%	1%	0%	67%

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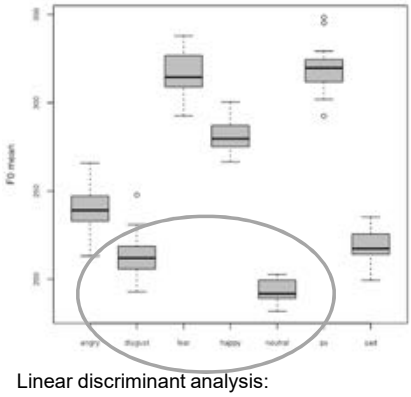
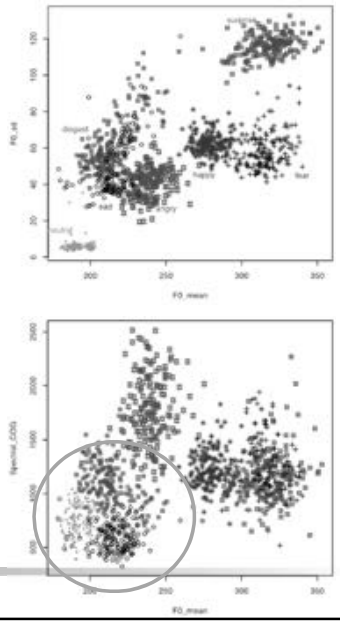
Combination of acoustic properties





Linear discriminant analysis:

Three measures of F0 mean, F0 SD and Spectral centre-of-gravity can correctly classify 96% of 1176 emotional speech tokens.

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Listening Conditions

"Processed Condition"

- All currently available sound cleaning on
- Frequency Lowering "on"
- Prescribed compression (WDRC)

"Unprocessed Condition"

- All adaptive sound cleaning features off
- Frequency-lowering "off"
- Linear amplification

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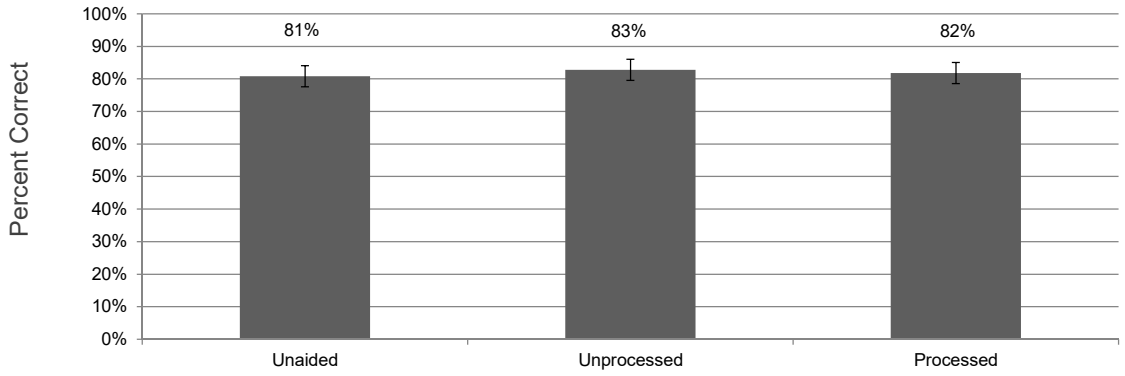
Average Performance – Normal Hearing

N.S.



- Avg = 82%
- Pilot Avg → 90%

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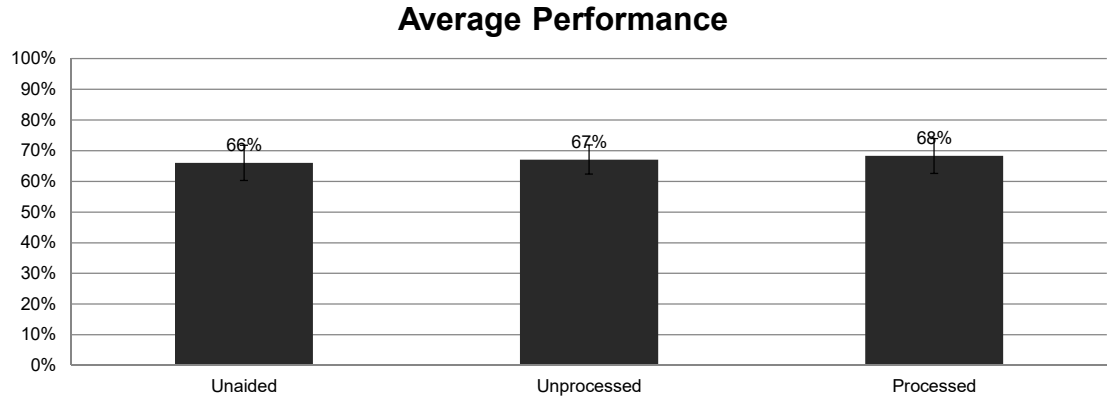
Average Performance – Moderate Hearing Loss

No S.D.



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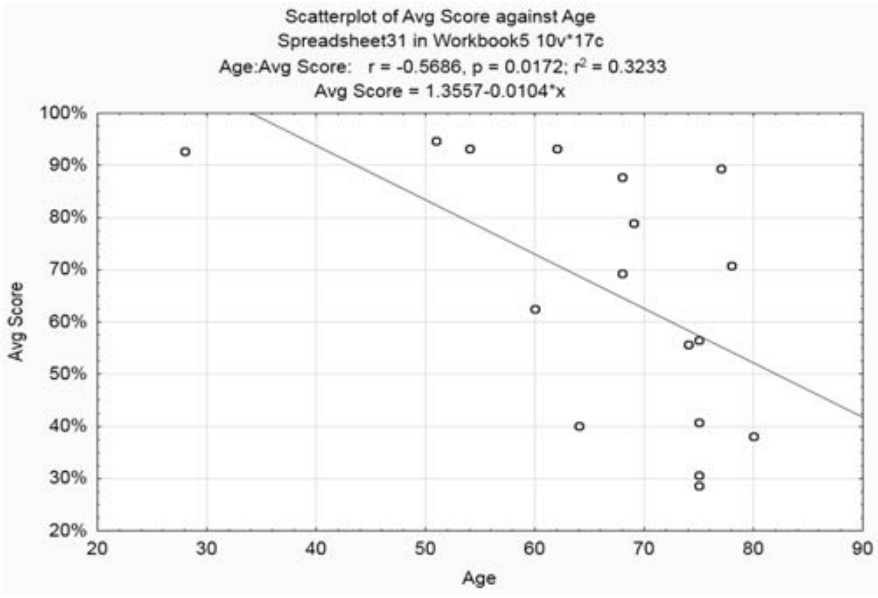
Age Effect



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Can we make hearing aids better?

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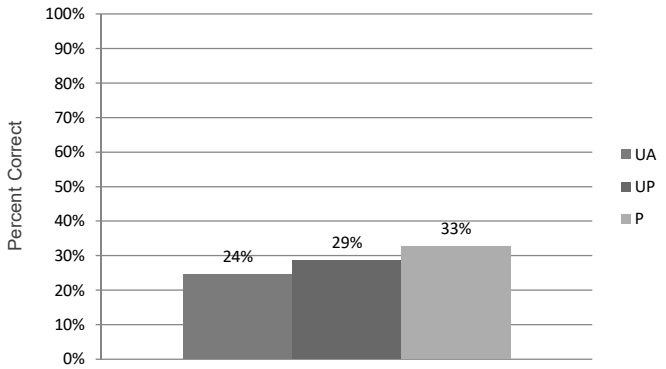
Interesting Cases

Are Participants Using Acoustic Cues (Pitch/Temporal)?

- Lifelong musician
- Conductor of a local orchestra
- Plays multiple instruments



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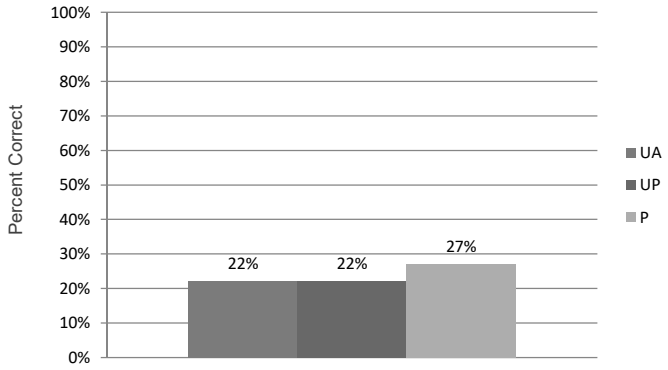
Is Audibility a Factor?

- Normal Hearing (35 dB or better across all frequencies from 250 – 8000 Hz, AU)



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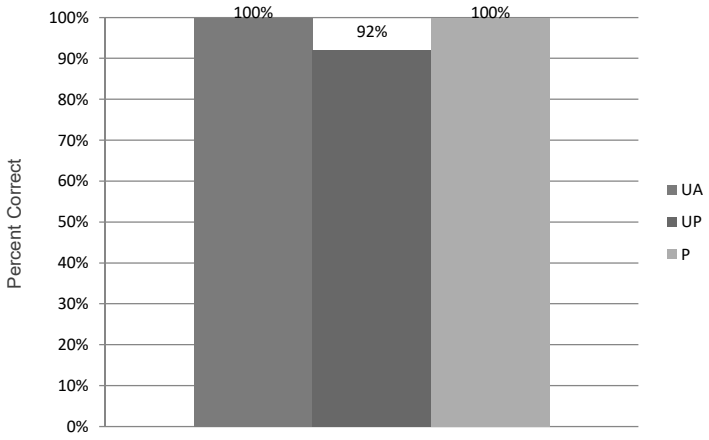
Does Duration of Hearing Loss Make a Difference? (Or HL since childhood)

- HL since 6-7 y.o.
- Inconsistent HA use
- HL for 25 years



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Summary and Remaining Questions

- Hearing loss and age impact emotion recognition ability
- Emotion recognition seems to reflect higher level cognitive abilities that remain unaffected by hearing aid processing
- Hearing aids neither help nor hinder emotion recognition ability
- Audibility does not appear to be a confounding factor

- Remaining Questions:
- Validity of TESS for measuring emotion recognition ability?
- Can anything be done with hearing aids to improve this skill?

- Next steps?

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Next phase of emotions study

Research Questions

1. Is there a relationship between emotion “recognition” performance, and experienced emotional range?
2. How do hearing aids impact emotional range?
3. How closely do we approximate emotional range in the lab as compared to the real world?

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1

Visit 1 – Subjective Measures

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Visit 1 Outcome Measures

LSNS (Lubben Social Network Scale)
- Developed by Lubben and Gironda (2004) – Boston College
- Brief instrument to gauge social isolation in older adults
- Perceived social support received by family and friends
- 12 items, Max = 60

FAMILY: *Considering the people to whom you are related by birth, marriage, adoption, etc…*

1. How many relatives do you see or hear from at least once a month?
   0 = *none* 1 = *one* 2 = *two* 3 = *three or four* 4 = *five thru eight* 5 = *nine or more*
2. How many relatives do you feel at ease with that you can talk about private matters?
   0 = *none* 1 = *one* 2 = *two* 3 = *three or four* 4 = *five thru eight* 5 = *nine or more*
3. How many relatives do you feel close to such that you could call on them for help?
   0 = *none* 1 = *one* 2 = *two* 3 = *three or four* 4 = *five thru eight* 5 = *nine or more*

N = 33

Lubben, J., Blozik, E., Gillmann, G., Iliffe, S., von Rentein Kruse, W., Beck, J.C., & Stuck, A.E. (2006). Performance of an abbreviated version of the Lubben Social Network Scale among three European community-dwelling older adult populations. *The Gerontologist, 46*(4), 503–513.

Error bars = SD of the mean

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Visit 1: Outcome Measures

TEIQue (Trait Emotional Intelligence Questionnaire)
- Developed at London Psychometric Laboratory
- Measure based on trait EI providing assessment of the emotional world of the individual
- 153 items, 15 facets- Score of 1 to 7 on each item

N = 3

Adaptability
Assertiveness
Emotion perception(self and others)
Emotion expression
Emotion management(others)
Emotion regulation
Impulsiveness (low)
Relationships
Self-esteem
Self-motivation
Social awareness
Stress management
Trait empathy
Trait happiness
Trait optimism

Petrides, K. V. (2009). Psychometric properties of the Trait Emotional Intelligence Questionnaire. In C. Stough, D. H. Saklofske, and J. D. Parker, Advances in the assessment of emotional intelligence. New York: Springer. DOI: 10.1007/978-0-387-88370-0_5

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2

Visit 2 – Lab Measures

Outcome Measures

IADS
(Emotional Range)

TESS
(Emotion Recognition)

- Impact of hearing aids on emotional range
- Relationship between these two measures
- Relationship between subjective measures of social interaction and these measures

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Visit 3 – Ecological Momentary Assessment

Next Steps

In-Situ questionnaire
8 "momentary" assessments (random)
Retrospective (end of each day, end of week)

Rating of 1-9 of pleasantness

Analysis of NFE over home trial

a. How do you rate the pleasantness of the soundscape? Unpleasant – Pleasant
b. How do you rate the loudness of the soundscape? Very Loud – Not loud
c. How do you rate the familiarity of the soundscape? Unfamiliar- familiar
d. What is the predominant sound source in the soundscape? Free-format response
e. How much attention did you pay to the soundscape before being prompted? Not at all- very much
f. Please describe your mood! Bad- Good
g. What are you doing at the moment? Free-format
h. I am currently…At home/ at work/ on the way somewhere/ at other (inside) / at other (outside
i. I am…. Alone/around others (not interacting)/ interacting with others

- What types of environments do people enter?
- Do the range of valence ratings reflect lab measurements?
- How does the timing of the measurement impact the outcome?

Conclusions

- Hearing loss seems to correspond with lower ratings of “pleasantness” than normal hearing individuals
- Individuals with hearing loss seem to have a more limited “range” of emotions in regards to non-speech stimuli as compared to normal hearing individuals
- This limited range seems to correlate with greater feelings of social isolation or disconnectedness
- We are investigating if this result is consistent with hearing aids, or if hearing aids help/harm
- Individuals with hearing loss seem to have more difficulty recognizing emotions, even with hearing aids

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Take-aways

- As hearing healthcare providers….
  - We must be aware of these potential difficulties so we can better understand and serve our patient populations
  - We must convey these difficulties to families, to facilitate a better understanding of a more “holistic” effect of hearing loss and better conversations
- As hearing aid manufacturers…
  - We must take these findings into consideration with up and coming technologies
  - Looking into what can be done with hearing aid processing to help in these domains

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