TV Listening and Hearing Aids

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in collaboration with:
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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*

Learner Objectives

- Participants will understand the importance of TV listening for hearing aid users
- Participants will understand why TV listening is difficult for hearing aid users
- Participants will learn how TV listening for hearing aid users was tested in three experiments, the outcomes of those studies, and their implications for audiologists

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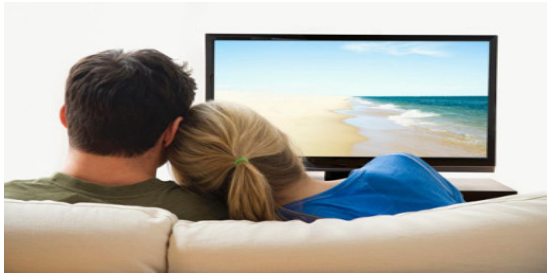
Does it Matter?

Why TV listening?

- Hasan et al. (2014): Listening to media is second most frequent listening activity
  1. Conversations, 33%,
  2. Listening to media, 31%
- MarkeTrak 9: 78% of HA owners have trouble understanding things on TV
  (similar to percentage of people having “trouble following conversation when 2+ people talking)
- Phonak US Tech Support: Problems with TV listening is one of the three most frequent support requests



How Much Do We Really Watch Television?

Nielsen (2015) reported that American adults of ages 50+ spend on average 6 h 45 min per day watching TV

Answer: A LOT!

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Defining The TV Listening Problem

TV listening, just another speech-in-noise problem?

- TV exhibits larger diversity and rate of change of talkers, unfamiliar accents, speaking rates and acoustic scenes (environment, viewing angles, etc.) than real world; aggravates reduced ability by elderly and HI to compensate for changing talkers (Sommers, 1997)

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Factors

- Speaker Configuration
- Compression
- Audio Settings
- Audio Codecs

Answer

Certain digital channels broadcast special subtitles and audio for people who are hearing and/or visually impaired. The TV settings for this option can be activated. Please proceed with the following step to activate or inactivate this setting:

Turn ON/OFF hearing and visually impaired settings

- Press the SETTINGS button on the remote control of the TV
- Select [General Settings] > [Accessibility] > [Audio description] or [Hearing impaired] > [ON/OFF]

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The TV Program

- Intelligibility is affected by foreign accents and dialects
- Mumbling
- Poor diction
- Fast speech
- Background noise effects
- Background Music
- Reverberation
- Lip-reading not available when speaker not facing camera or when dubbed

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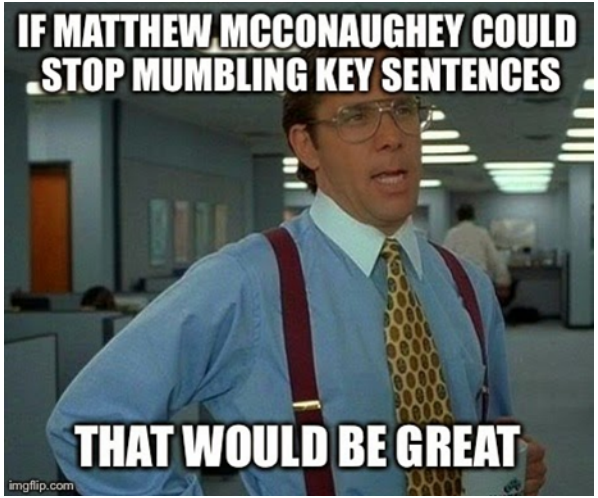
SPEAK UP! Or why mumbling actors are ruining TV drama

"At first I thought something had gone wrong with my hearing….My wife whose aural sense is so acute that she could hear a bat squeak at 300 yards, turned to me and asked, "What on earth did he just say?"

"A temporary set of relief came over me. It was not my advancing decrepitude that was responsible."

Leo McKinstry – DailyMail.com



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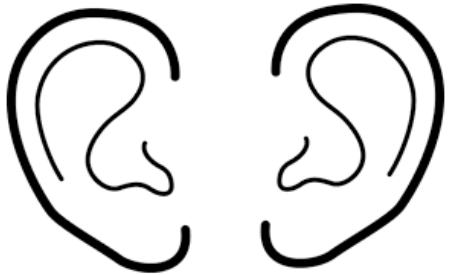
Factors

- Cognitive factors
- Processing speed
- Hearing Loss



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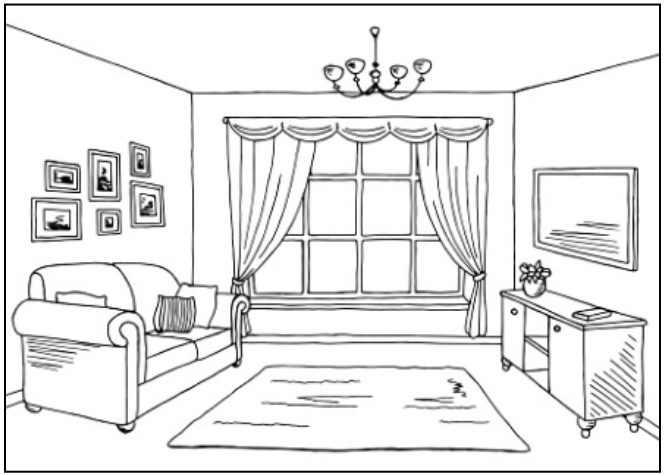
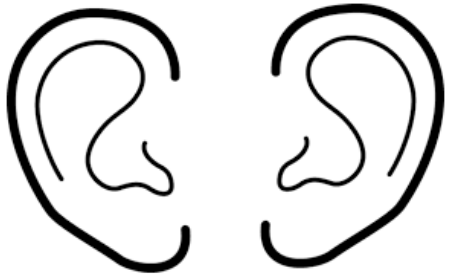
Factors





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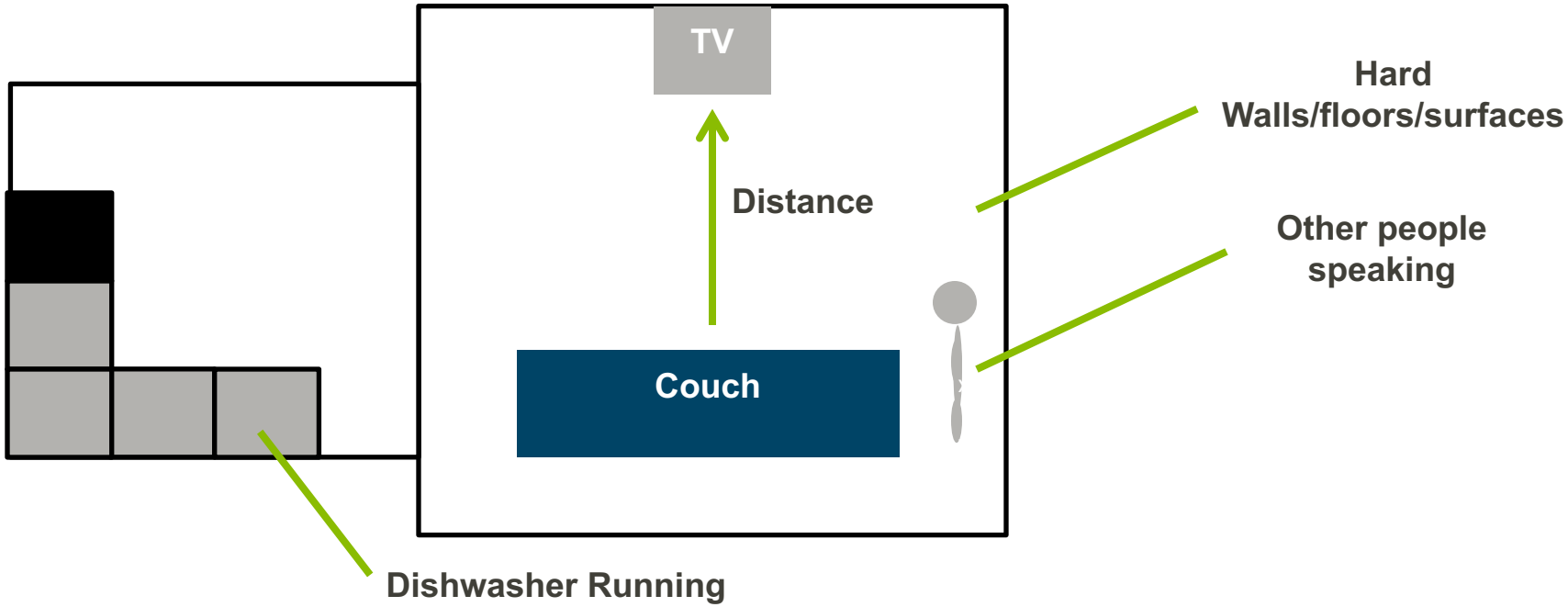
The Room Acoustics



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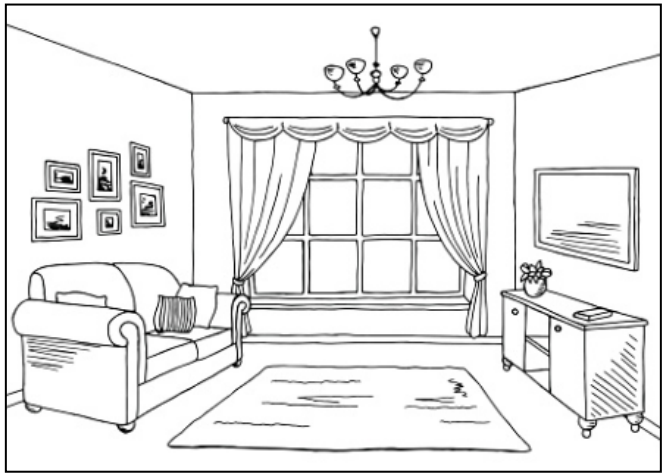
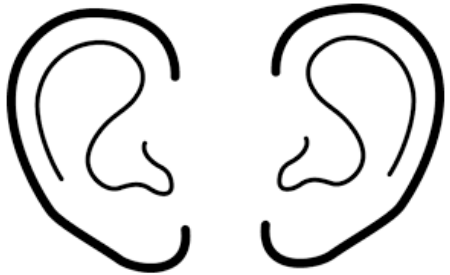
Factors





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The Hearing Aids

- Compression – (Double compression?)
- What do we do with the hearing aids as audiologists?
  - Music program
  - Increase high frequencies
  - Increase volume for soft sounds

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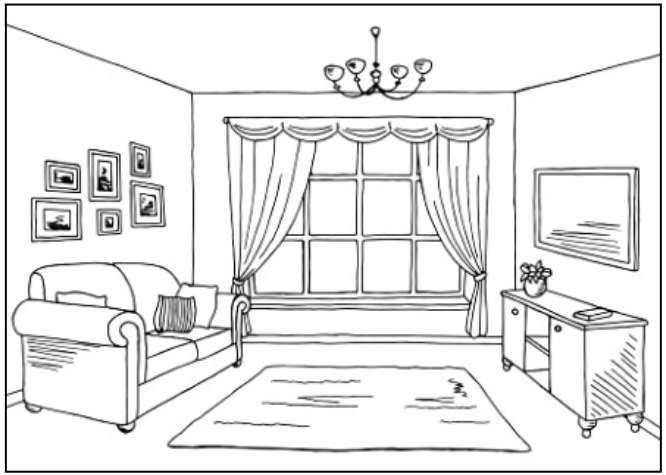
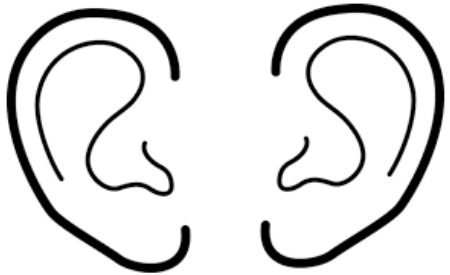
Factors





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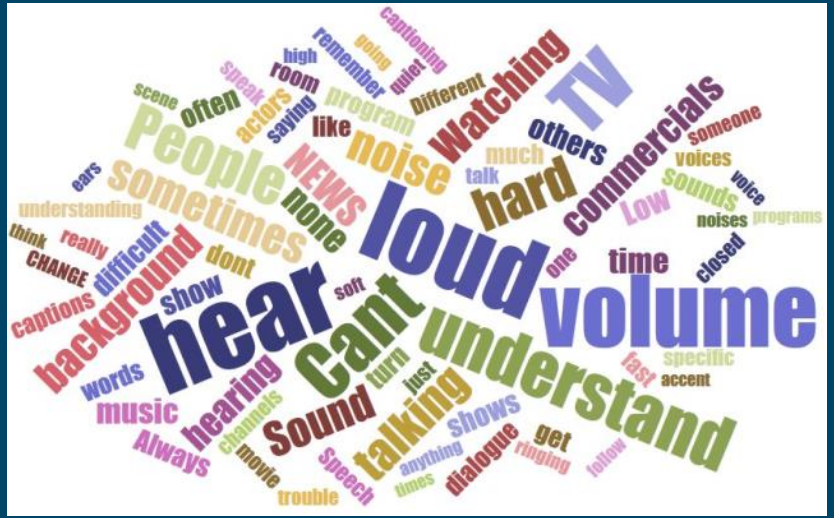
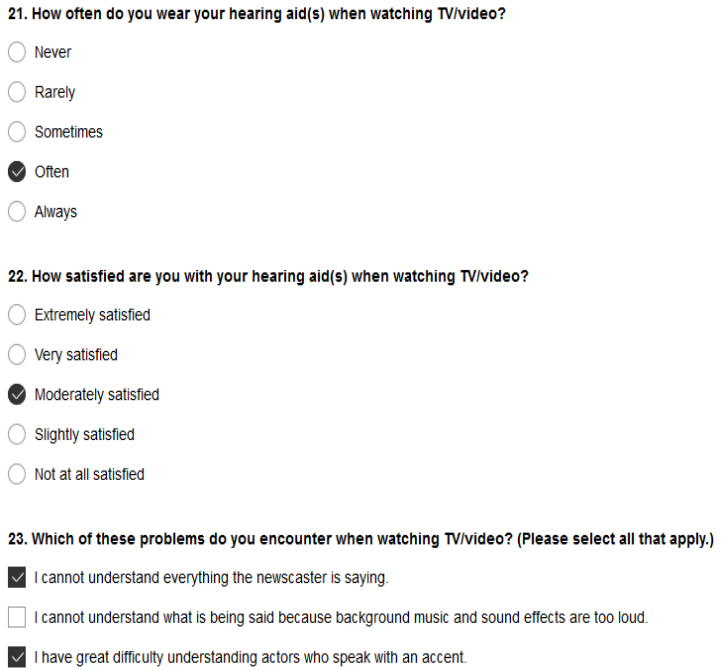
TV / Media Survey



- Online survey via Amazon Mechanical Turk and Survey Monkey in USA, 2015
- Data based on self-report

- 518 HI respondents
- 256 non-HA owners
- 58% bilateral
- 42% unilateral
- PSAP owners not included



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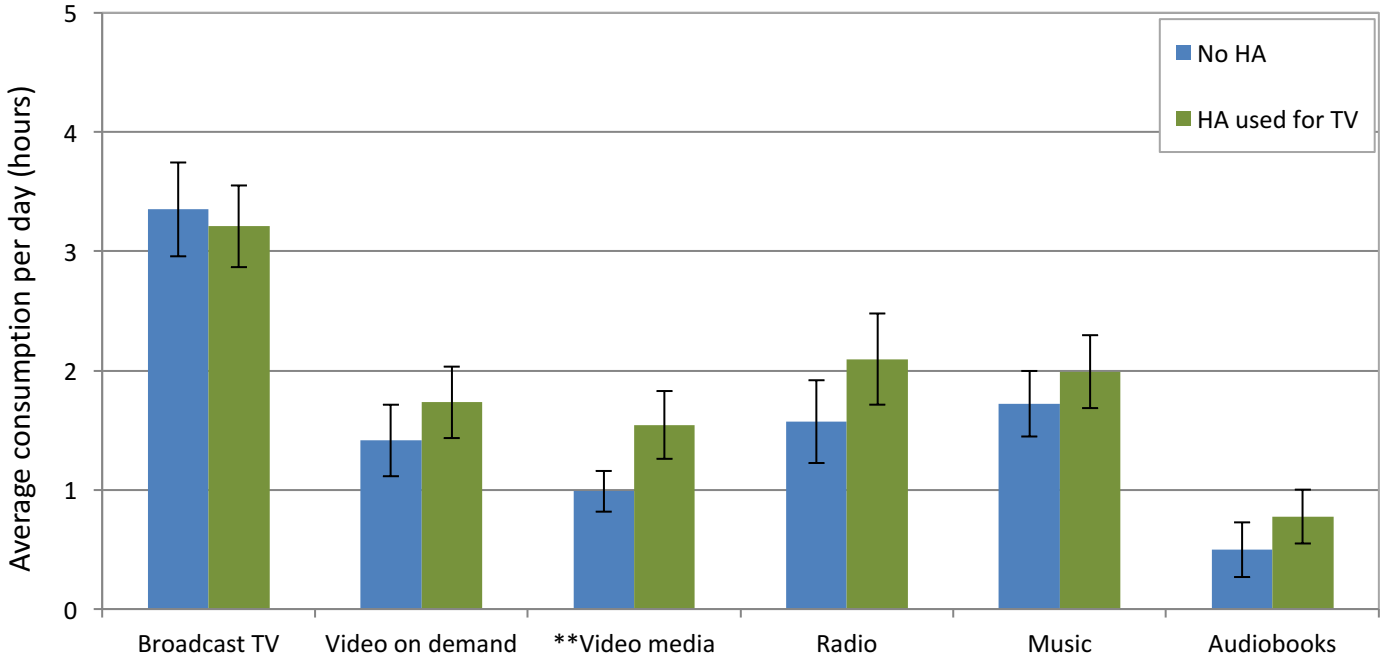
Media Consumption per Day



» Conclusions: People spend several hours a day watching/listening to TV/video

- No significant differences between groups

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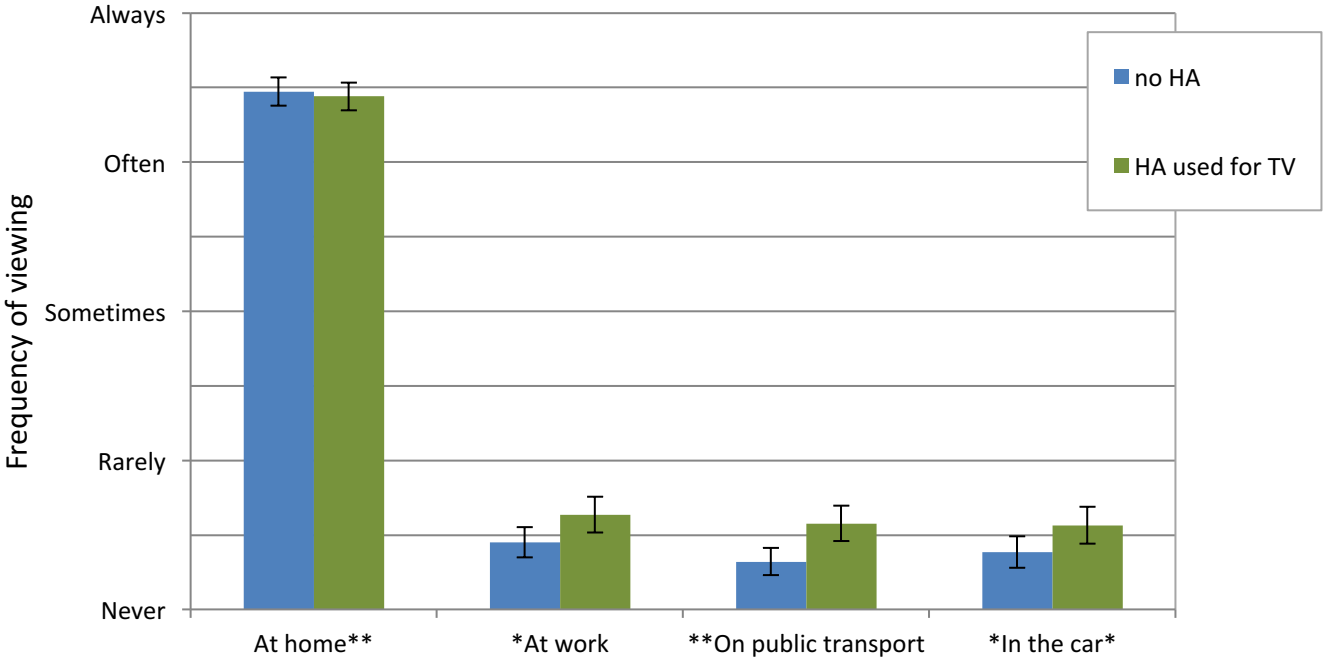
TV Viewing Locations



- Conclusions: People watch TV at home the most
- People who don't use hearing aids to watch TV watch at home less, and other places more than those who rely on HAs for TV

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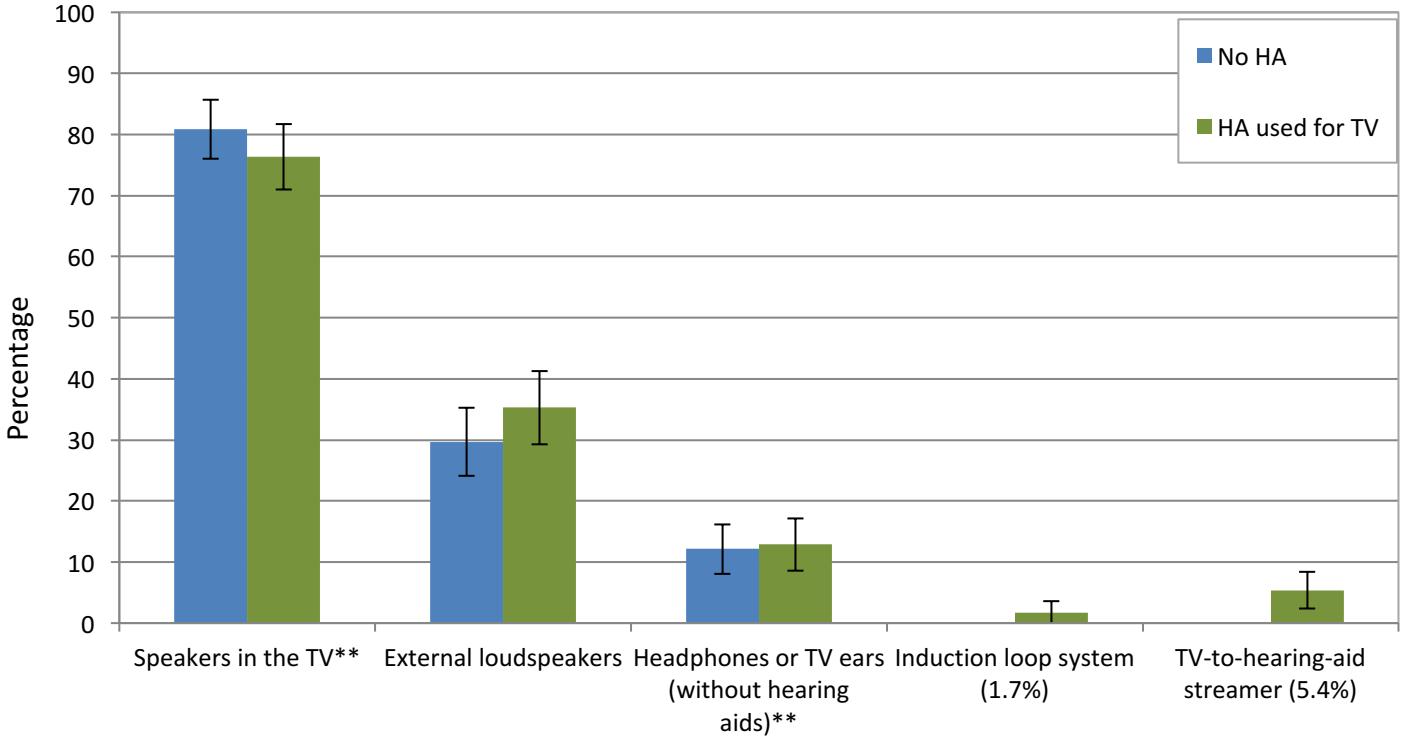
Type of Speakers



» Conclusions: Most use speakers in the TV, so we need a better solution for this!

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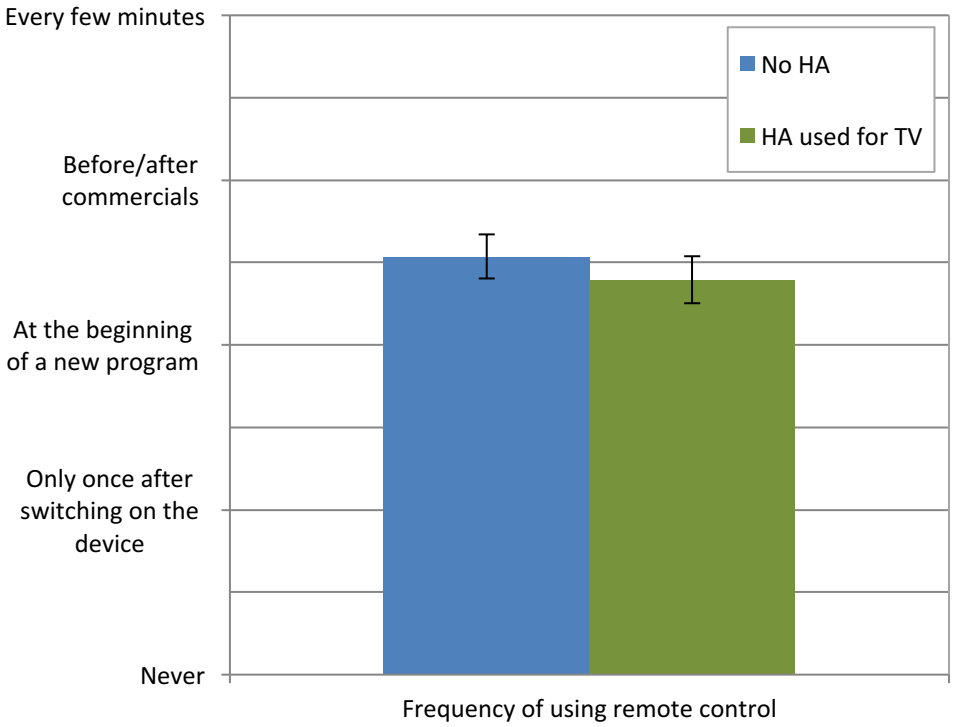
Use of Remote Control to Change Volume



Reasons for volume changes (in order of frequency):

1. Decrease/mute commercials
2. Increase soft sections to hear (dialog) better
3. Adjust volume for loudness differences between programs, channels or media
4. Decrease sections that are too loud (effects/music)
5. Adjust for external noise, e.g., street noise, AC, space heater, cooking, dogs barking, kids playing, people talking

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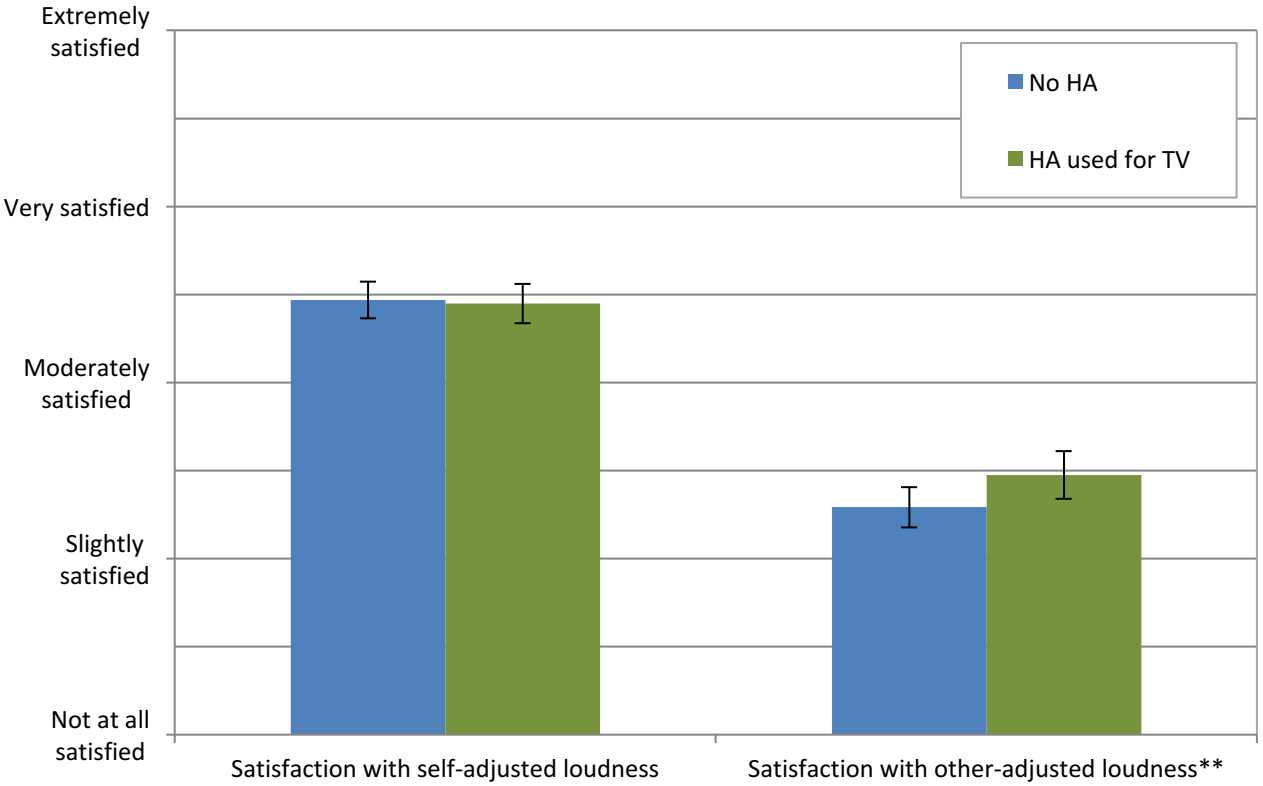
Satisfaction with loudness of TV



→ Satisfaction is low when someone else with good hearing sets TV loudness.

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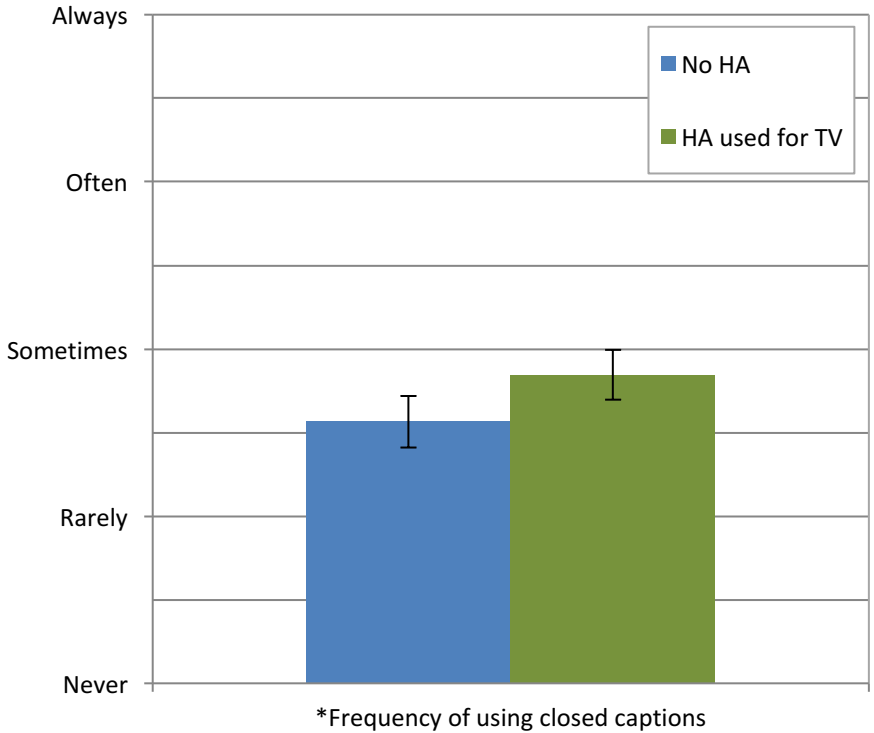
Use of Closed Captions



→ 58% use closed captions sometimes", "often" or "always"

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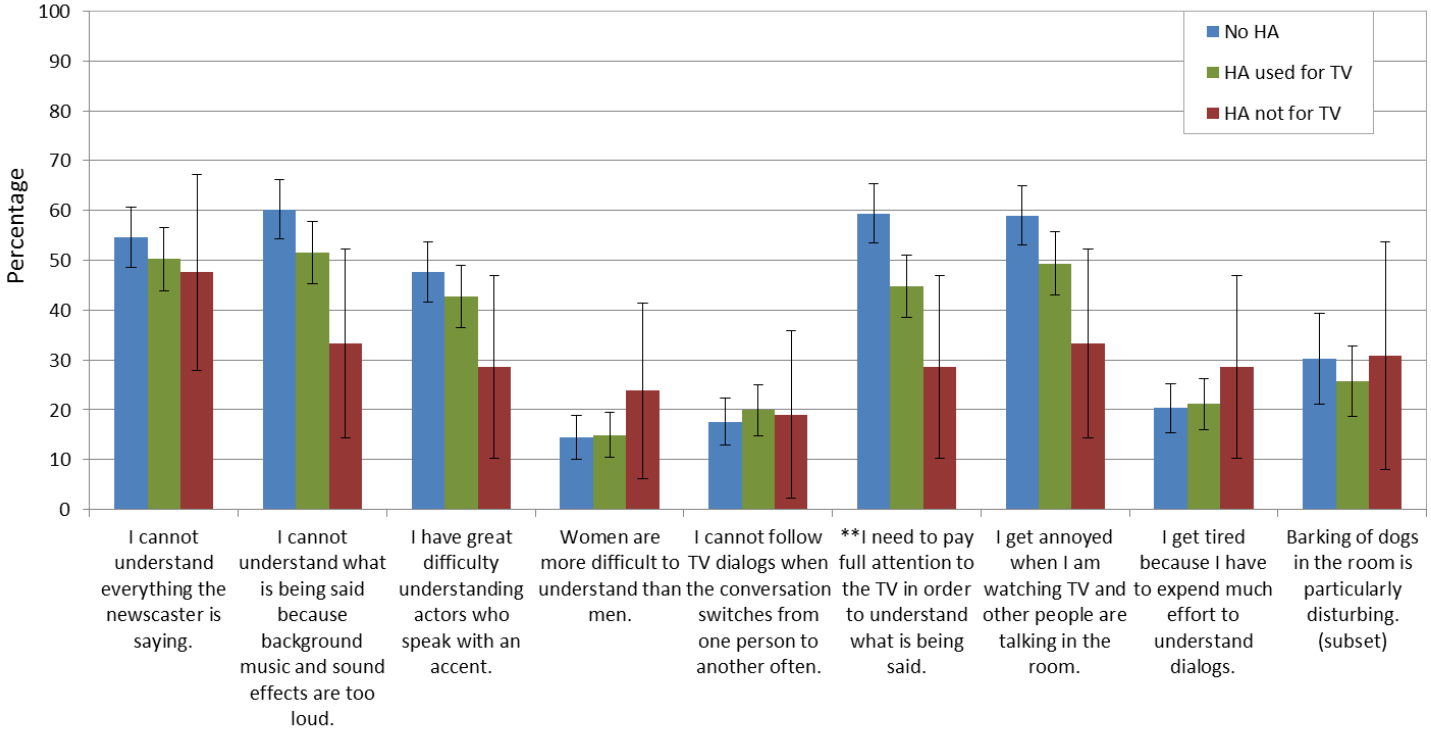
Problems people report when watching TV



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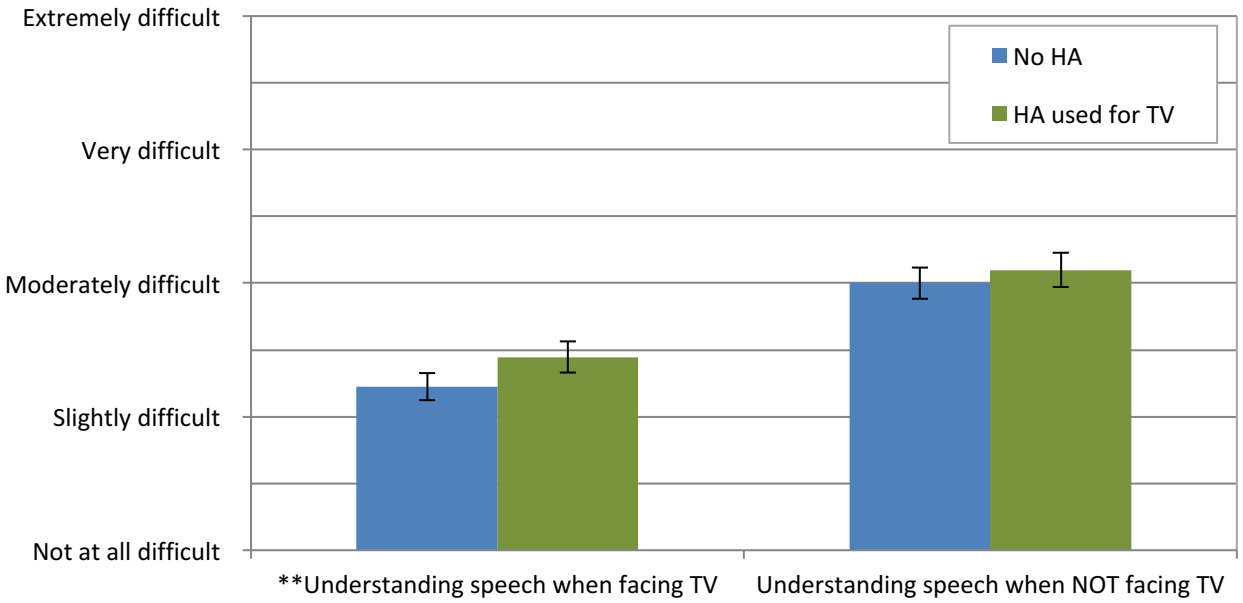
Understanding speech



→ Many have difficulty with understanding speech when they are not facing the TV or video (absence of lip reading, visual context and closed captions?)

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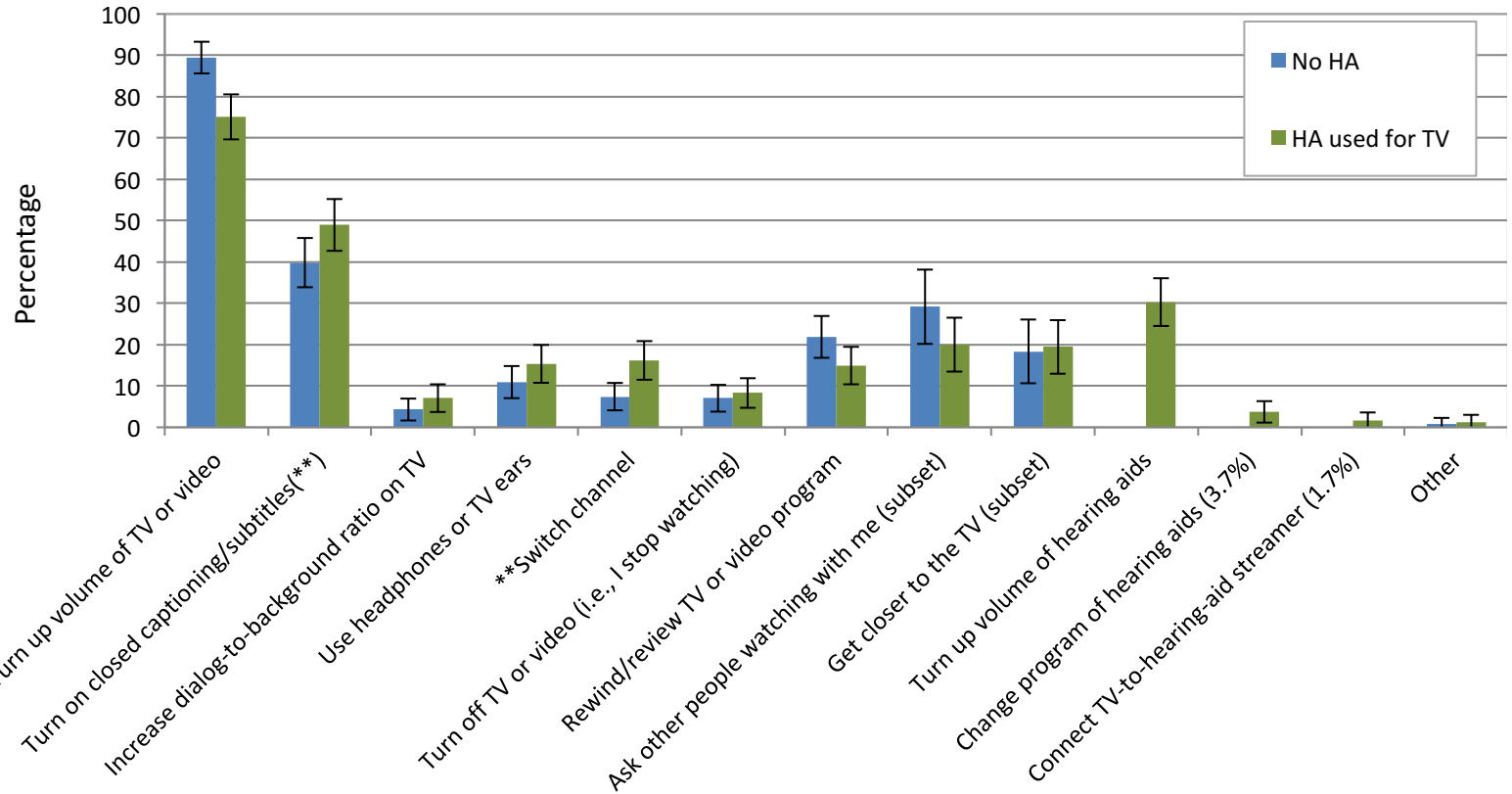
What do you do when you are having difficulty understanding TV?



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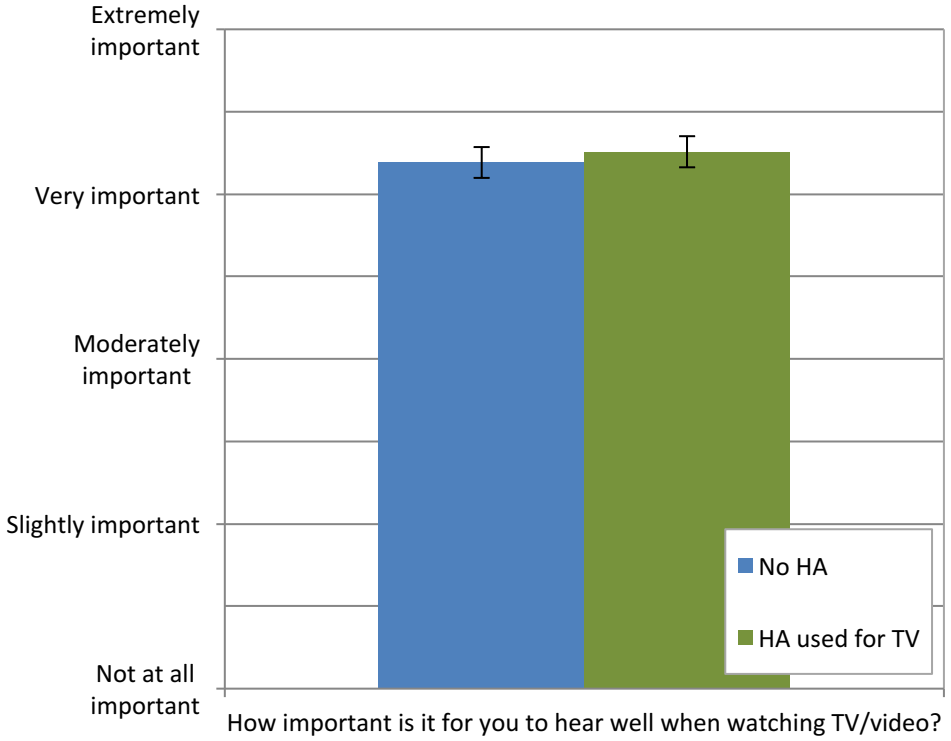
How important is it for you to hear well when watching TV?



» One thing everyone can agree on!

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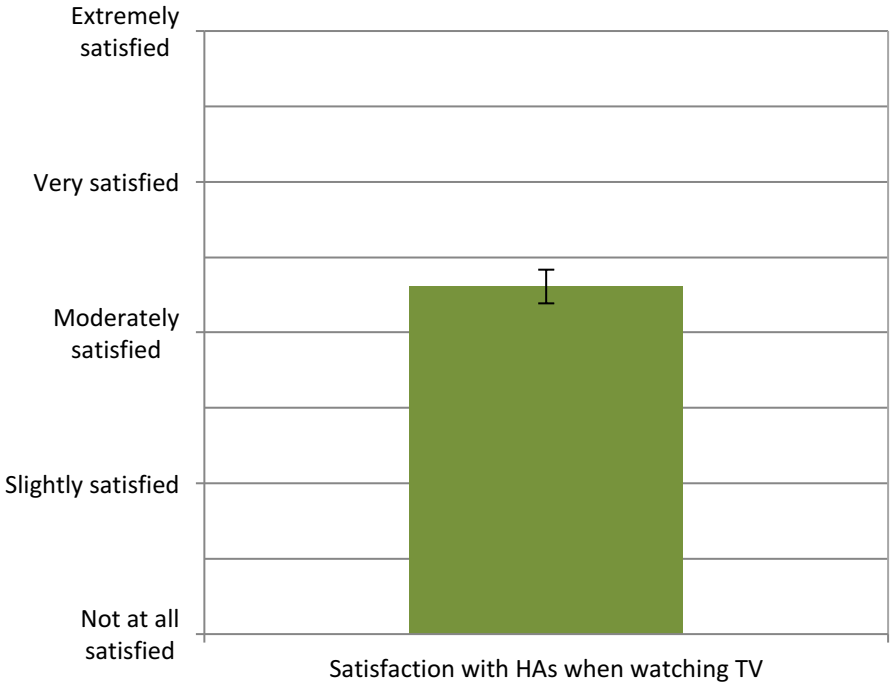
How satisfied are you with HAs when watching TV? (HA users)



Only 41% are “very satisfied” or “extremely satisfied” with HAs when watching TV/video

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Highlights – TV survey

- Adults watch TV/video several hours per day
- They consider hearing TV audio well as very important
- More non-HA users than HA users…
  - need to pay full attention to understand TV
  - cannot understand vocals in music
  - Report Fx being too loud
  - Report commercials being too loud
- Not extremely satisfied with TV-watching experience

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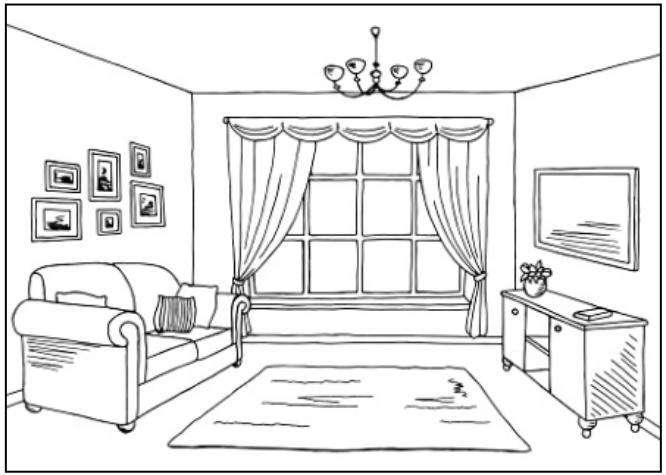
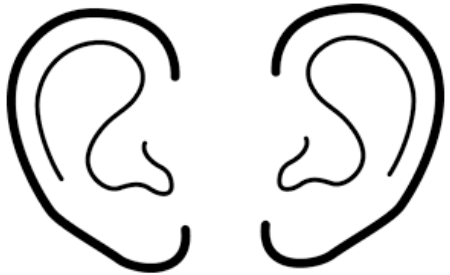
Factors





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TV Listening Experiment 1

Hearing Aids

Research Question:

- What hearing aid parameters can be adjusted to improve certain factors related to TV watching?
- - Sound Quality
- - Intelligibility

- Manipulation of:
- - Echoblock
- - Compression Speed

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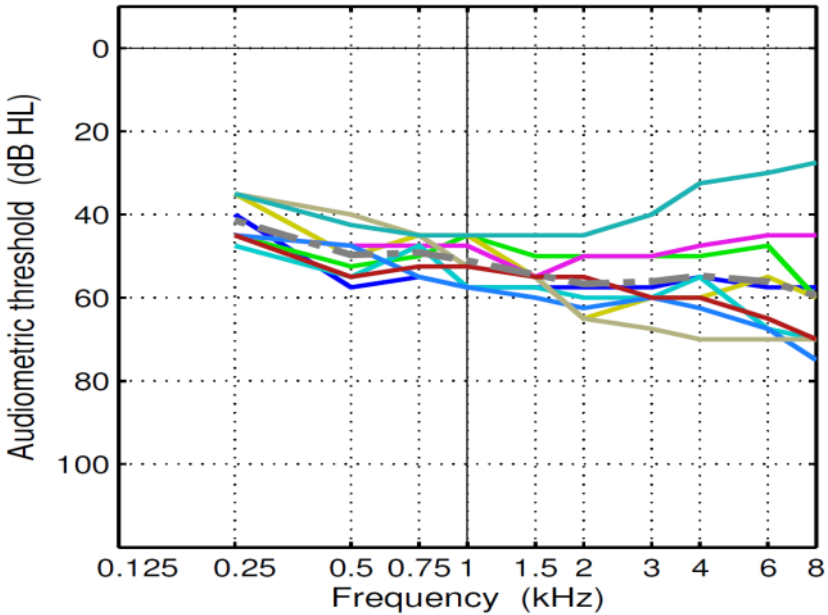
Subjects

- Nine hearing-impaired (five female, four male) with bilaterally symmetric hearing losses
- Ages: 22 to 66 years (median: 57)



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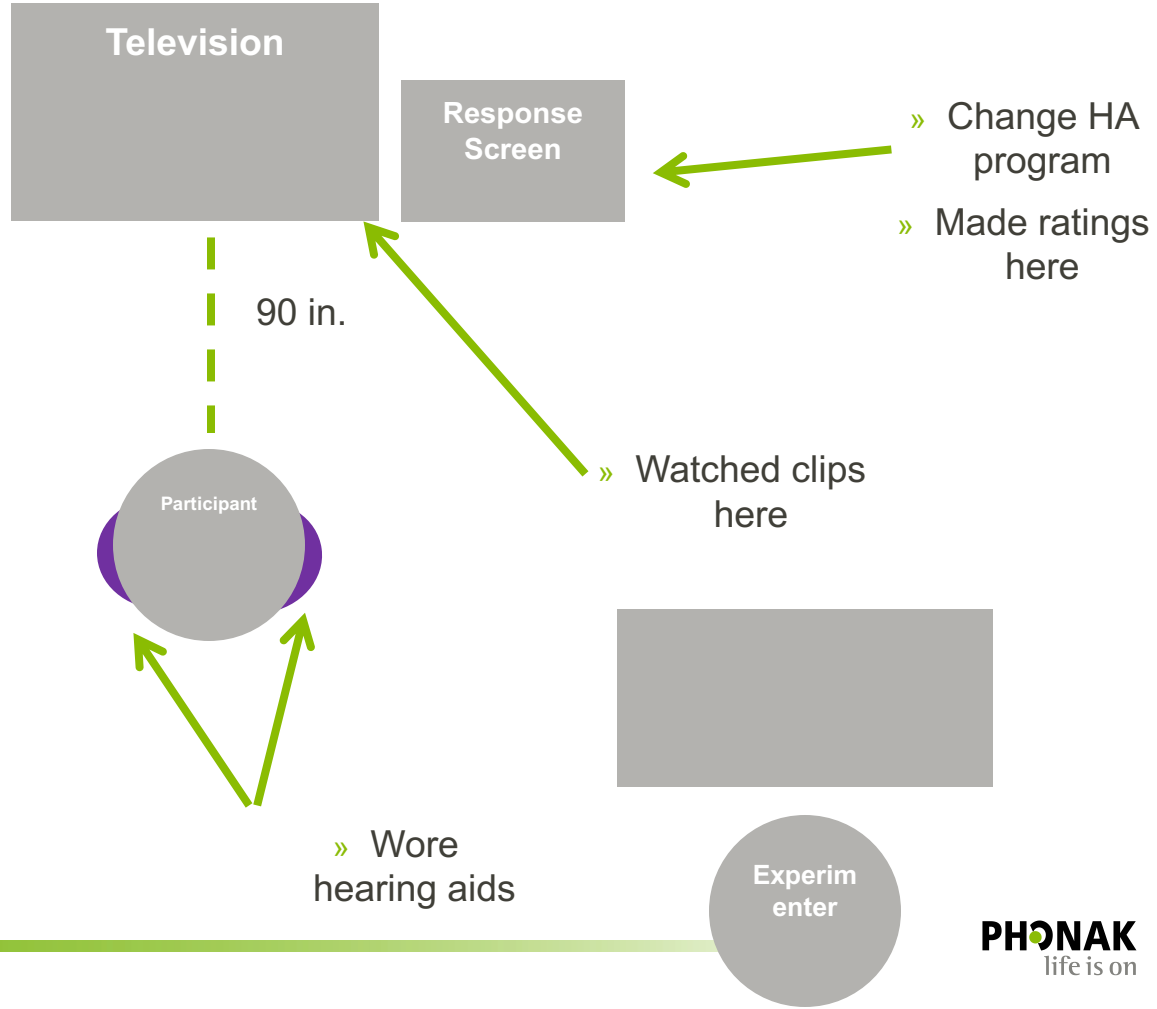
- Participants were asked to:
  - Watch 60-sec movie clips
  - Listen to three different HA settings (blinded)
  - While each clip played, listened to each HA setting for a particular parameter (intelligibility, sound quality, etc.)
  - Rated each HA setting based on that parameter



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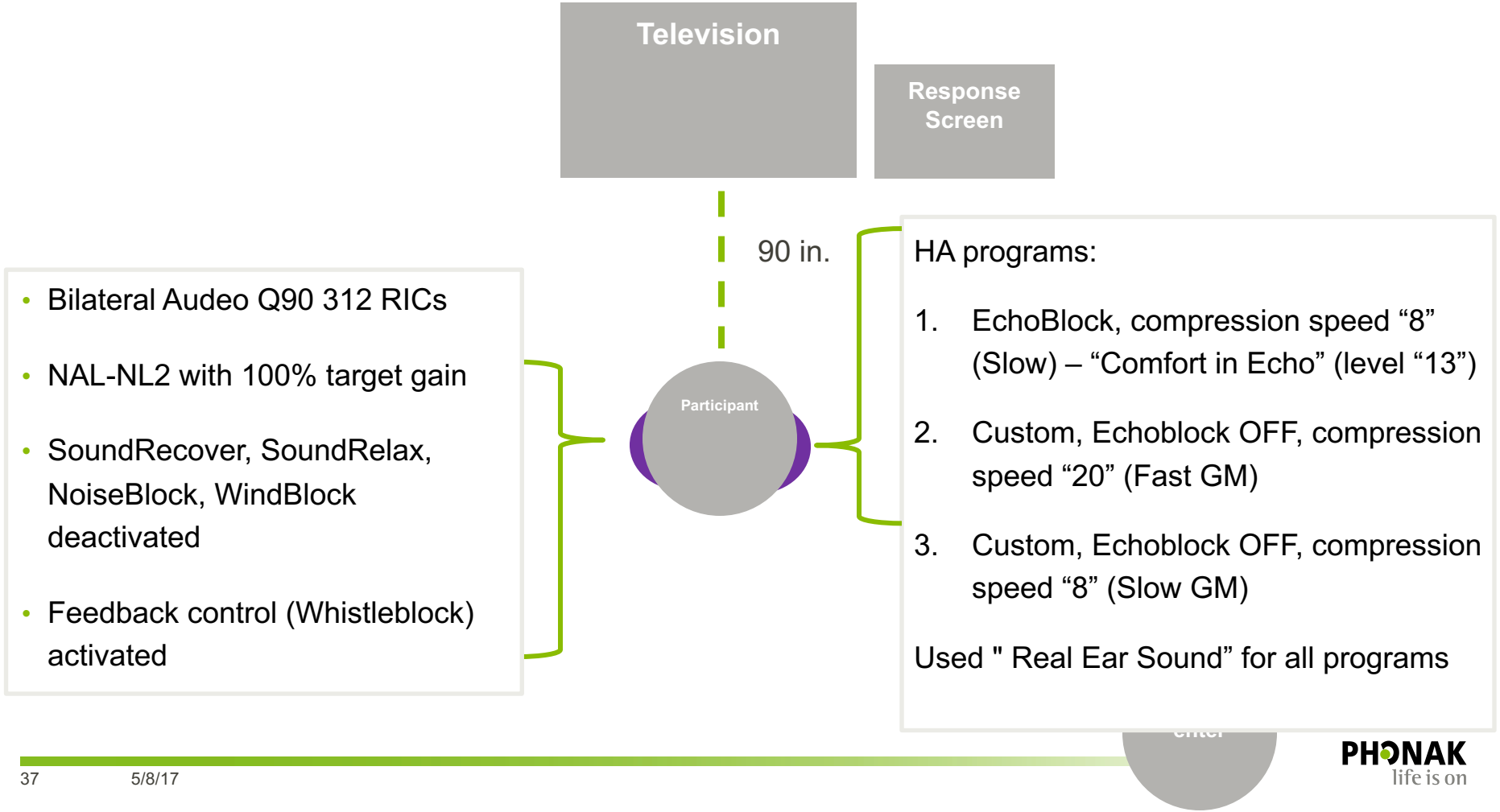

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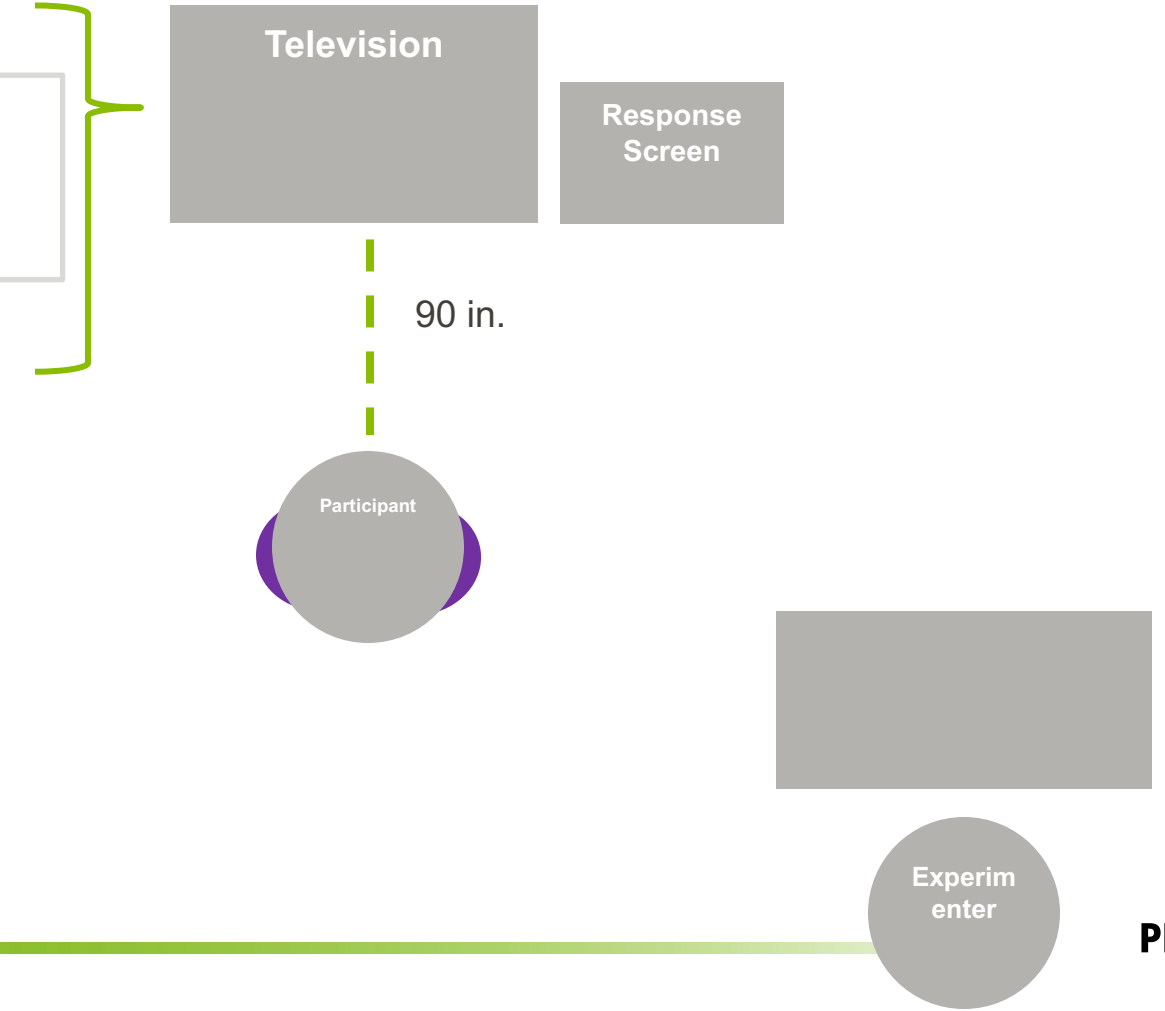
- 60 dBA Presentation Level
- TV 90 in. from participant



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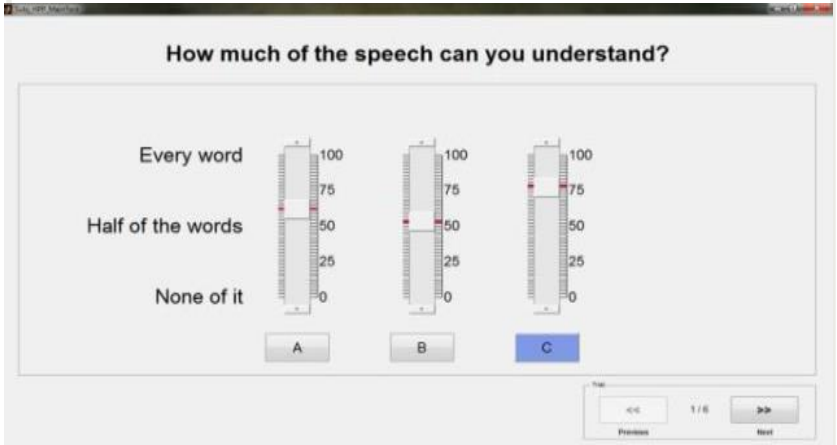
Television

Response Screen

90 in.

Participant

Response Screen:



Experim enter

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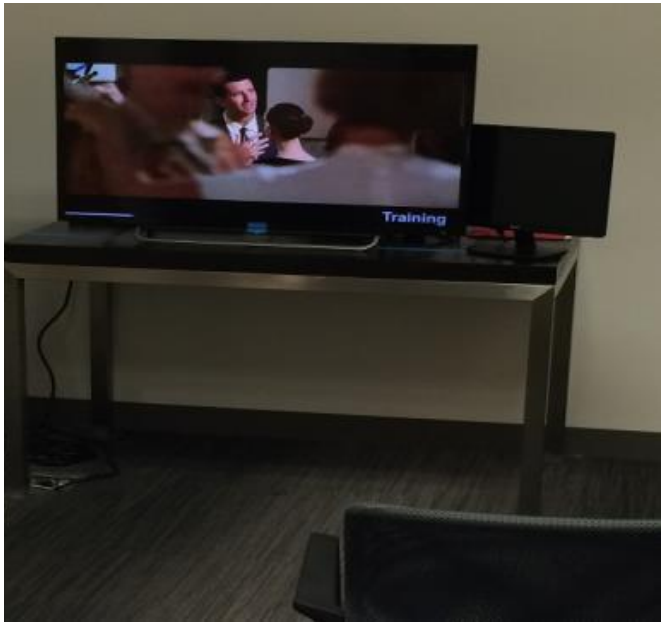
Procedures



- Used Subjective HPP MUSHRA tool for HA-program ratings
  - Five rating blocks, counterbalanced across participants (one training clip at beginning of each block)

A – Speech intelligibility, audio only

B – Sound effects and music; audiovisual

C – Externalization; audio only

D – Source width; audio only

E – Reverberation; audio only

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Procedures – TV screenshots

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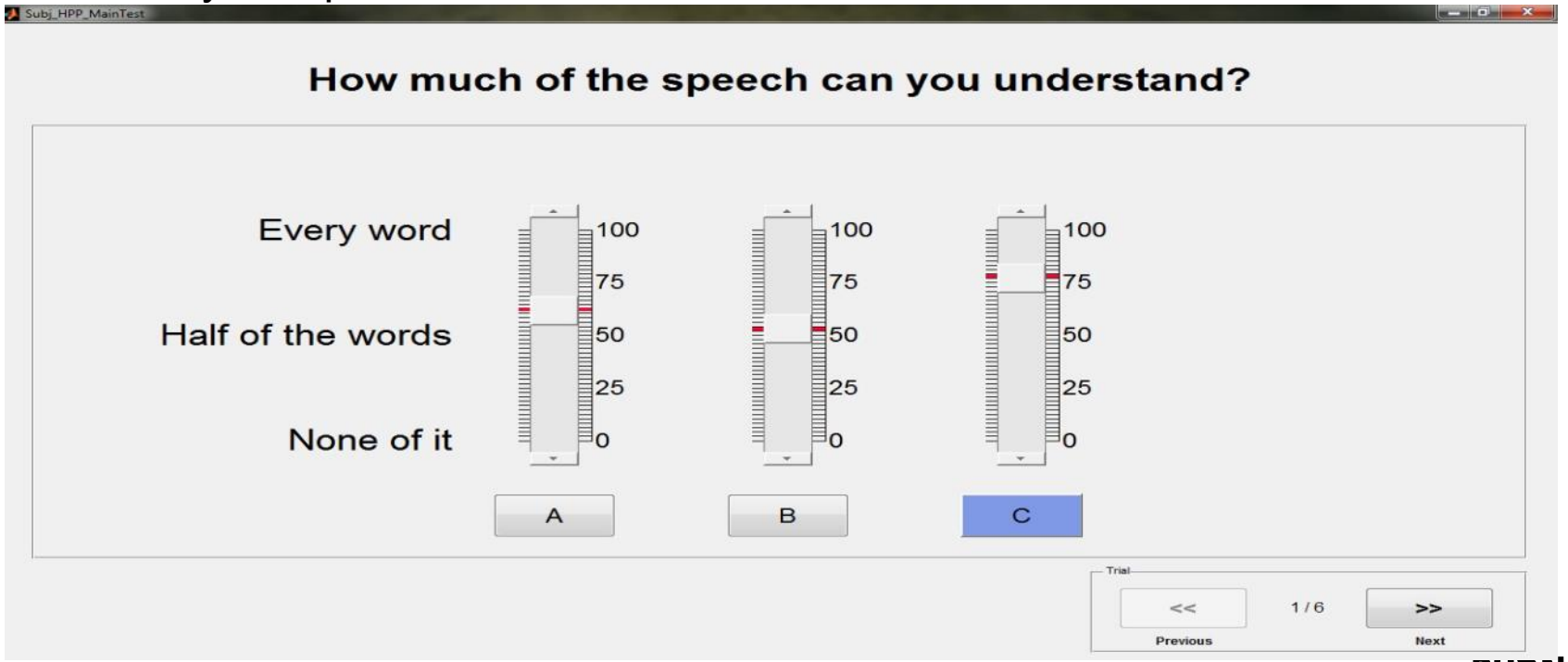
Results of Experiment 1

Perceived speech intelligibility

- Audio only, 6 clips



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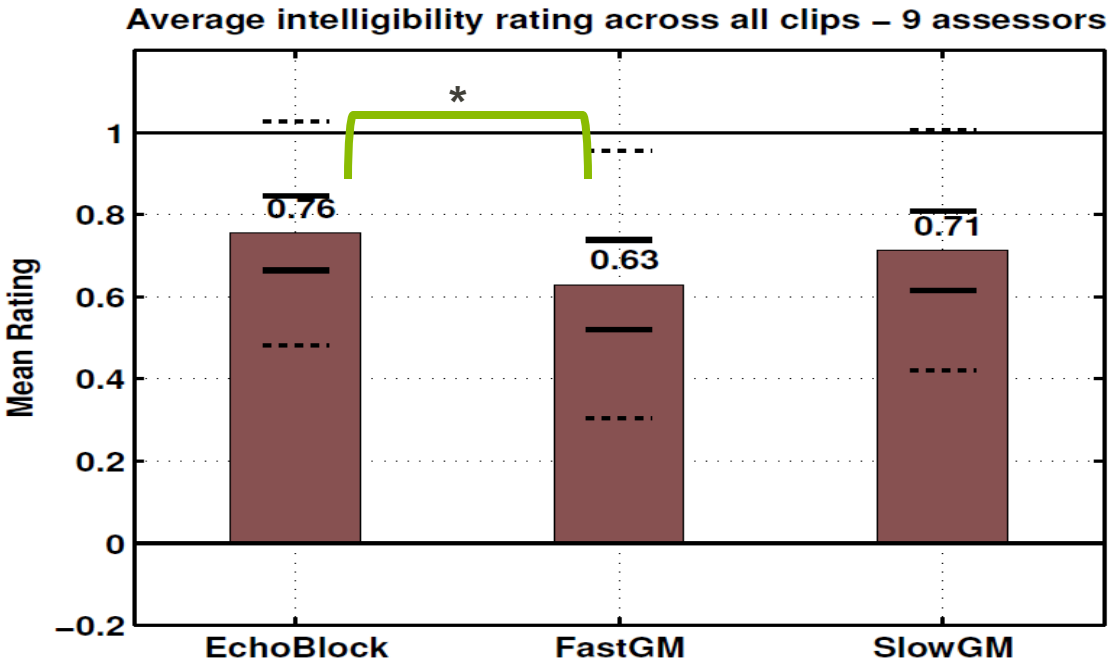
Intelligibility – averaged across clips



Dashed err bars: 2 x std deviation

Solid err bars: 2 x std error

5 subjects show this pattern; 4 show no average differences across clips

* = p < .05

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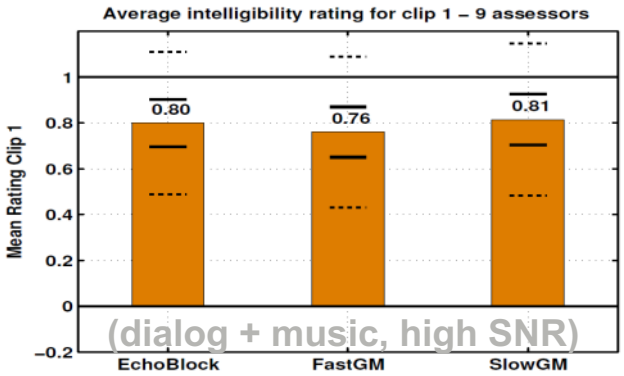
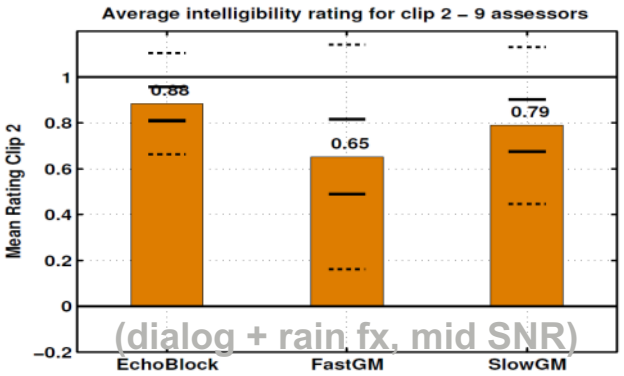
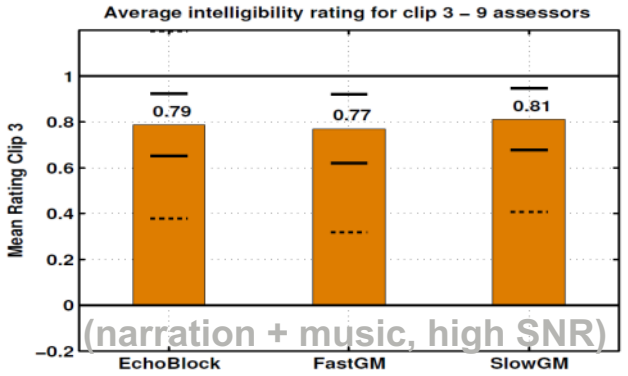
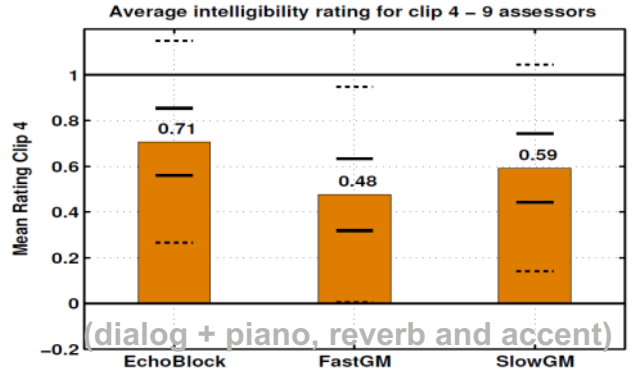
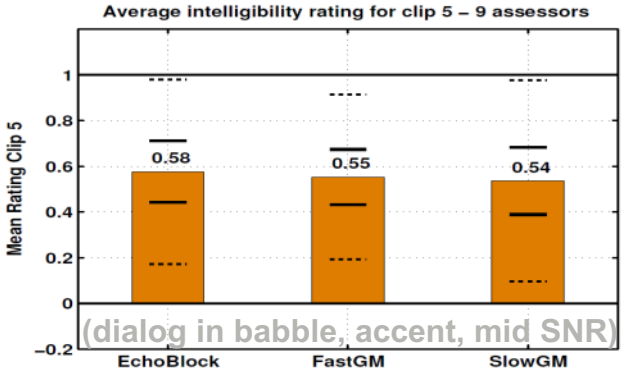
Intelligibility for each clip

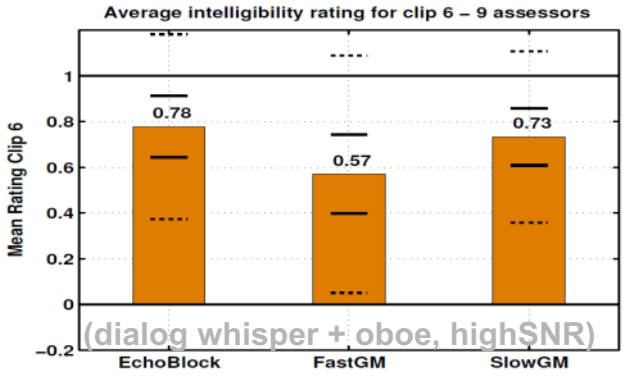






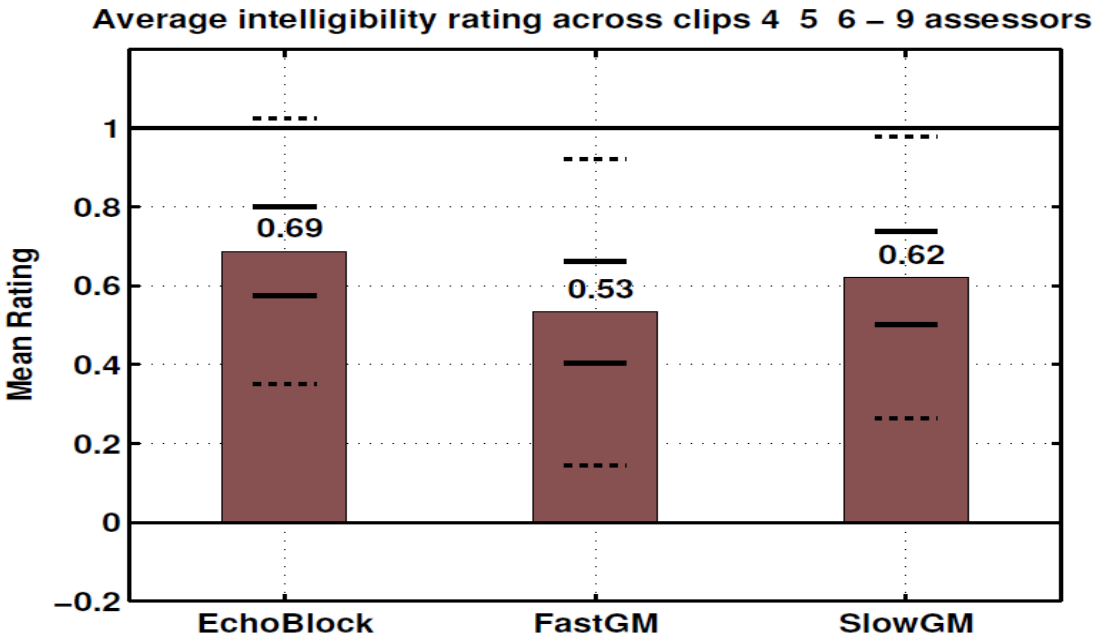






→ Can the programs not be discriminated if the scenes are too easy?

Intelligibility – for 3 clips perceived as most difficult



→ The method seems to be sensitive to across-listener perceived intelligibility differences; material may need to be sufficiently challenging though.

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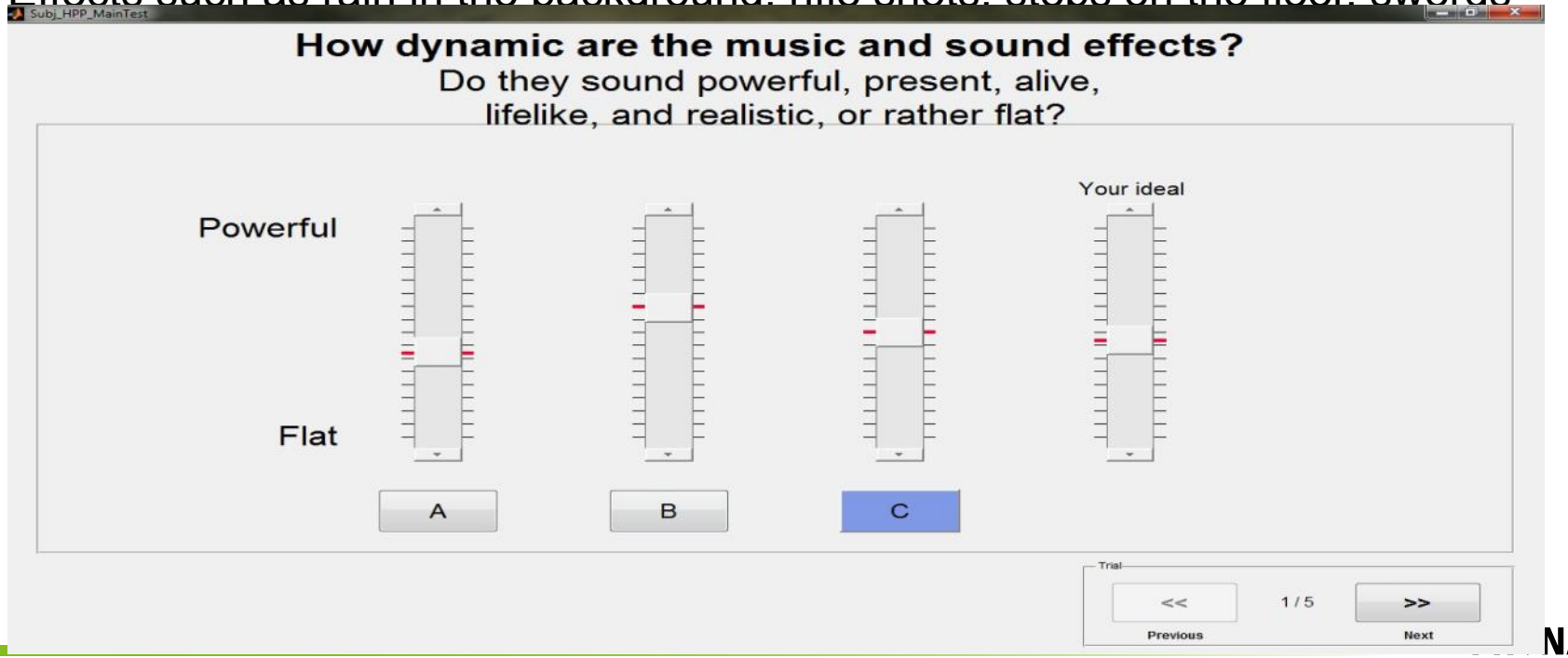
Dynamics of music and sound effects – flat or powerful?

- **Audiovisual**, 5 clips
- Effects such as rain in the background, rifle shots, steps on the floor, swords



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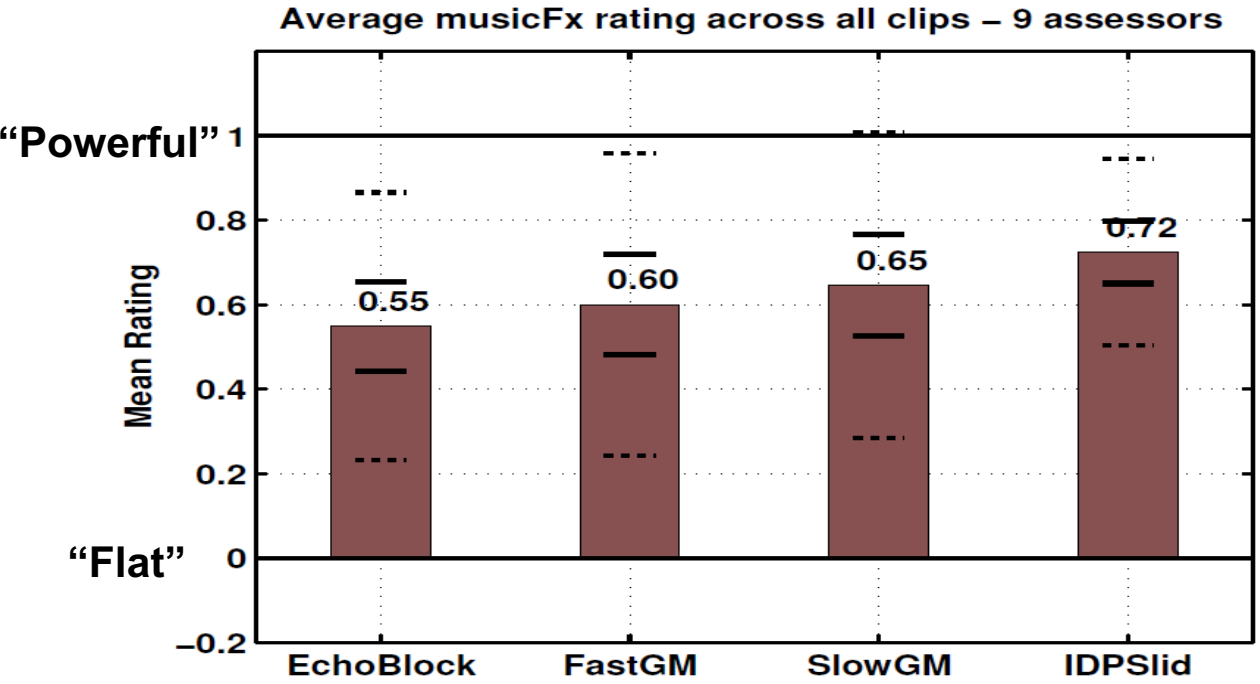
Dynamics of music and Fx



Dashed err bars: 2 x std deviation

Solid err bars: 2 x std error

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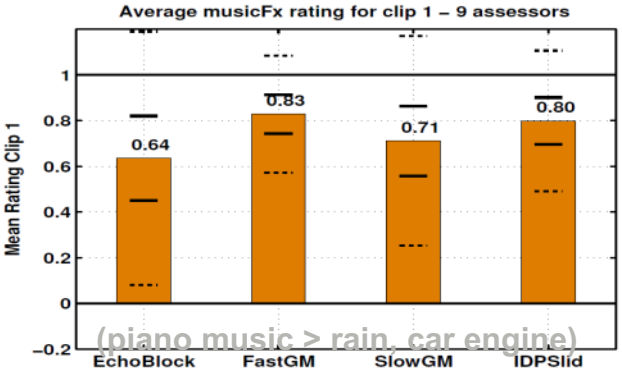
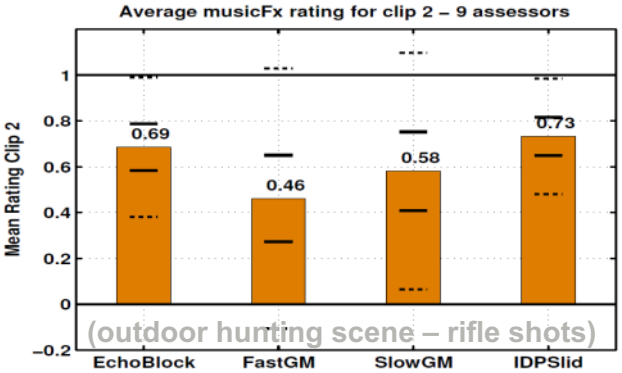
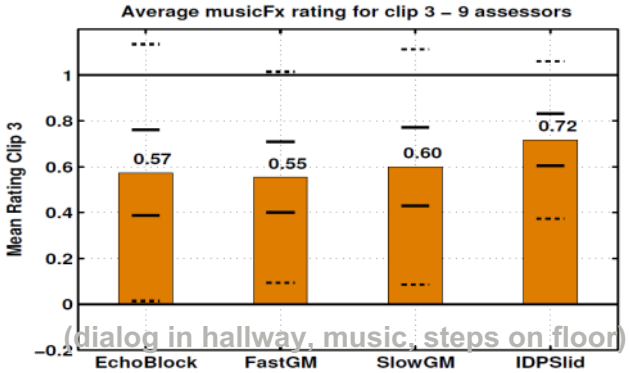
Dynamics of music and Fx for each clip



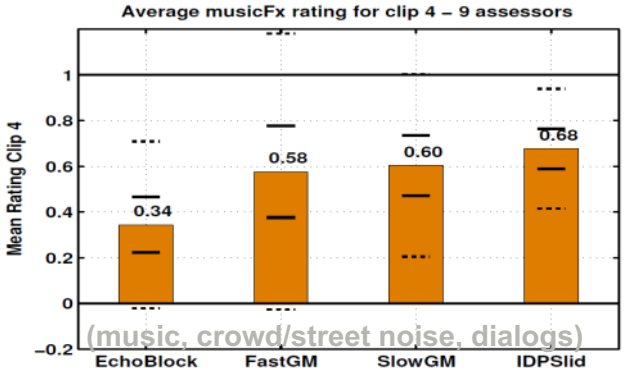
(piano music > rain, car engine)



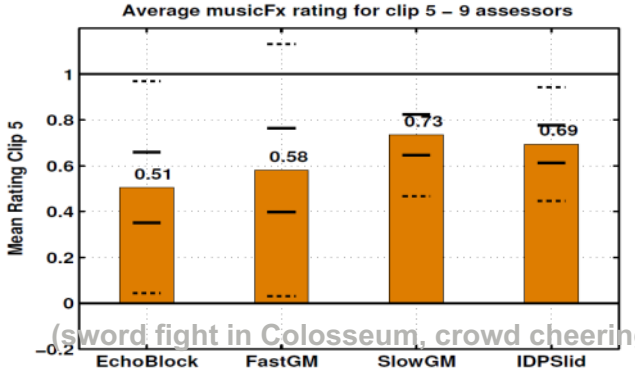
(outdoor hunting scene – rifle shots)



(dialog in hallway, music, steps on floor)



(music, crowd/street noise, dialogs)



(sword fight in Colosseum, crowd cheering)

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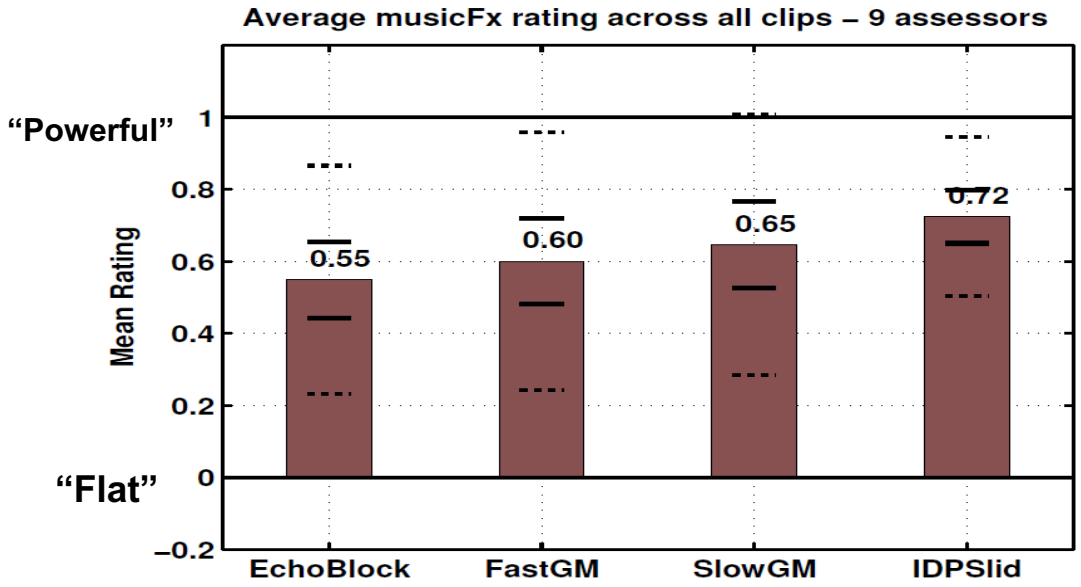
Dynamics of music and Fx



Dashed err bars: 2 x std deviation

Solid err bars: 2 x std error

→ EchoBlock seems to produce flatter music and effects.

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Conclusions Experiment 1

Methodology:

- Multiple HA-program ratings to running film clips can be used to differentiate programs
  - Clips need to be carefully selected (each clip needs to be more or less constant in terms of acoustic content over entire duration)
  - Need to drill down to individual clips (ratings differ across clips)
  - May need to drill down to individual subjects too (if participant number is small as in the present case)

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Conclusions Experiment 1

Average program preferences:

- EchoBlock and slow GM preferred over fast GM for intelligibility
- Slow GM may produce more powerful music and effects than EchoBlock; difference seems to depend strongly on program material

Overall, open for speculation:

→Slow GM may be best for general programming including music and Fx

→EchoBlock might be better than slow GM for speech-only programming or for people who want intelligibility at the cost of music and Fx

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Possible next steps

- Repeat present study as **field study** (in listener's homes)
- Develop additional method: **objective TV speech intelligibility measure** (never done)
- Another radical solution: Test **linear program** for TV listening
- Other hearing aid manipulations: Music program, directionality, frequency shape

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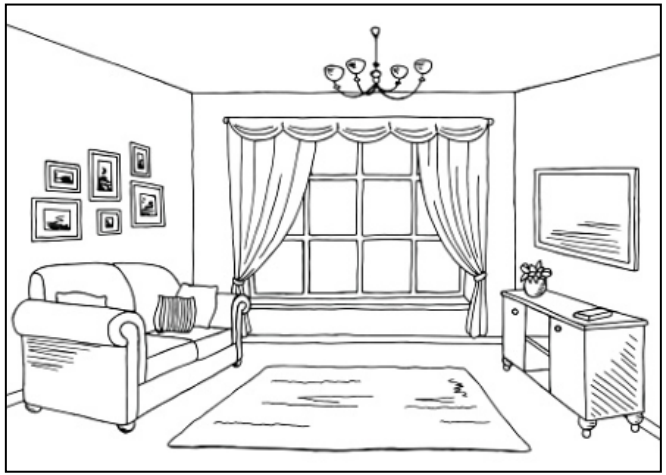
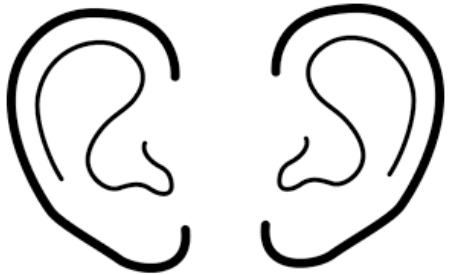
TV Experiment 2

Hearing Aid Streaming

Factors





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Research Question:

- Do the results from Experiment 1 hold true when TV signal is streamed?
- -Results of Exp 1 due to reverberation in room?

- How can hearing aid manufacturers manipulate a media streaming program to maximize comfort and audibility?

- Manipulation of:
- - Echoblock
- - Compression

- Is streaming an effective solution for individuals with TV understanding difficulty?

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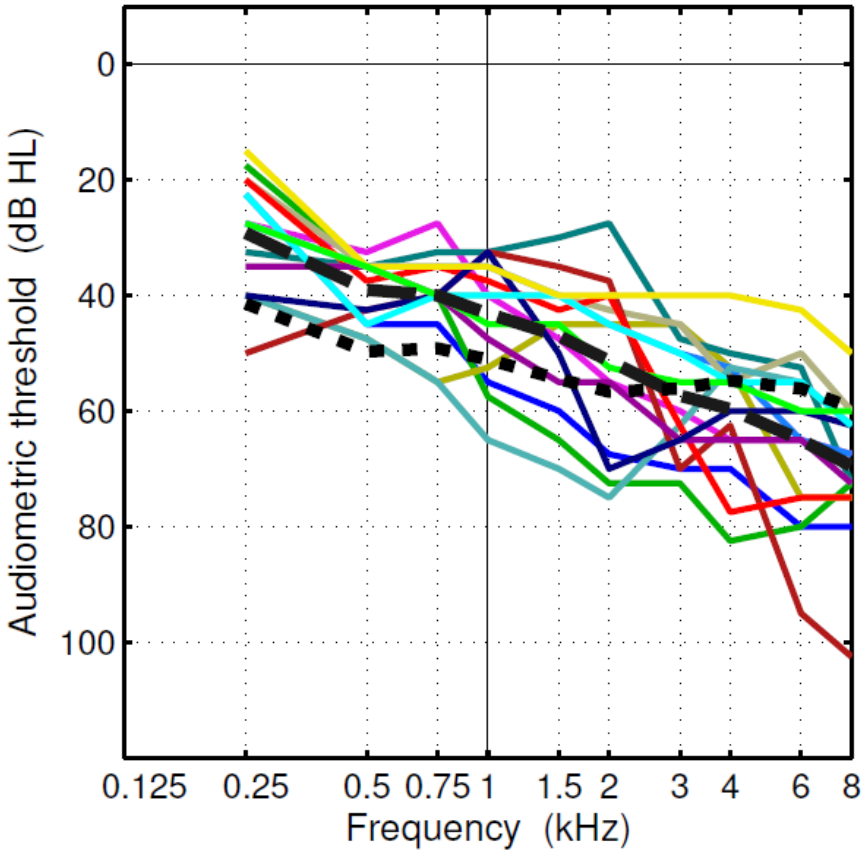
Participants

- Bilateral Symmetric Hearing Loss (no greater than 10 dB HL difference in PTAs)
- Mild to moderately- severe hearing losses
- Wear hearing aids for at least eight hours per day



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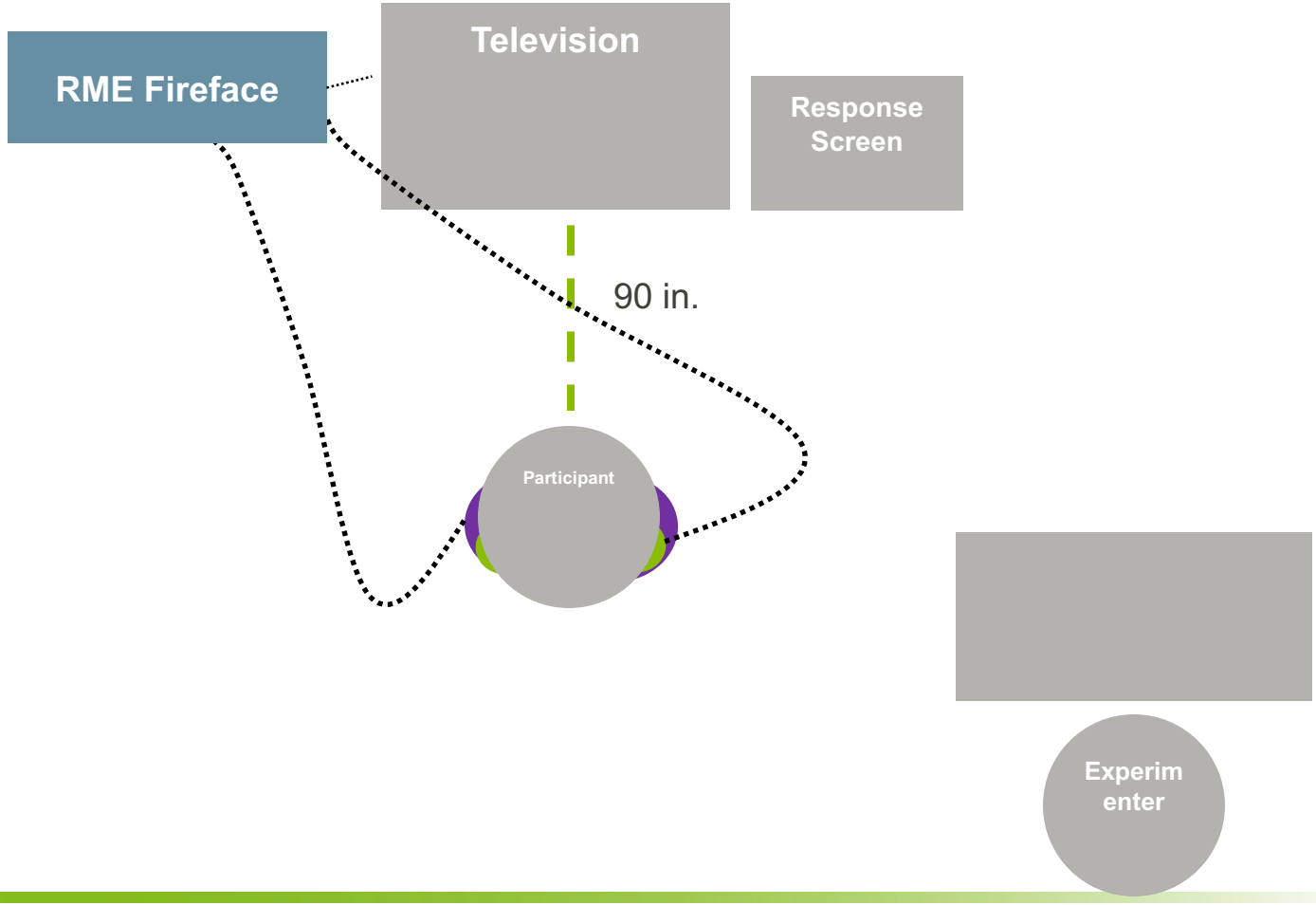

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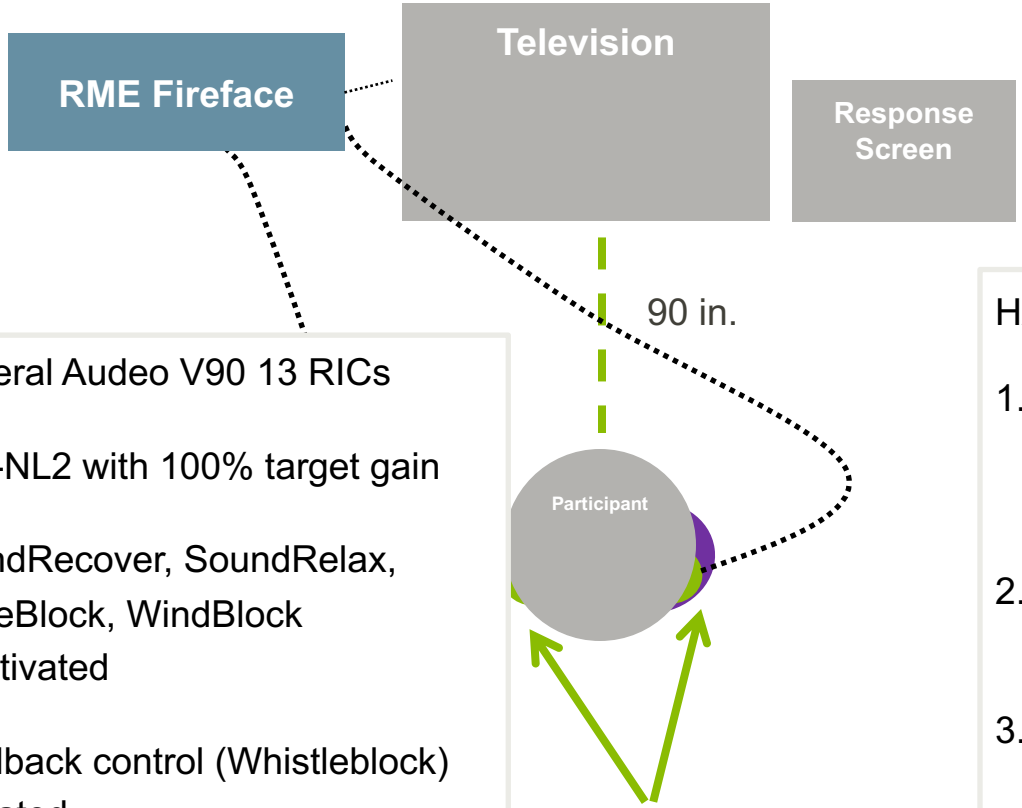

- Bilateral Audeo V90 13 RICs
- NAL-NL2 with 100% target gain
- SoundRecover, SoundRelax, NoiseBlock, WindBlock deactivated
- Feedback control (Whistleblock) activated

HA programs:

1. Roger/DAI + Mic, EchoBlock, compression speed “8” (Slow) – “Comfort in Echo” (level “13”)
2. Roger/DAI + Mic, Echoblock OFF, compression speed “20” (Fast GM)
3. Roger/DAI + Mic, Echoblock OFF, compression speed “8” (Slow GM)

Used " Real Ear Sound” for all programs

» Wore hearing a
with AS18 and I

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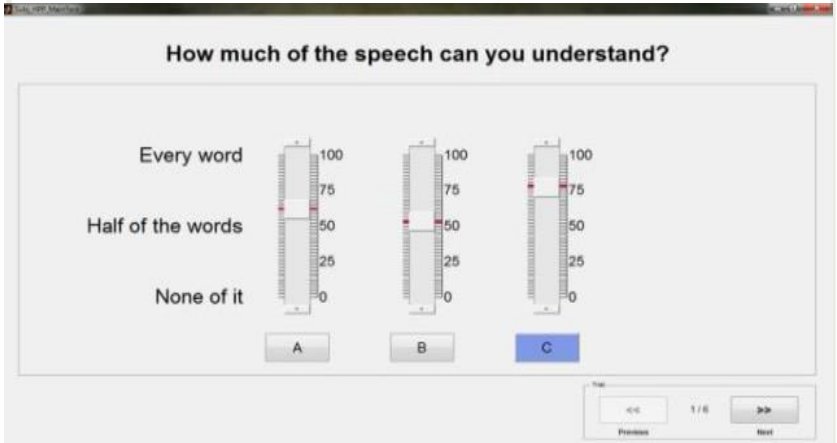
Television

Response Screen

90 in.

Participant

Response Screen:



Experim enter

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Procedures

- Used Subjective HPP MUSHRA tool for HA-program ratings
  - Five rating blocks, counterbalanced across participants (one training clip at beginning of each block)

A – Speech intelligibility, audio only

B – Sound effects and music; audiovisual

C – Sound effects and music ; audio only

D – Source width; audio only

E – Reverberation; audio only

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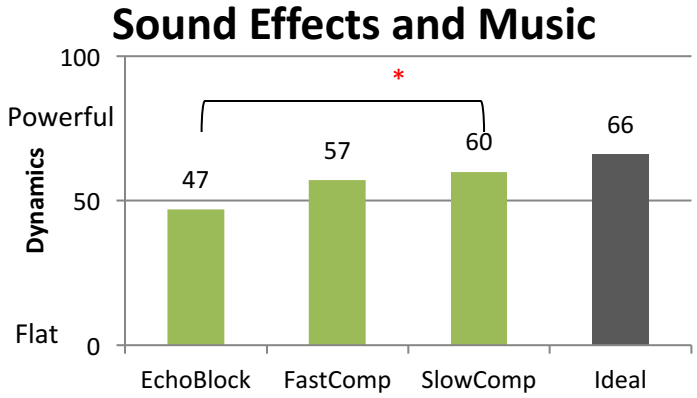
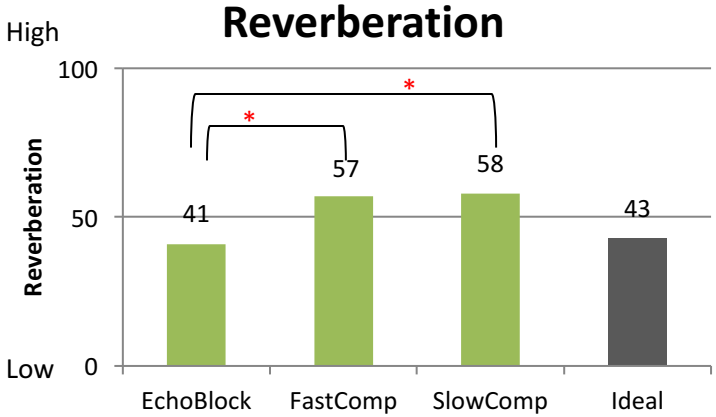
Results

Speech Intelligibility – No significant differences between the three programs (79, 78, and 80%)

Sound Effects and Music– Slow compression more powerful than the other two programs (consistent with Exp 1)

Reverberation – EchoBlock program significantly lowest reverberation rating than the other programs (consistent with Exp 1)





* = p < 0.05

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Conclusions for TV Experiment 2

- Streaming is an effective solution for improving speech intelligibility
- Echoblock seems to show less of a preference than Experiment 1, but shows the same decrement in the dynamics and sound effects
- Slow compression speed preferred for music and sound effects (consistent with Experiment 1)

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TV Experiment 3

Television Settings

Research questions

- Can HA wearers distinguish between different Stereo Mixing Methods (SMMs) in streamed TV presentation?
- If so, what are their SMM preferences? In particular, is stereo objectionable via hearing aids?
- Study designed to inform future products, and determine if specific audio codecs (Dolby) are of benefit/preferable for hearing aid users

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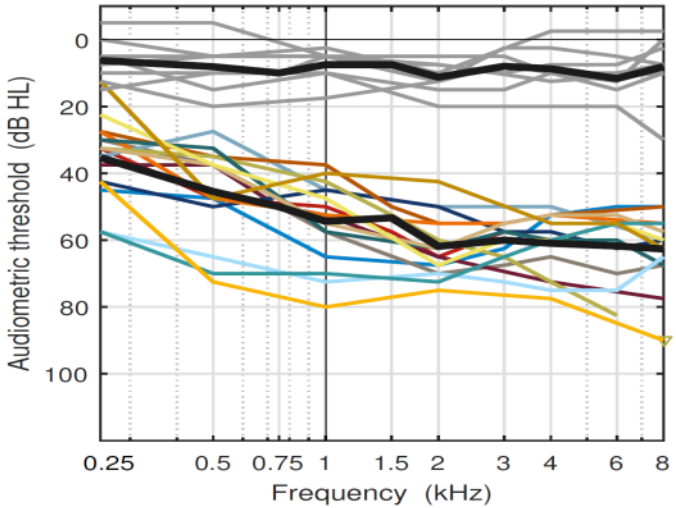
Participants

	HI	NH
# Participants	16	8
Ages / median	23 to 81 / 71	27 to 67 / 35
Gender	8 female / 8 male	5 female / 3 male
Hours TV per day	0.5 to 10 / 2.0	0.5 to 2.5 / 1.25



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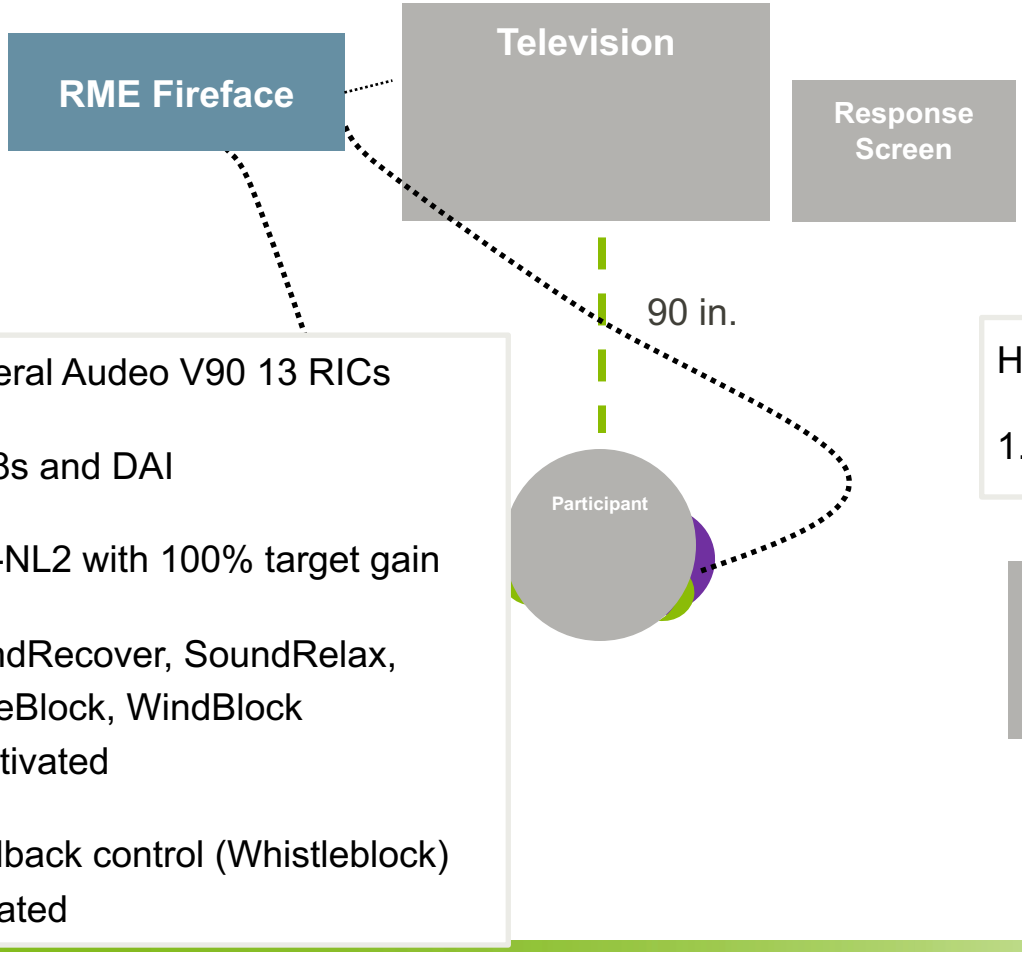

- Bilateral Audeo V90 13 RICs
- AS18s and DAI
- NAL-NL2 with 100% target gain
- SoundRecover, SoundRelax, NoiseBlock, WindBlock deactivated
- Feedback control (Whistleblock) activated

HA Program:

1. Roger/DAI + Mic, Mic attenuation of 6

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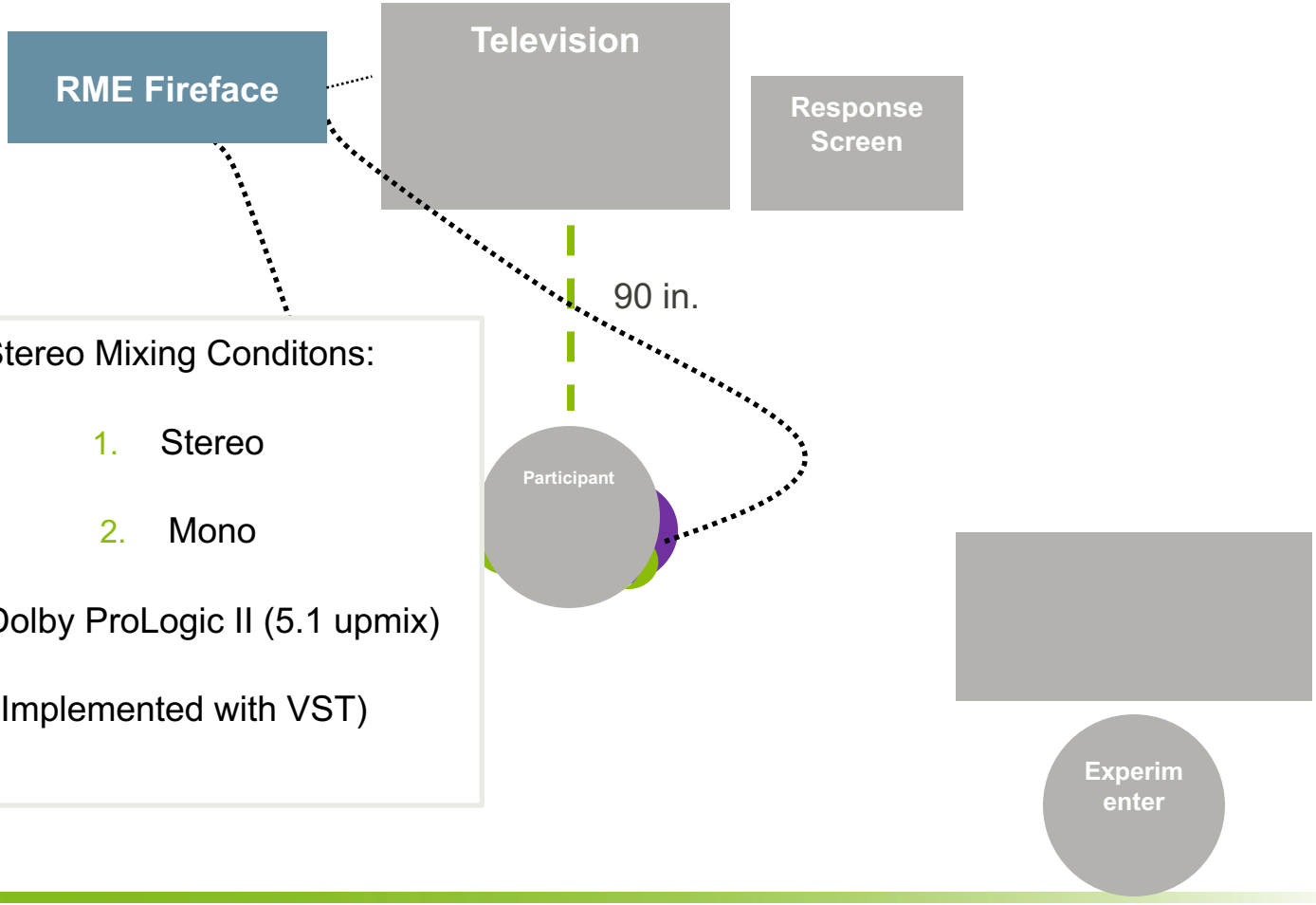

Stereo Mixing Conditons:

1. Stereo
2. Mono
3. Dolby ProLogic II (5.1 upmix)

(Implemented with VST)

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Attributes

- Five rating blocks (one training clip at beginning of each block)

  A – Speech intelligibility, audio only

  B – Realism; audiovisual

  C – Position of virtual loudspeaker (externalization); audio only

  D – Ease of distinguishing source locations; audio only

  E – Comfort of extended listening; audiovisual

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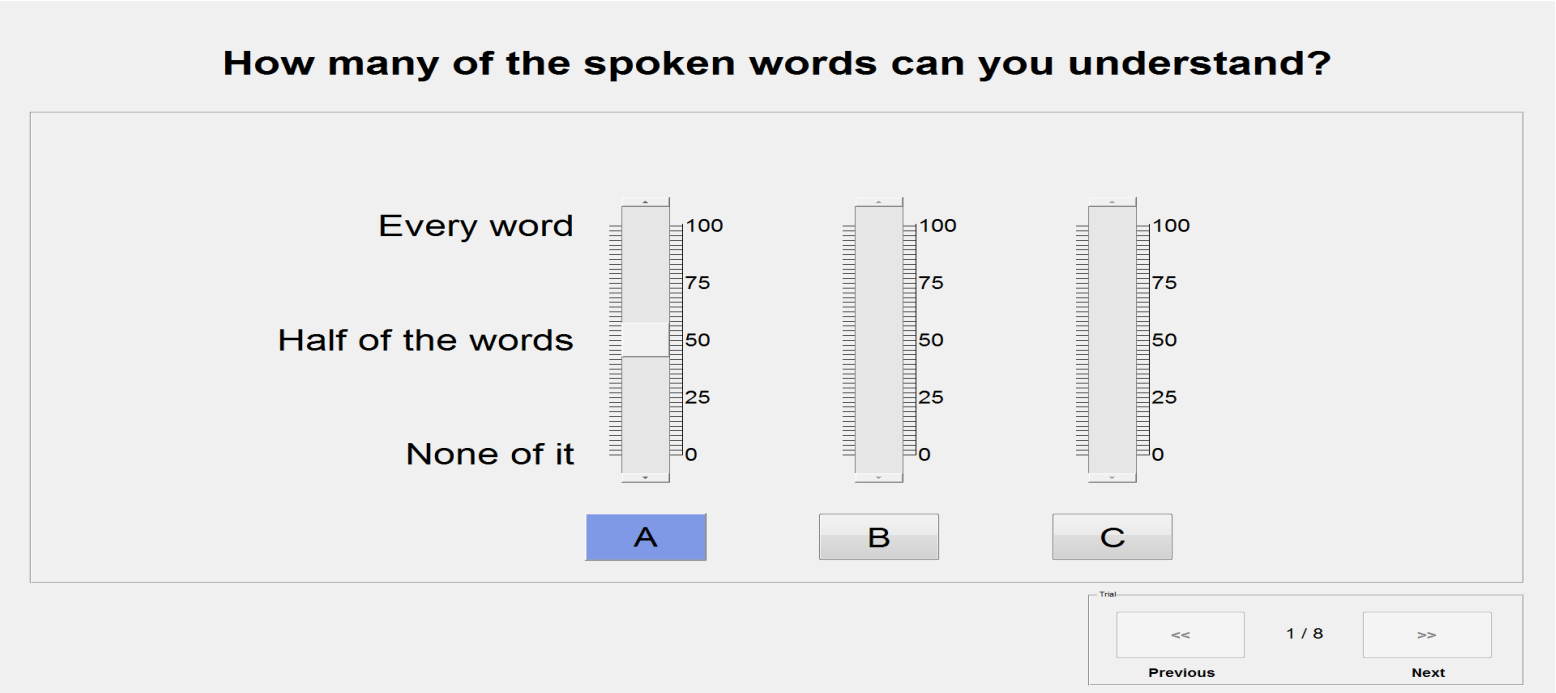
Results of Experiment 3

Perceived speech intelligibility

- Audio only, 8 clips



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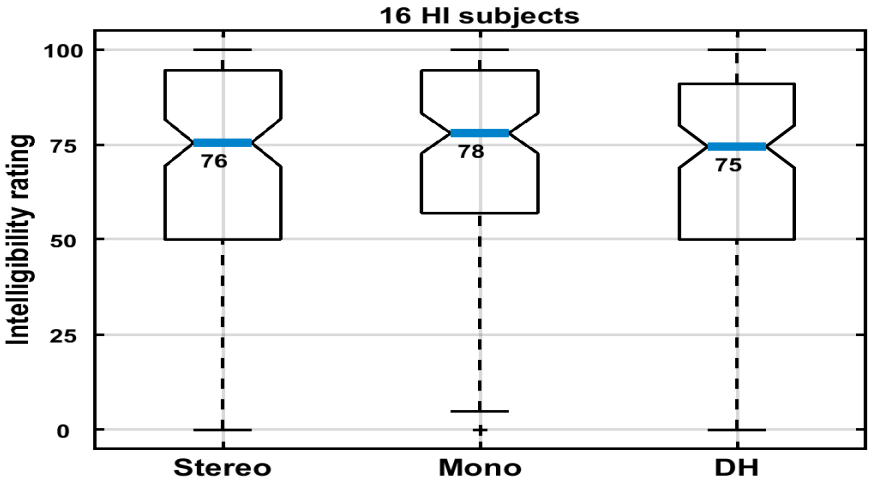
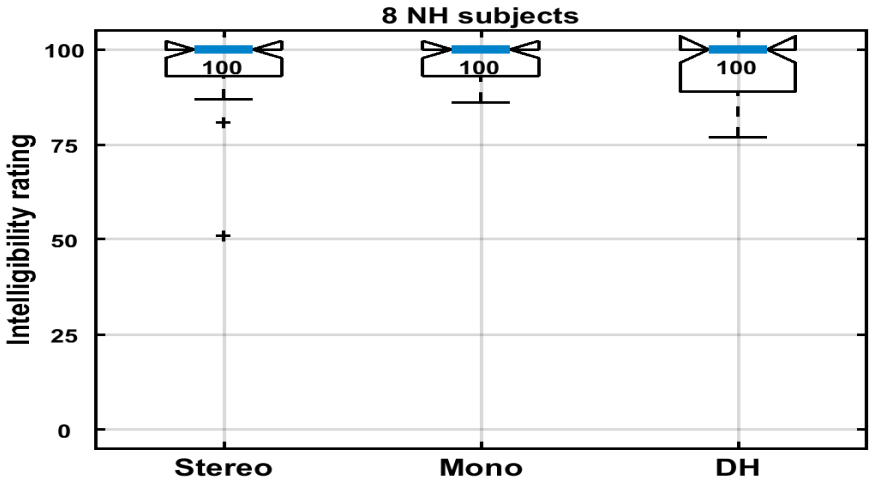
Intelligibility – averaged across clips

HI



NH



→ No differences in intelligibility

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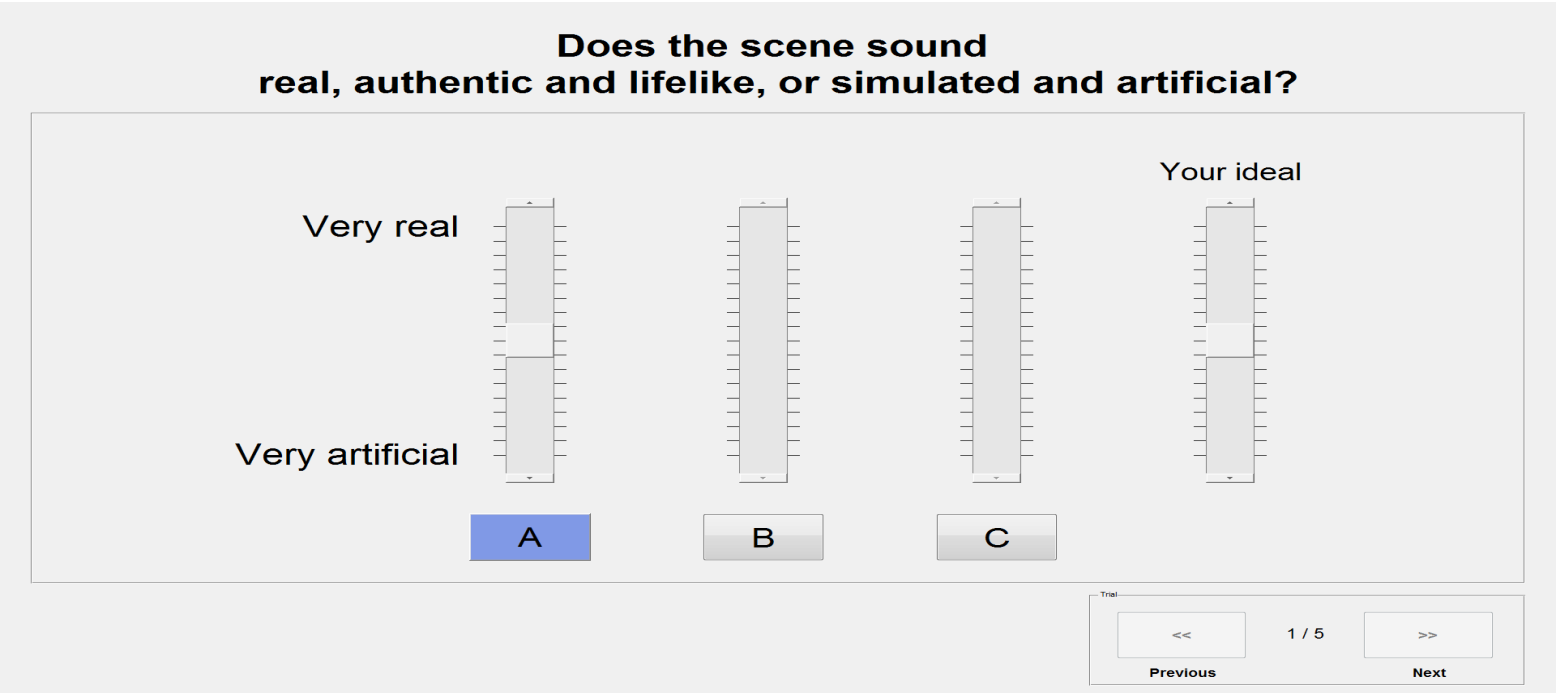
Perceived realism of sound scene

- Audiovisual, 5 clips



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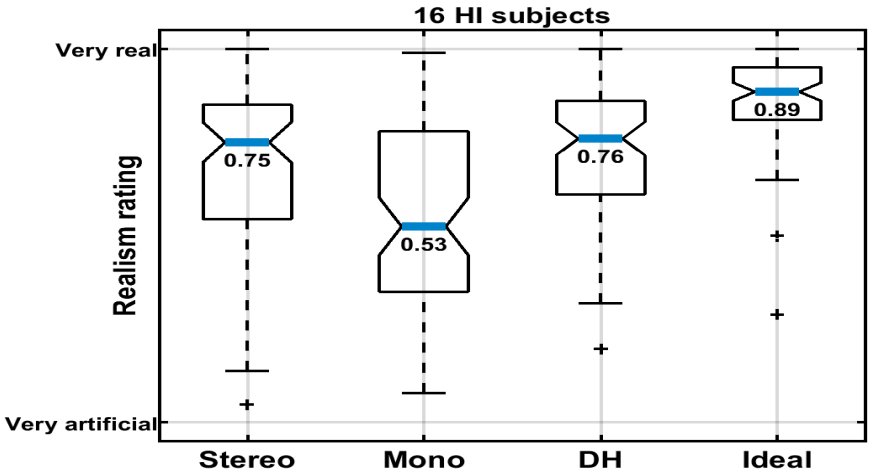
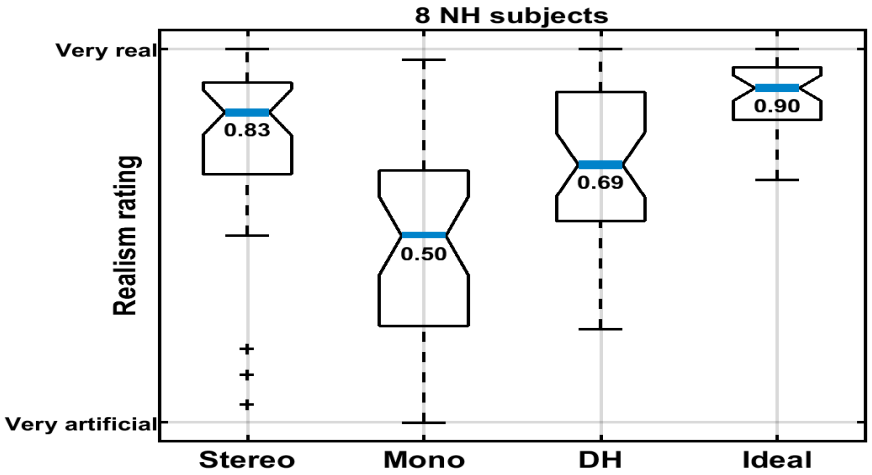
Realism – averaged across clips

HI



NH



→ Both HI and NH rate mono least realistic (with large across-subject variability)

→ NH seem to prefer stereo over Dolby headphone (consistent with Lorho and Zacharov, 2004; Lorho, 2005), HI do not

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Conclusions from Experiment 3

Intelligibility: SMM did not affect subjective intelligibility

Realism: Mono least realistic (NH and HI)

NH preferred Stereo

HI preferred both Stereo and Dolby

More diversity in preferences for HI listeners- more flexibility in settings in hearing aids/streamers?

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Summary and Conclusions

- People watch TV a lot!
- Satisfaction when watching TV is not incredibly high, even with hearing aids
- Watching TV is a complex issue with many factors
- Recommendations can vary depending on individual preferences (speech understanding vs. sound effects)
- Lots of research into the best settings, parameters, and frequency shape for television
- Perhaps things like Echoblock, compression speed can be manipulated to improve intelligiblity/realism
- Lots of variability in preferences

Thank you

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