

The Art of Asking – Considerations when using Ecological Momentary Assessment in Hearing Research

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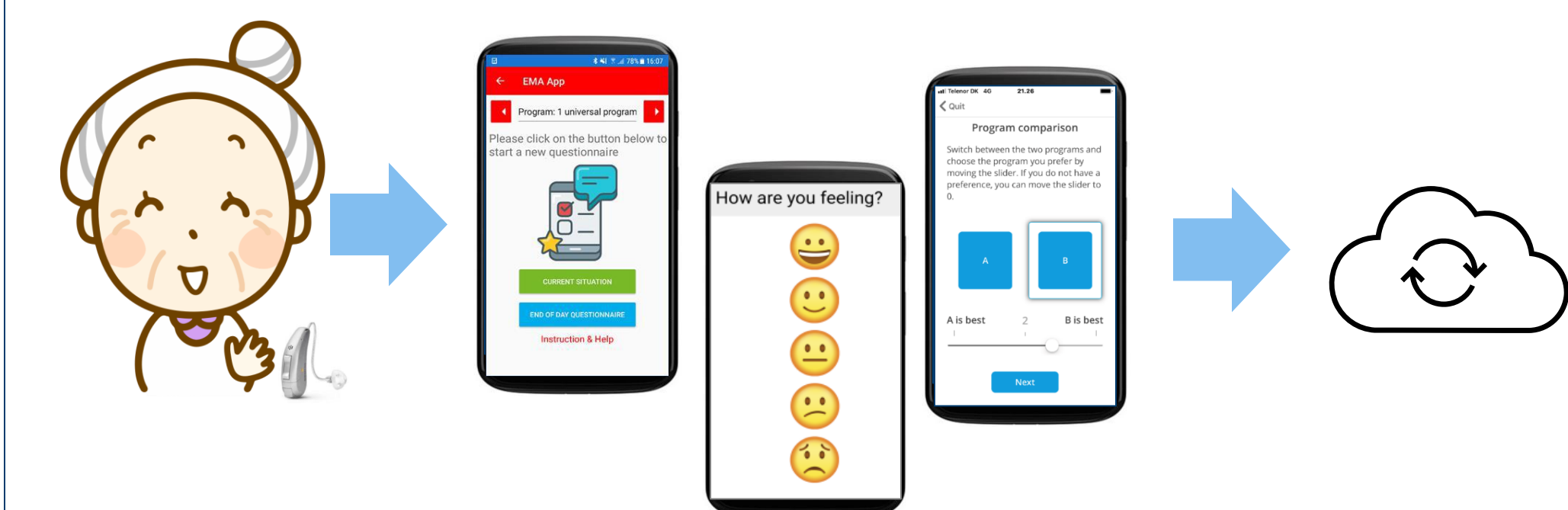


Motivation

Ecological Momentary Assessment (EMA) is increasingly popular as a methodology in hearing research. With the use of EMA, valuable insights have been gained into people's auditory ecology, perceived hearing difficulties, and hearing device use and benefit. However, it is sometimes difficult to compare results from different studies because the methodology used varies considerably.

Ecological momentary assessment (EMA):

“Ecological momentary assessment (EMA) involves **repeated sampling** of subjects' current behaviors and experiences **in real time**, in subjects' **natural environments**. EMA aims to minimize recall bias, maximize ecological validity, and allow study of microprocesses that influence behavior in real-world contexts.” [1]



- Minimizes memory bias, is context sensitive
- Gaining popularity in hearing sciences
- Smartphone based EMA allows to record acoustic parameters and information of the current hearing device functionality

But:

- No consensus on design choices
- No validated or standardized questionnaires
- No guidelines for EMA in hearing sciences

Collection of experiences and things to consider to help researchers using EMA in hearing sciences

EMA workshop series

What we did:

- We gathered researchers with experience in EMA in hearing research
- Over the past two years we have met in a monthly online workshop series
- We exchanged on past EMA studies and learned from each other's experiences - successes and failures
- Comparison of study designs revealed implications of design choices

Goals:

- Focus on EMA as research tool, rather than a rehabilitative intervention
- Original ambition: align questionnaire vocabulary and build a core set of questions useful for hearing research
- Turn our common learnings into a journal publication serving as a guideline and inspiration on EMA methodology in hearing research

Questionnaire items

The examples are meant as inspiration, but no recommendations on exact wording are given. Therefore, the response options and the scales used vary from item to item. However, when designing an EMA study, it is recommended to be consistent with response options and scales.

References are ordered alphabetically. The example reference is underlined and marked in bold. An asterisk (*) denotes that the example is translated to English and the original language is given in parentheses.

Despite the long list of EMA items, the list is not complete, and new research topics will require new EMA items.

Questionnaire items applicable in most research contexts in audiology

Item	Description	Example
Location	Reasons to include The location can indirectly say something about familiarity, typical activities, and physical features of the place (reverberation, wind noise etc.). Things to consider Subjectively reported location data can be supplemented by GPS data. References: [4, 6, 7, 8, 15, 18, 19]	Where are you right now? <ul style="list-style-type: none"> • In my home • Restaurant/bar/cafe • Outdoors • Shops • Work • In transit • Other
	Reasons to include The listening activity (task) will likely affect the experience and the benefit of hearing solutions. By asking the participant to state one main listening activity, a complex situation will be easier to understand for the researcher and the data will be easier to interpret. Things to consider If the research is focused only on situations with speech, the response alternatives can be tailored to those situations. However, it is a recommendation to use the common sound scenarios (CoSS) categorization [22], as illustrated in the example, or response options that can afterwards be grouped into the CoSS categories [19]. References: [3, 4, 5, 8, 9, 10, 11, 13, 15, 17, 19]	Type of situation * (Swedish) <ul style="list-style-type: none"> • Conversation with one person, • Conversation with more than one person • Conversation through telephone or other communication device • Focused listening without ability to control the sound source (for example lecture, concert) • Focused listening with ability to control the sound source (for example TV, radio or other media) • Situation without conversation or focused listening
Background sounds	Reasons to include The presence of background noise will likely affect the experience and the benefit of hearing solutions. Some studies ask for specific background sound sources, others if background sounds are present. Things to consider Sometimes it is hard for participants to distinguish between the listening activity and background sounds References: [4, 13, 15, 19]	What sounds are audible in the background? * (German) <ul style="list-style-type: none"> • Voices/other people • Traffic noise • Household noise • Music/television • Engines/Machinery/ventilation • Wind • Silence • Other/further details If 'Other/further details' is selected: Please describe which sounds are audible in the background (free text).
	Reasons to include Asking for importance (of hearing well) gives the opportunity to focus the attention on the important situations in the analysis. In addition, this item could potentially be used as a proxy for motivation. Things to consider In some studies, researchers have asked about the general importance of the situation, which is different from the importance of hearing well. References: [5, 15, 17, 19]	How important is it for you to hear well in this situation? * (German) <ul style="list-style-type: none"> • Very important • Important • Rather important • Partly important • Rather unimportant • Unimportant • Completely unimportant
Importance of hearing well	Reasons to include Asking for difficulty gives the opportunity to focus the attention on the easy or difficult situations in the analysis. Things to consider The concept could be related to listening effort (see below) but is easier to understand and does not change if the participant gives up in a very difficult situation. References: [2, 5, 11, 12, 15]	How difficult is it for you to hear in this situation? * (Danish) <ul style="list-style-type: none"> • Not difficult • Slightly difficult • Moderately difficult • Very difficult • Extremely difficult

Questionnaire items for studies using hearing devices

Item	Description	Example
Hearing-device use	Things to consider It might be important to know if a self-report reflects aided or unaided listening. Also, if the EMA questionnaire is adaptive, hearing-device related questions can be skipped if the participant is not wearing hearing devices. Objective data can replace or supplement self-reports. Information about hearing-device use can also be included in other items. References: [5, 18, 20]	Are you currently wearing hearing aids? <ul style="list-style-type: none"> • Yes • No
	Things to consider Test participants might interpret satisfaction differently, since it could be related to for instance sound quality, aesthetics, physical fit or the benefit they provide. References: [5, 9, 11, 13]	In this situation, how satisfied are you with the hearing aids? <ul style="list-style-type: none"> • 5: Very satisfied • 4 • 3 • 2 • 1: Very dissatisfied (Only anchor words for extreme values.)
Satisfaction with hearing devices	Things to consider Hearing-device benefit might be a difficult concept to evaluate using EMA. Test participants could be asked to • Compare current performance with how they think they would do in the situation without hearing devices • Compare current performance with how they think their own hearing devices would work in the situation • Make direct paired comparisons of benefit for two hearing-aid programs (see below) References: [5, 9, 21]	In this situation, how much does your hearing aid help you? <ul style="list-style-type: none"> • Hearing aid is no use at all • Hearing aid is some help • Hearing aid is quite helpful • Hearing aid is a great help • Hearing is perfect with aid
	Things to consider Even when hearing devices are helping, there may be difficulties remaining. When hearing aids are used, this question can replace the difficulty question in the first part of the table. References: [9, 21]	In this situation, how much difficulty do you still have? <ul style="list-style-type: none"> • 5: No difficulty • 4 • 3 • 2 • 1: Very much difficulty (Only anchor words for extreme values)
Benefit of hearing devices	Things to consider Sound quality could be a difficult concept for test participants to understand. Sometimes dimensions of sound quality with descriptive adjectives could be easier to use. Examples: loudness (very loud), clarity (very clear), brightness (muffled). References: [2, 3, 13, 14]	How is the sound quality in your hearing aids right now? * (Danish) <ul style="list-style-type: none"> • Very good • Rather good • Neither good nor bad • Rather bad • Very bad
	Things to consider Program preference can be investigated either using <i>direct</i> paired comparisons (A/B) in each experienced situation or <i>indirectly</i> , for instance by using alternating programs each day and rate some attribute that afterwards can be compared across days. Alternatively, a crossover design with one program per study phase can be used. If the EMA app allows automatic program switches, the direct paired comparisons can be done in a randomized and blind way. See [14] for a comparison of both methods regarding sensitivity and burden. References: [8, 14, 15]	Which HA program did you prefer? * (Swedish) <ul style="list-style-type: none"> • Program 1 • Program 2 • Heard the difference but have no preference, • Heard no difference
Residual activity limitation		
Quality of processed sound		
Program preference		

Additional items depending on research context

Time since event	Localization	Fatigue
Frequency of occurrence	Loudness/Noisiness	Location of sound source
Activity	Annoyance	Activity limitation
Speaker characteristics	Perceived level of speech of interest relative to background sounds	Feelings related to hearing difficulties
Mood	Pleasantness	Impact on others
Visual cues	Speech understanding	Listening effort

Examples, things to consider and references omitted for brevity

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