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The use of mHealth tools to measure real-world hearing performance and hearing aid benefits

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- Rehabilitation outcomes for adults with hearing impairment
- Implementation of family-centred care in audiology
- Neurofeedback training interventions for hearing and balance issues
- New approaches in mHealth and eAudiology.

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This module:

What is Ecological Momentary Assessment (EMA)?

Using EMA to explore hearing difficulties of older adults with mild hearing impairment

Using EMA to measure hearing aid benefit

EMA as a clinical eAudiology tool

Gaining insight into hearing loss

- Audiometry shows hearing acuity
- Low correlation with self-reported hearing difficulties, esp. for mild hearing loss

- Self-report gives better insight into activity limitations and participation restrictions

Timmer, B. H. B., Hickson, L., & Launer, S. (2015). Adults with mild hearing impairment: Are we meeting the challenge? *International Journal of Audiology, 54*(11), 786-795

Self-report measures

- Traditional self-report measures require input from the participant based on his/her memory and experience of select listening situations
- This input is often generalized across listening situations
- Ecological Momentary Assessment (EMA) captures data about experiences in real time, in participants' natural environments

Timmer, B. H. B., Hickson, L., & Launer, S. (2018). The use of ecological momentary assessment in hearing research and future clinical applications. Hearing Research, Early online. doi: 10.1016/j.heares.2018.06.012.

What is EMA?

Surveys of current experiences in real time and at multiple times per day

- Used across many health disciplines to investigate chronic conditions e.g. pain, substance addiction, eating disorders, and mental health disability
- Also called experiential sampling
- Can yield a large number of reports per participant and allow for investigation of variability between and within individuals
- Use of smartphones increases reliability
- Valid and relevant for audiology research

EMA study #1: Using EMA to explore hearing difficulties of older adults with mild hearing impairment

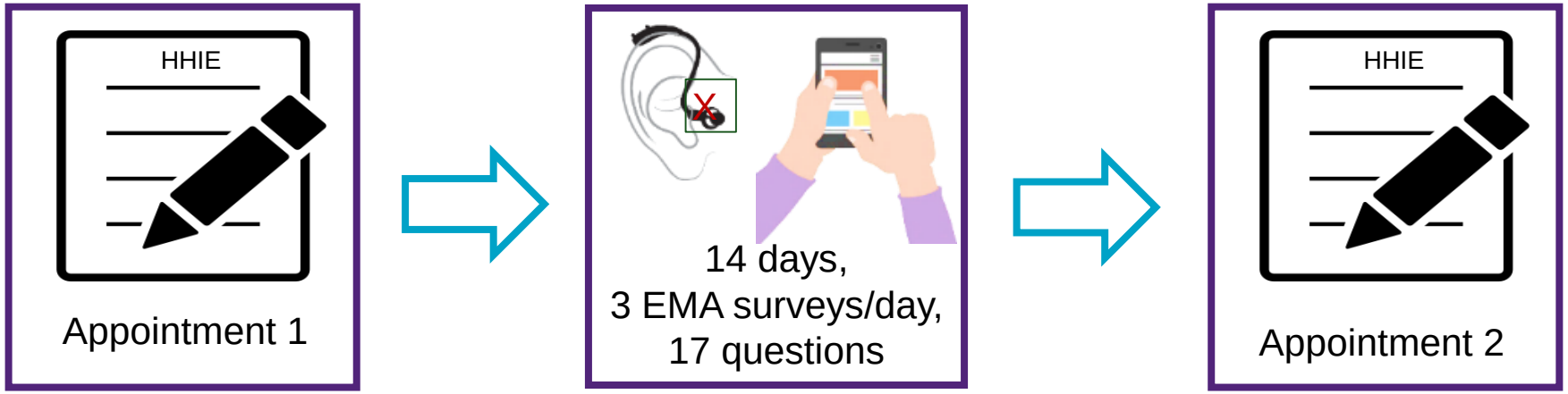
Research questions:

- What are the common listening situations of adults with mild hearing impairment and
- How do adults with mild hearing impairment rate their hearing performance in those situations?

Timmer, B. H. B., Hickson, L., & Launer, S. (2017). Ecological momentary assessment: Feasibility, construct validity and future applications. *American Journal of Audiology, 26*(3S), 436-442.

Characteristic	Classification	N=29
Age, years	Mean (range)	69.0 (57 to 79)
Gender, n(%)	Female	11 (38%)
	Male	18 (62%)
Own hearing aids, n(%)	Yes	5 (17%)
	No	24 (83%)
Attitude towards HA, n(%)	Neutral/negative	14 (48%)
	Positive	15 (52%)
HHIE score	No disability, n(%)	11 (38%)
	Mild to moderate disability n(%)	17 (69%)
	Significant disability, n(%)	1 (3%)
	mean (SD)	19.9 (12.5)
Hearing status, dB HL	4 FAHL (0.5, 1, 2, 4 kHz) better ear, median (IQR)	26.3 (22.5 to 31.3)
	4 FAHL worse ear, median (IQR)	32.5 (26.3 to 35.0)
	6 FAHL (0.5, 1, 2, 4, 6, 8 kHz) better ear, median (IQR)	35.0 (31.7 to 40.8)
	6 FAHL worse ear, median (IQR)	39.2 (36.7 to 46.7)

EMA study design



- Participants received instructions (verbal and written) during appt 1 and were contacted 2-3 days later
- App (MobEval) included time- and environmental triggers to alert for survey completion; surveys could also be self-triggered
- Equipment collected and participants debriefed during appt 2

EMA survey - listening event

Listening activity, and characteristics of the listening situation and acoustic environment, e.g.

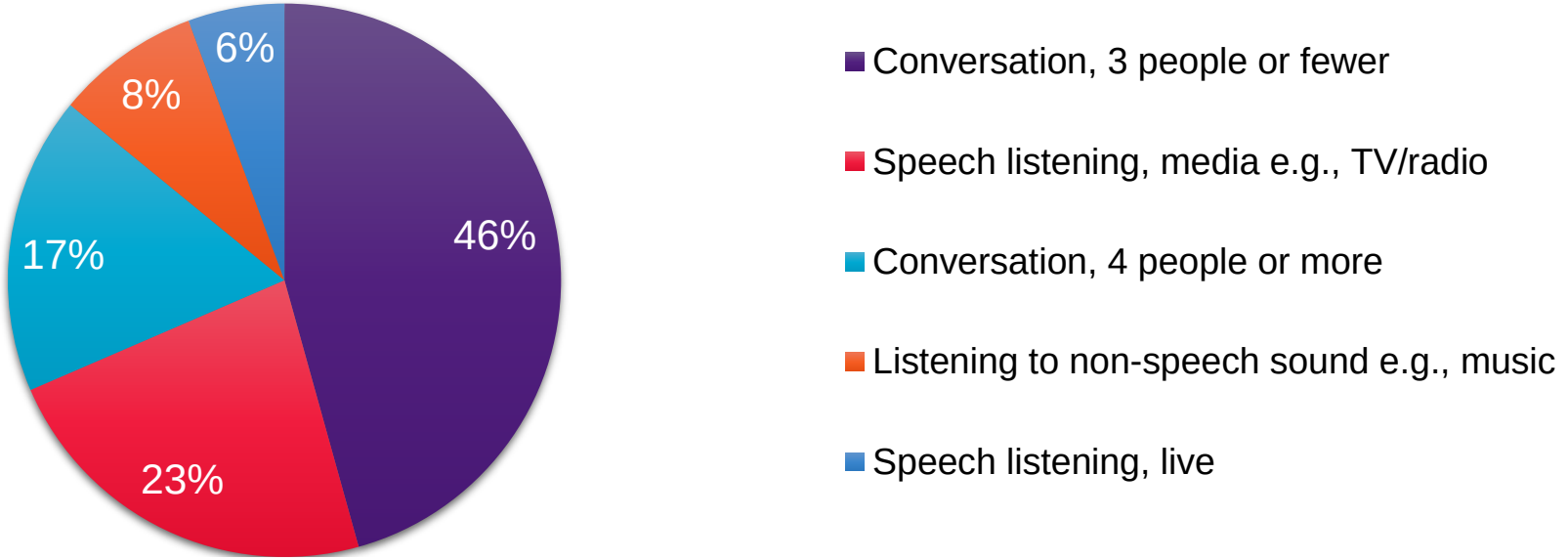
What were you listening to?	□ Conversation, 3 people or fewer □ Conversation, 4 people or more □ Speech listening, live □ Speech listening, media □ Conversation on phone
Compared to an average living room, how large was the room?	□ Smaller □ About average □ Larger
Were you familiar with the speaker(s)?	□ Unfamiliar □ Somewhat unfamiliar □ Somewhat familiar □ Familiar
On average, how noisy was it during the listening event?	□ Quiet □ Somewhat noisy □ Noisy □ Very noisy

EMA survey - hearing performance

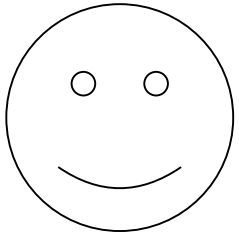
On average, how much **speech** did you understand during the listening event?	☐ 0% ☐ 25% ☐ 50% ☐ 75% ☐ 100%
On average, how much **effort** did you have to put in to listen effectively?	☐ No effort ☐ Some effort ☐ Moderate effort ☐ Quite a bit of effort ☐ A lot of effort
How much have your **hearing difficulties affected** what you wanted to do during the listening event?	☐ Not at all ☐ A little ☐ Moderately ☐ Quite a bit ☐ Very much

EMA findings

- A total of 1128 surveys collected, 98% of which were completed during or within 1 hour of a listening event
- The most frequent listening event was conversation with three or fewer people, with familiar speakers, in the home and in a quiet or only somewhat noisy environment



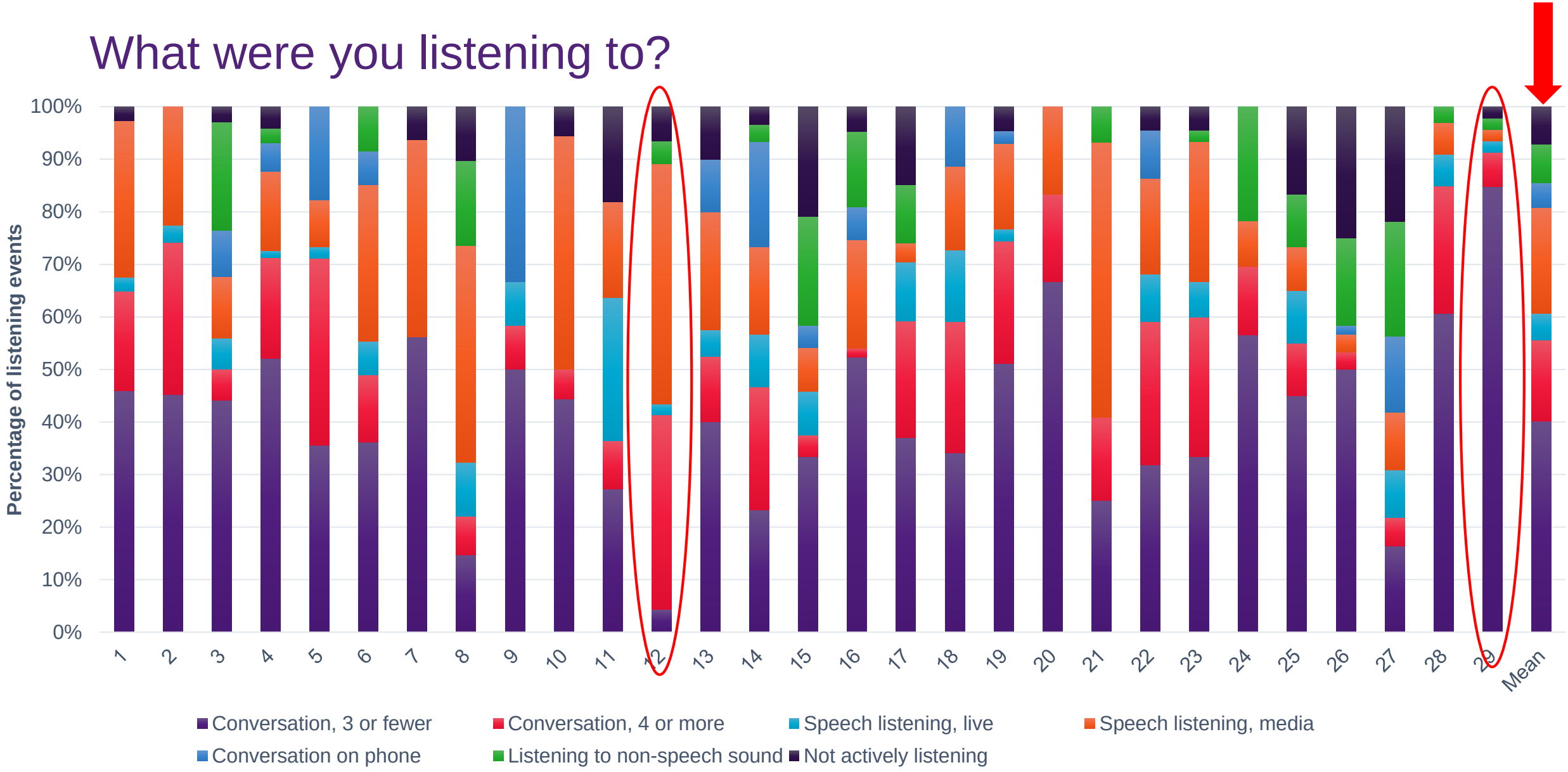
EMA findings



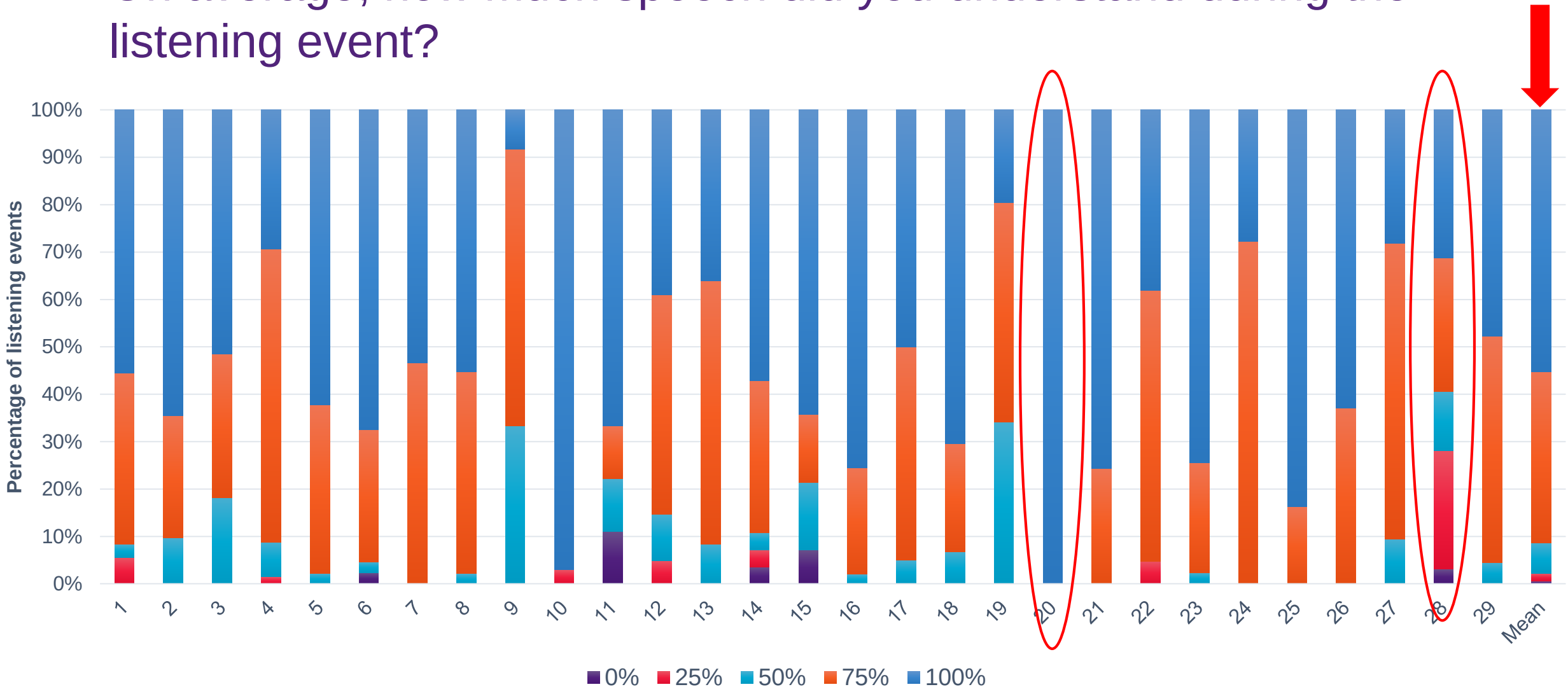
In 91% of listening events participants rated their percentage of speech understanding as either 75% or 100%

In 67% of listening situations, participants reported that listening effectively required effort

What were you listening to?



On average, how much speech did you understand during the listening event?



Conclusions EMA study 1:

- The most common listening situations surveyed were non-complex
- Participants reported very good to excellent speech understanding
- Participants were expending effort to reach that performance level

Even in simple listening situations, adults with mild hearing loss are putting in significant effort to hear well

EMA study #2: Using EMA to measure hearing aid benefit

- Speech perception tests in quiet or in noise show only a moderate correlation, at best, with self-reported hearing difficulties for adults with mild hearing impairment
- The most common intervention for adults with mild hearing impairment is the provision of hearing aids

Research question:

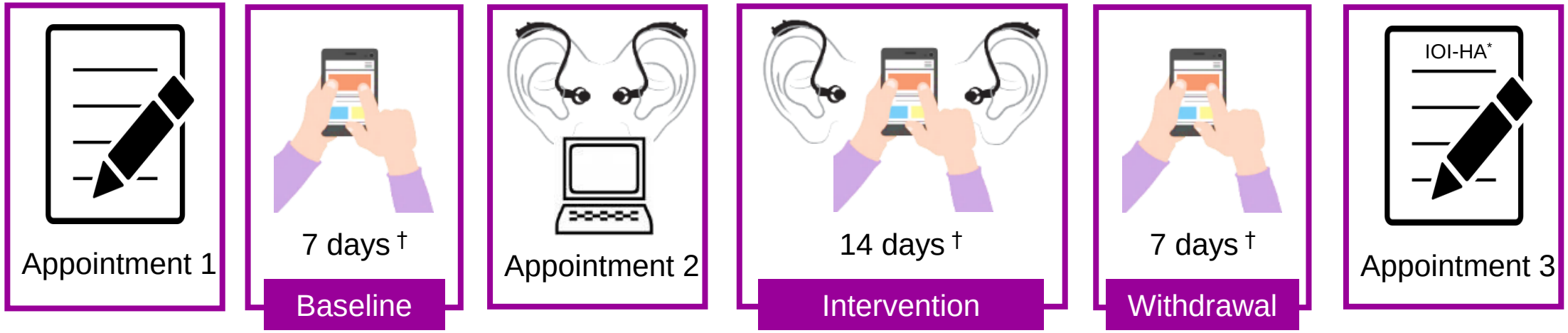
- Can hearing aids provide benefit for adults with a mild hearing impairment in daily life, as measured by EMA?

Timmer, B. H. B., Hickson, L., & Launer, S. (2018). Do Hearing Aids Address Real-World Hearing Difficulties for Adults With Mild Hearing Impairment? Results From a Pilot Study Using Ecological Momentary Assessment. *Trends in Hearing, 22*, doi: 10.1177/2331216518783608.

Participant characteristics

	Age (years)	Gender	Length of hearing difficulties (years)	Confidence in managing HAs	Attitude to HAs
1	71	Female	2	Quite a bit	0
2	73	Male	10	Quite a bit	2
3	75	Female	9	Quite a bit	-3
4	65	Male	17	Quite a bit	-1
5	65	Male	8	Extremely	1
6	81	Female	15	Somewhat	1
7	71	Female	7	Quite a bit	0
8	57	Male	20	Extremely	2
9	72	Male	6	Quite a bit	0
10	67	Male	4	Extremely	-2

Study design



† Target: 3 EMA surveys/day, 16 questions including 4 hearing performance dimensions: speech understanding, effort required to listen effectively, hearing difficulties negatively affecting or hampering communication and enjoyment of the listening events

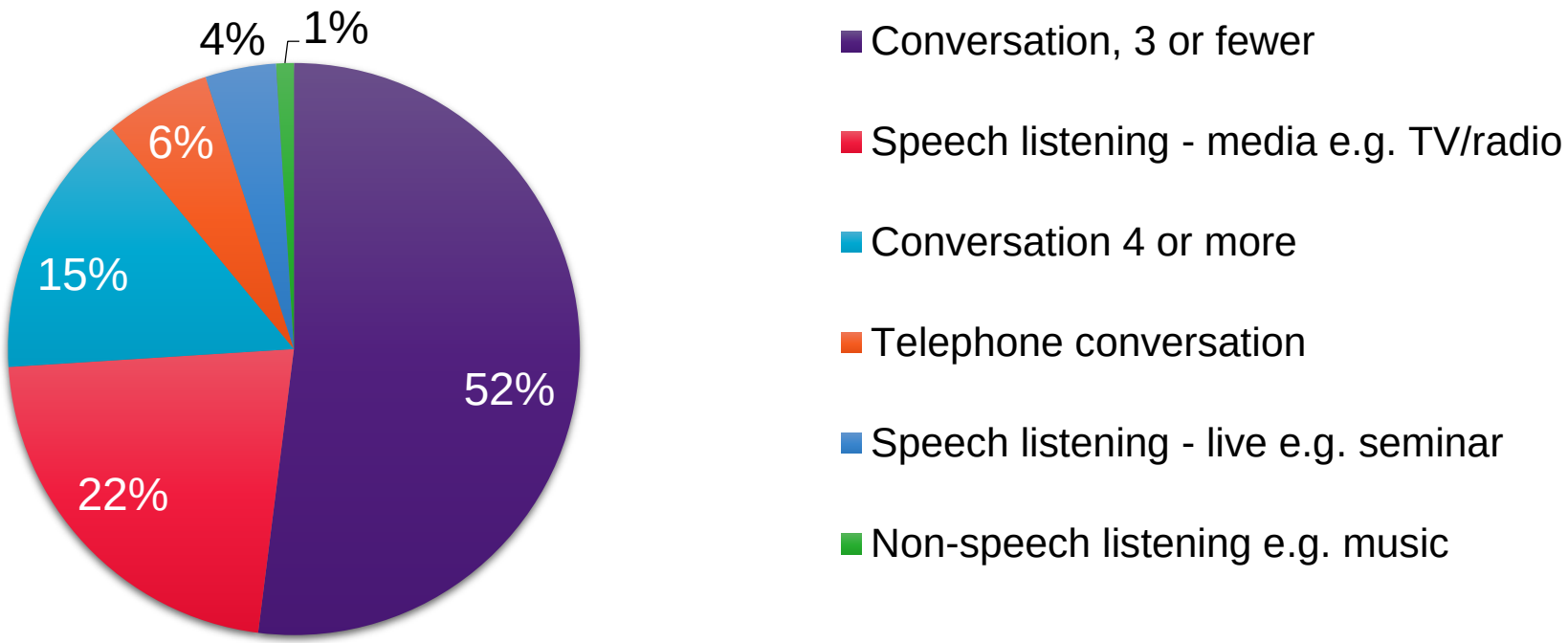
EMA Survey – hearing performance

On average, how much speech did you understand during the listening event?	☐ 0% ☐ 10% ……. ☐ 90% ☐ 100%
On average, how much effort did you have to put in to listen effectively?	☐ No effort ☐ Some effort ☐ Moderate effort ☐ Quite a bit of effort ☐ A lot of effort
Do you feel that any difficulty with your hearing negatively affected or hampered communication during this listening event?	☐ Not at all ☐ A little ☐ Moderately ☐ Quite a bit ☐ Very much
Do you feel your hearing negatively affected your enjoyment of this listening event?	☐ Not at all ☐ A little ☐ Moderately ☐ Quite a bit ☐ Very much

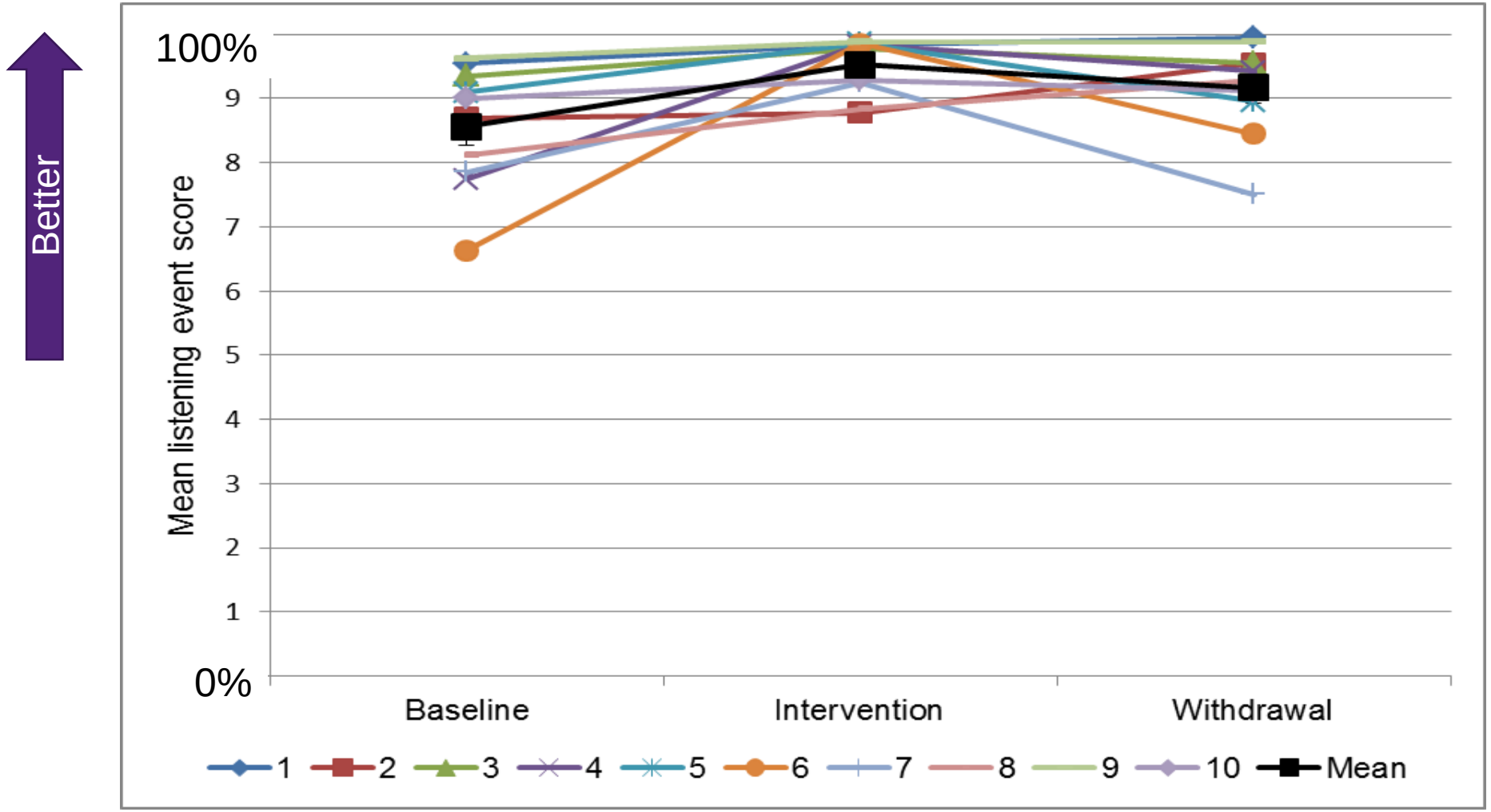
Results

A total of 860 listening event surveys collected from the 10 participants (mean= 67.4, range = 43 – 112 per participant)

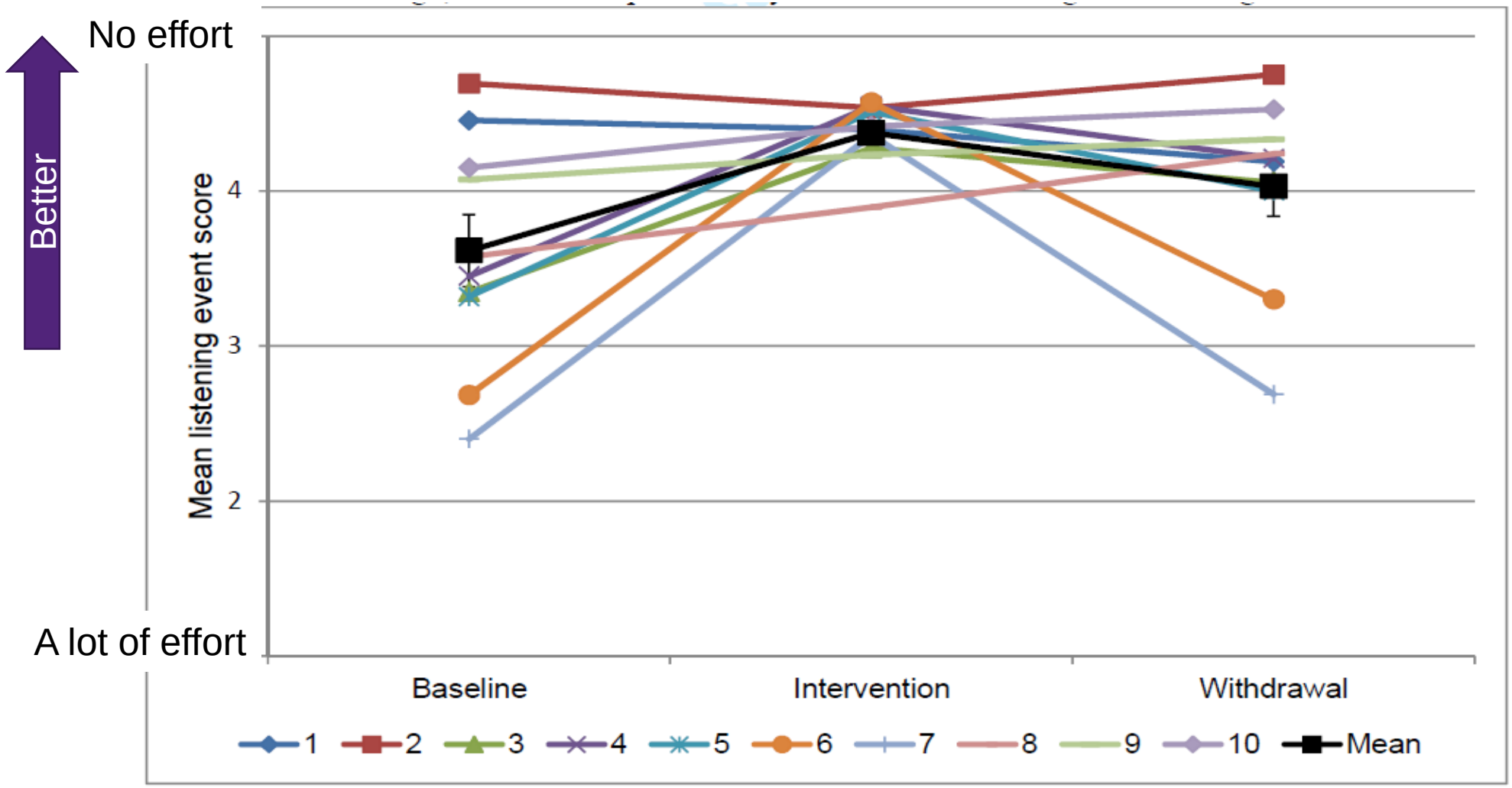
Predominantly non-complex listening situations:



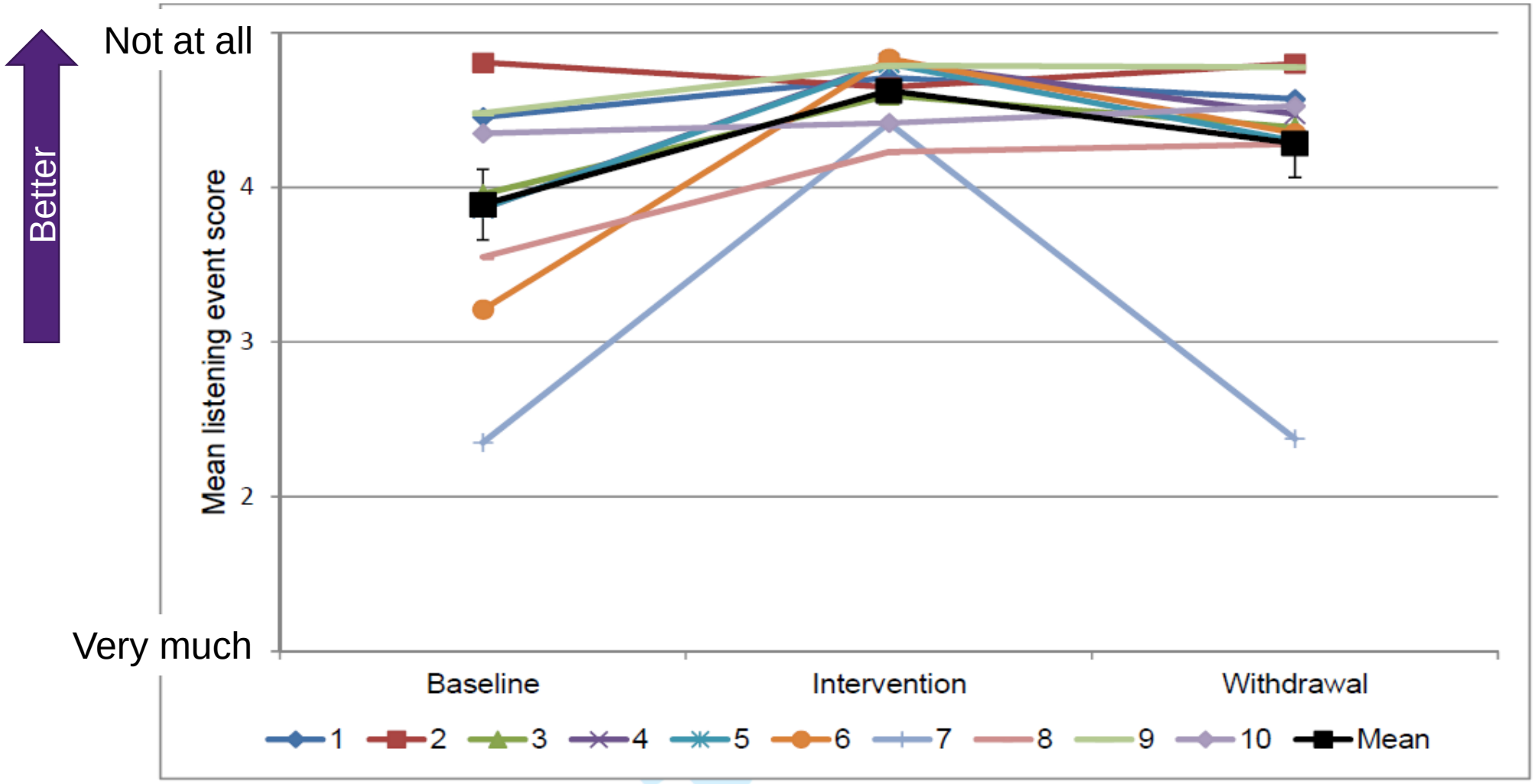
Results: On average, how much speech did you understand during the listening event?



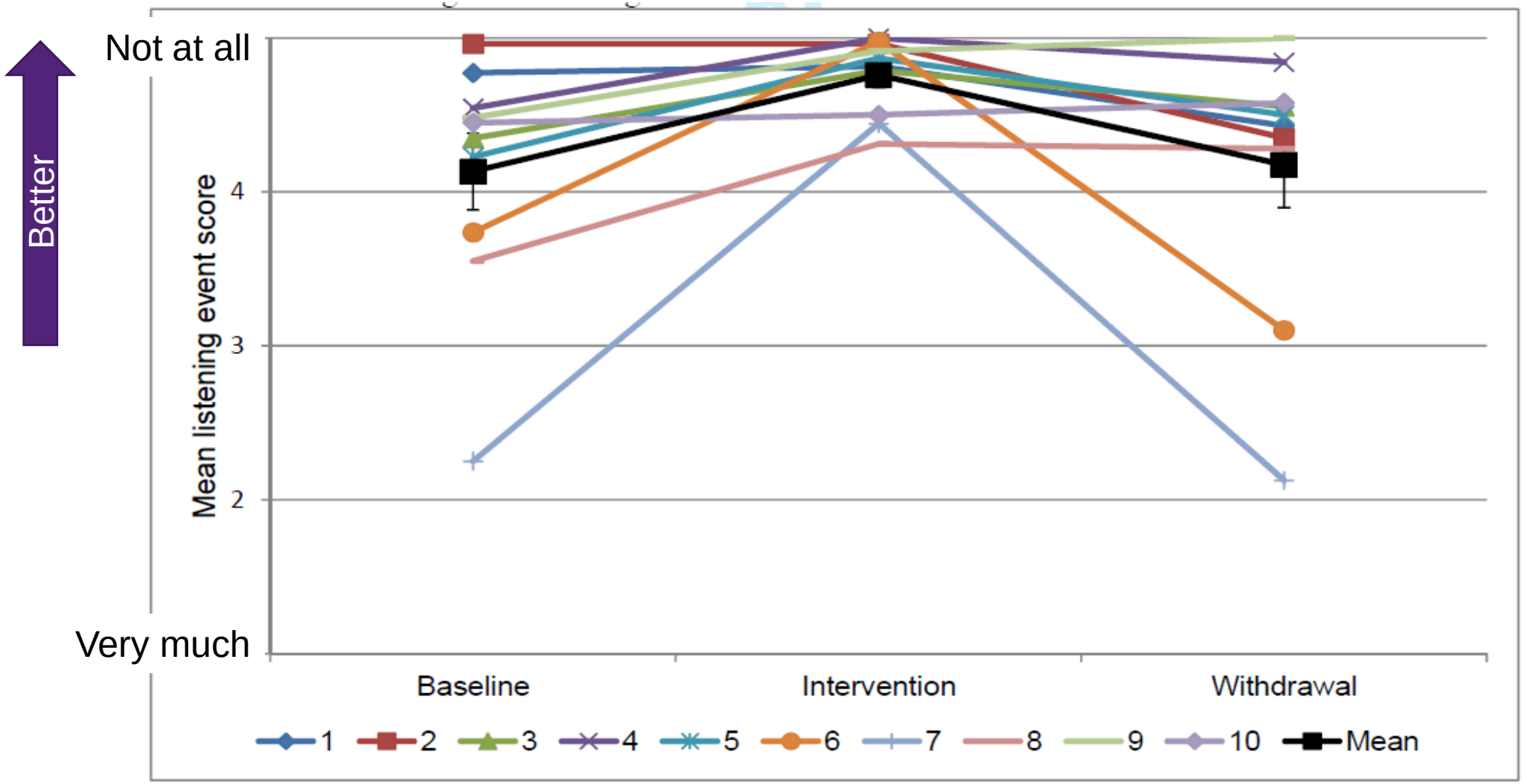
Results: On average, how much effort did you have to put in to listen effectively?



Results: Do you feel that any difficulty with your hearing negatively affected or hampered communication during this listening event?



Results: Do you feel your hearing negatively affected your enjoyment of this listening event?



What does this mean?

This data can be converted into a benefit effect size using scores from the baseline (no HA) and intervention (HA) phases

Benchmarks for effect sizes from:

J Am Acad Audiol 27:293–310 (2016)

Hearing Aid Benefit in Patients with Mild Sensorineural Hearing Loss: A Systematic Review

DOI: 10.3766/jaaa.14076

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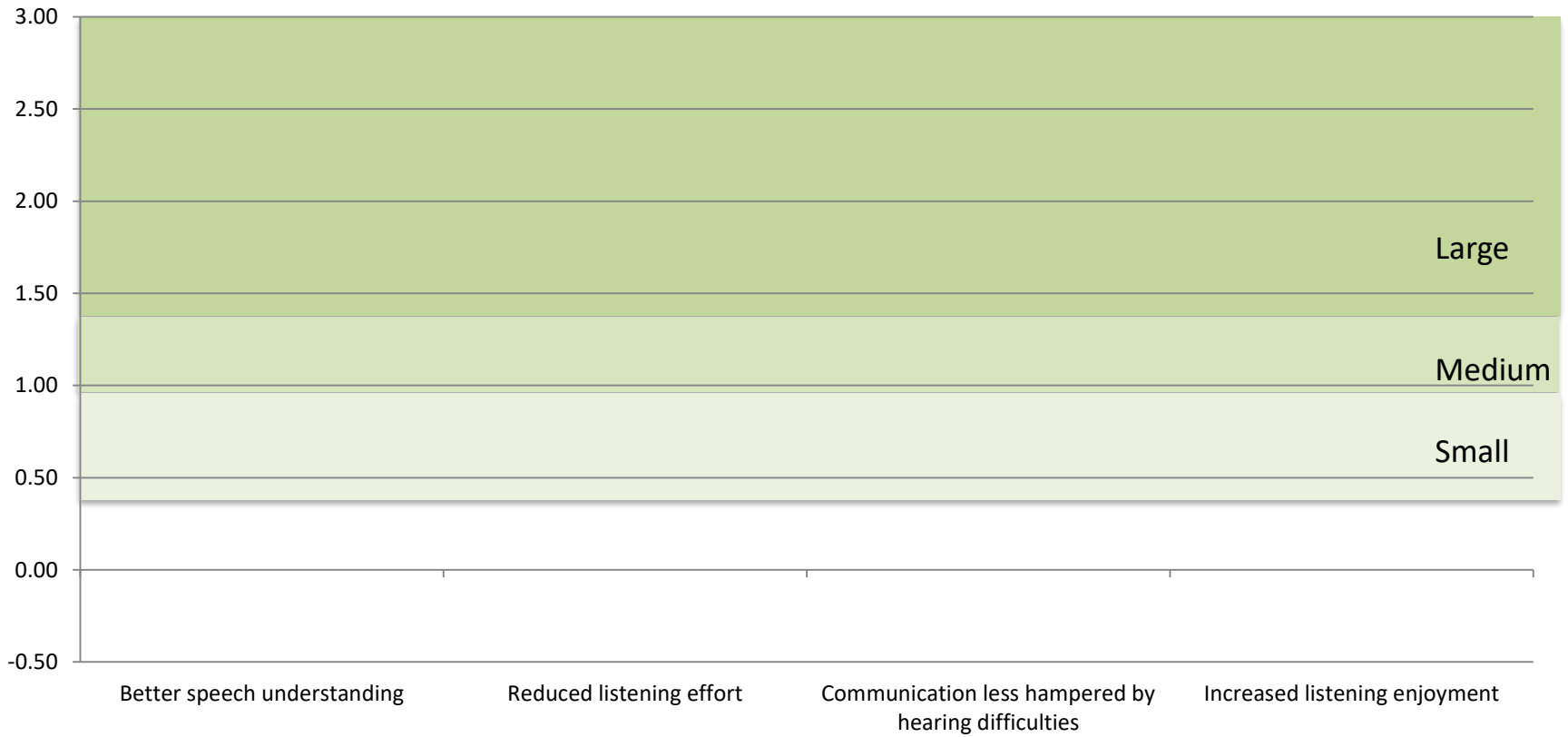
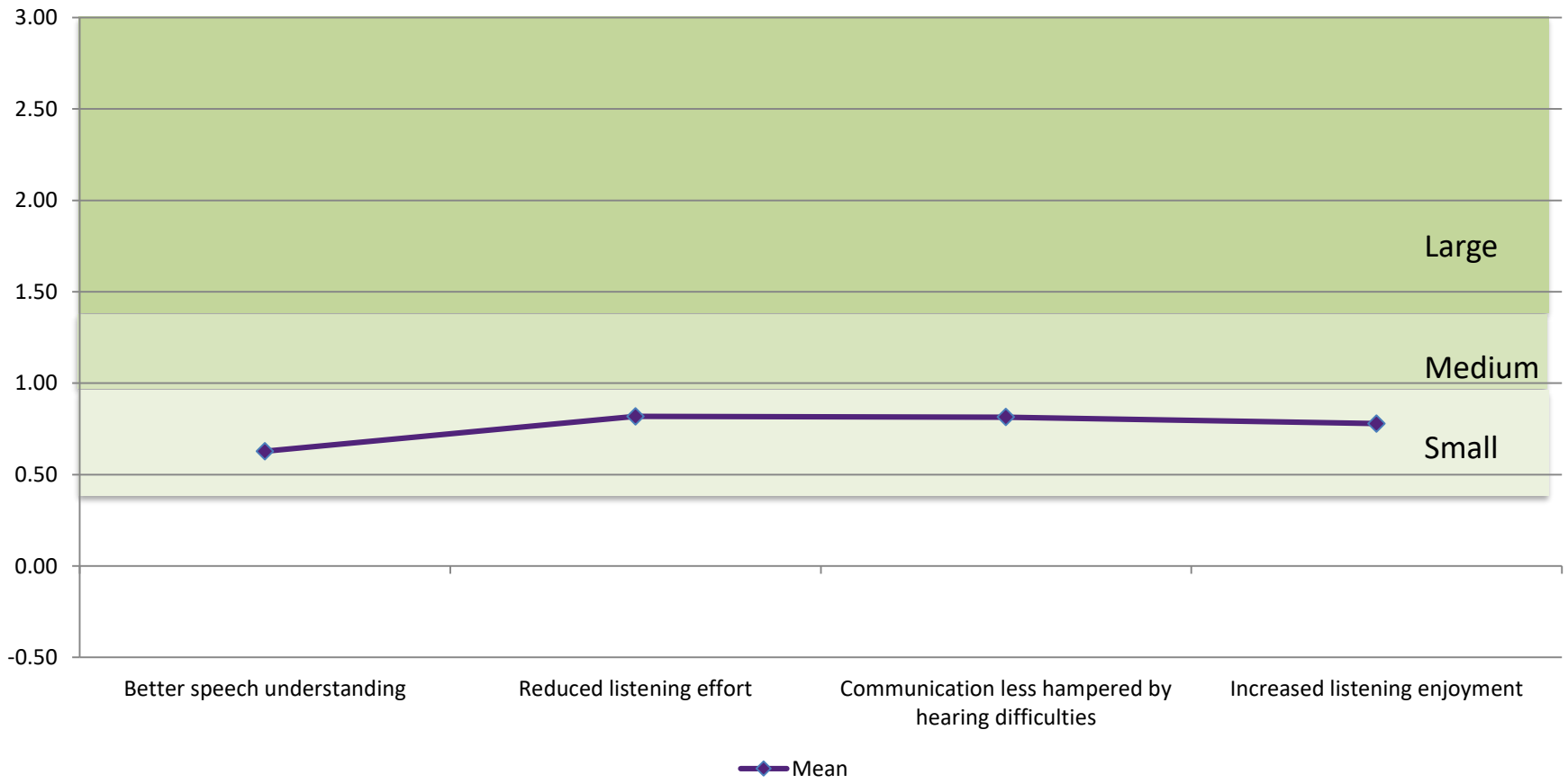
Effect size benchmarks

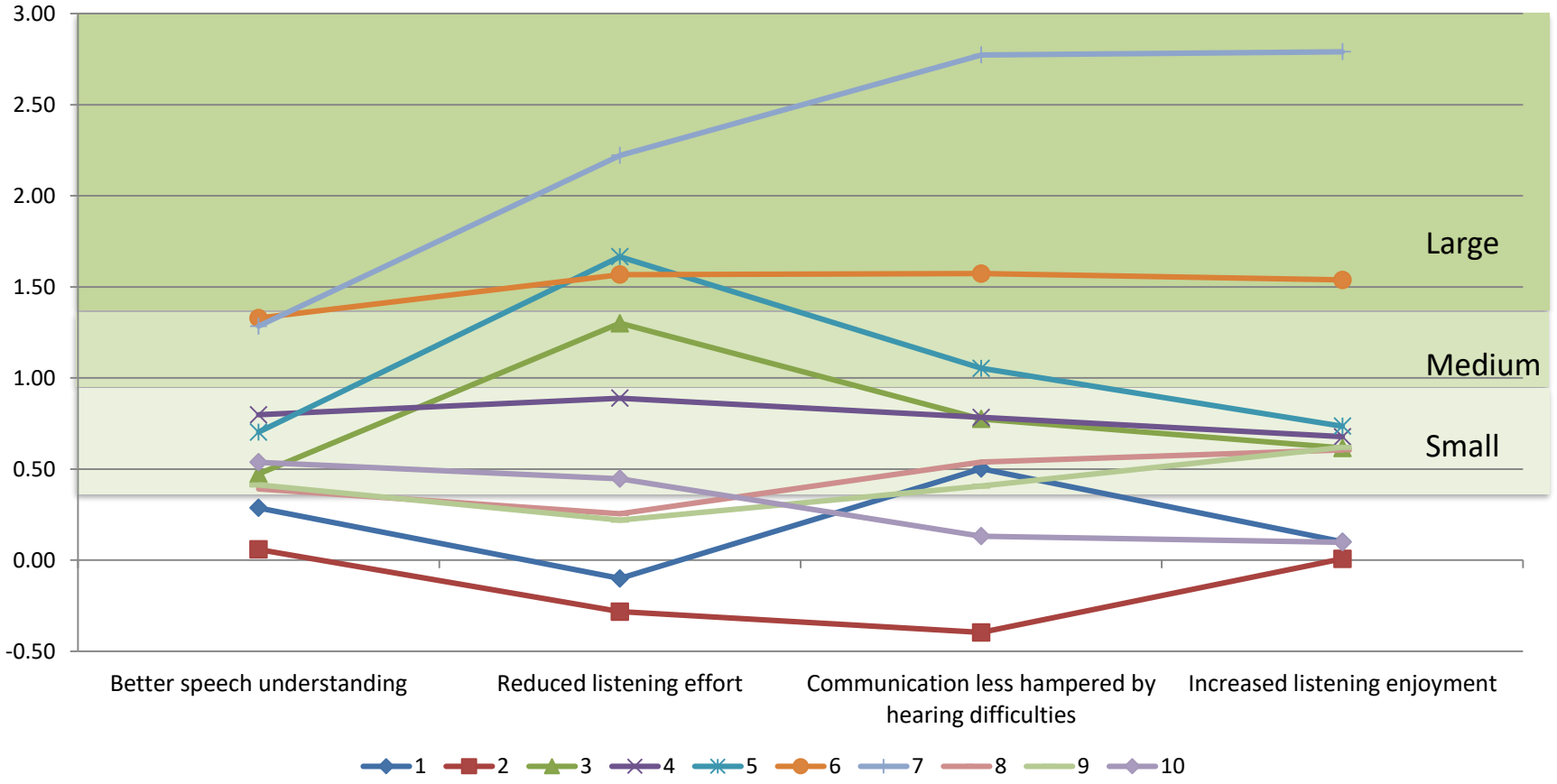


Johnson, C. E., Danhauer, J. L., Ellis, B. B., & Jilla, A. M. (2016). Hearing aid benefit in patients with mild sensorineural hearing loss: A systematic review. *Journal of the American Academy of Audiology, 27*(4), 293-310.

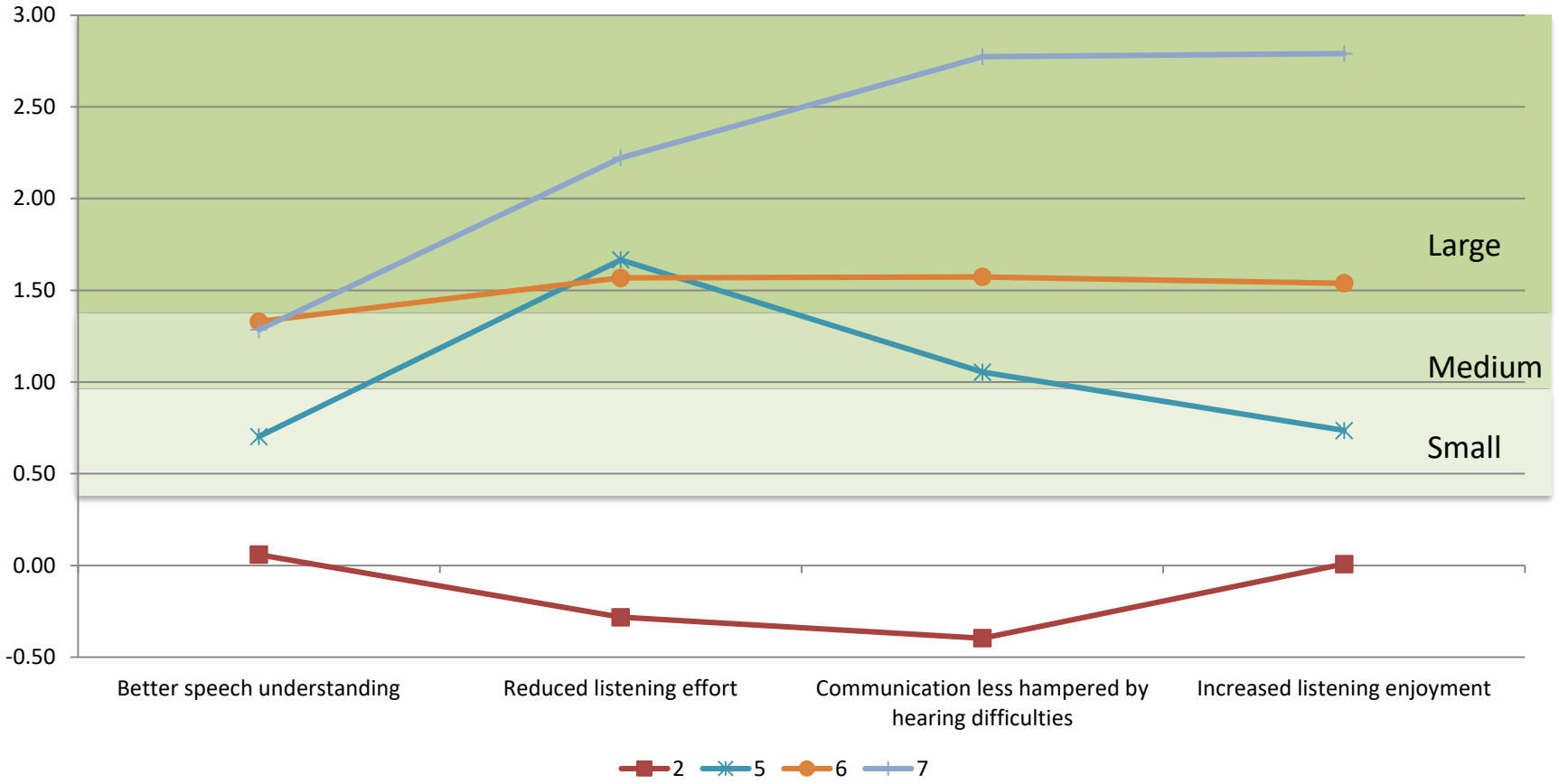
Group hearing aid effect size



Individual hearing aid effect size



Individual hearing aid effect size



Conclusions EMA study #2:

- Mild hearing impairment may have little bearing on speech understanding in common (non-complex) real-world listening events, but greater impact on other aspects that affect daily communication
- Real-world data can be used to highlight **individualised** hearing aid benefit, a need for further counselling, or hearing aid modifications

Hearing aid outcome goals for adults with mild hearing loss should include more aspects than improved speech understanding

EMA as a clinical eAudiology tool

- EMA is a prime example of a potential mHealth tool with relevant clinical benefits
- Smartphone and tablet ownership is increasing in all age groups
- EMA can support the entire patient journey

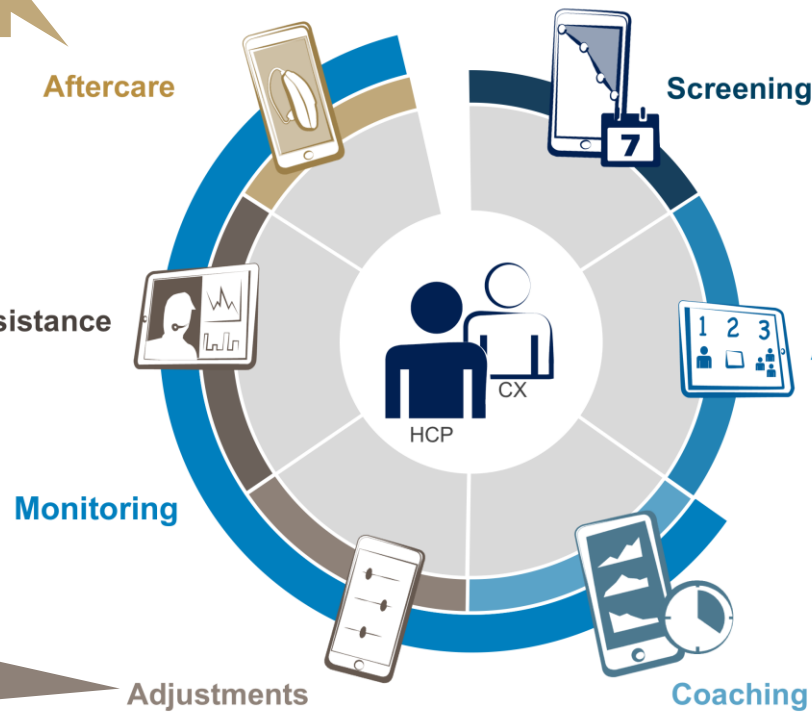
Timmer, B. H. B., Hickson, L., & Launer, S. (2018). The use of ecological momentary assessment in hearing research and future clinical applications. Hearing Research, Early online. doi: 10.1016/j.heares.2018.06.012.

EMA within the patient eAudiology journey

EMA can be used when goals or outcomes change

EMA can alert HCPs to provide assistance during the journey

EMA can inform HCPs during follow-up and adjustments



EMA can provide insights into patient candidacy and outcome assessment

EMA can guide individualized goal setting

EMA: a person-centered clinical case example

Mrs Jones isn't sure if she needs a hearing aid but her family has suggested she visit a HCP as they notice she is sometimes not hearing well. Her HCP installs an app on Mrs Jones' phone and asks her to complete surveys about her hearing during her daily activities.

Mrs Jones' EMA surveys show she's having hearing difficulty at family gatherings and when talking to her grandchildren. The surveys also show she's putting in a lot of effort to follow her favourite shows on TV. Her HCP explains she can address these difficulties with a hearing aid trial.

Her HCP provides Mrs Jones with hearing aids and asks her to continue filling in the surveys. The HCP can monitor these individualized surveys remotely and sees after 2 weeks that Mrs Jones is doing better in her target listening situations but is having some issues with the phone.

Mrs Jones' HCP adjusts her hearing aids (f2f or remotely) to improve the telephone streaming program and continues to remotely monitor Mrs Jones' answers to the EMA surveys. Mrs Jones can also track her hearing improvements and set new goals.

The HCP updates the survey questions in the EMA app to reflect Mrs Jones' new hearing goals now that she has resumed attending her club events again.

EMA can:

- Collect real-world information, about situations relevant to the individual
- Gain information about dimensions beyond speech understanding which can affect communication
- Provide insights other measures can’t
- Be easily individualized
- Support the individual in self-management
- Be a valuable mHealth clinical tool in future

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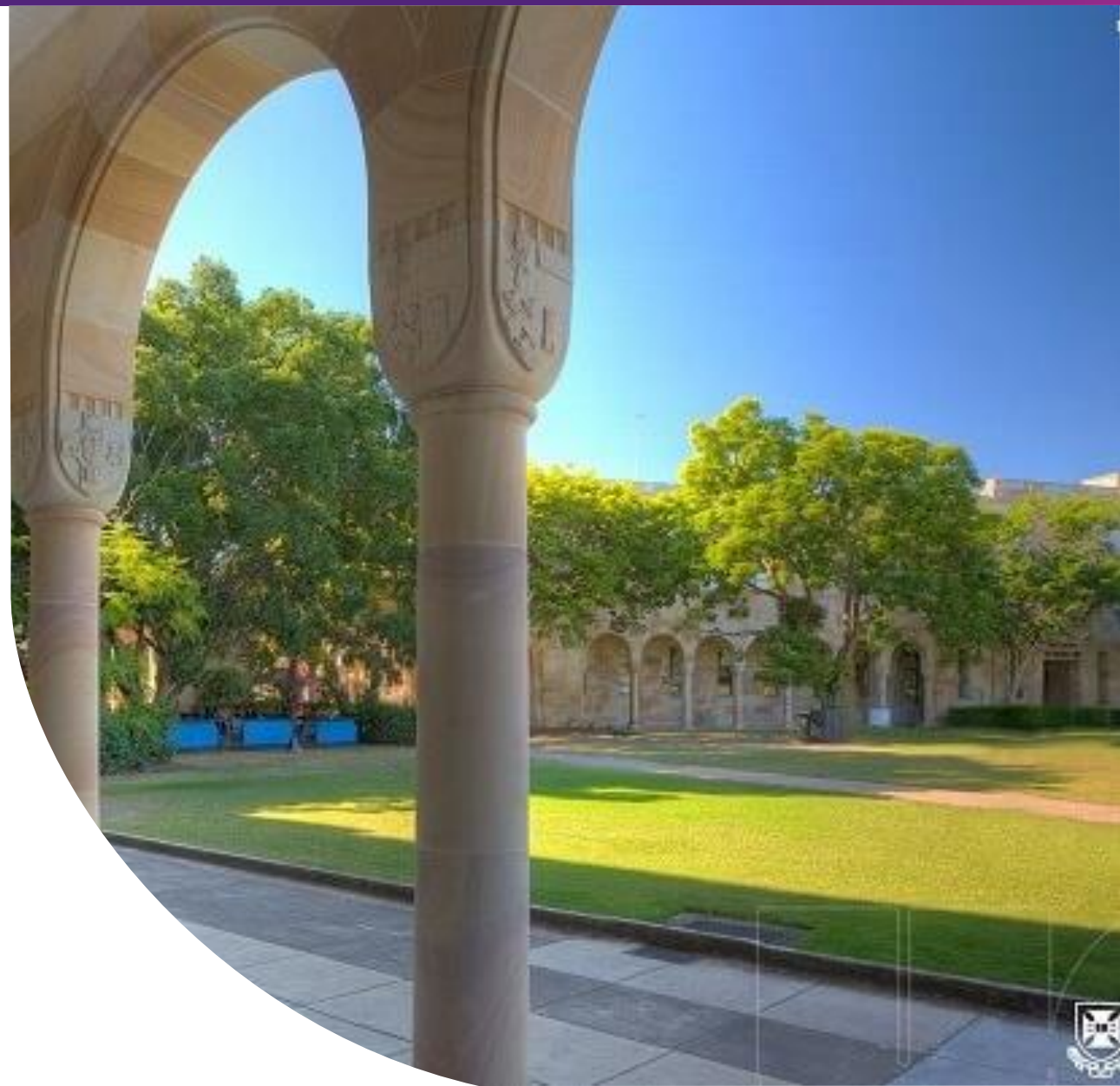
Thank you

Questions?



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