



Assessing Effectiveness of Ecological Momentary Assessment (EMA) for Hearing Aid Evaluation in Singapore

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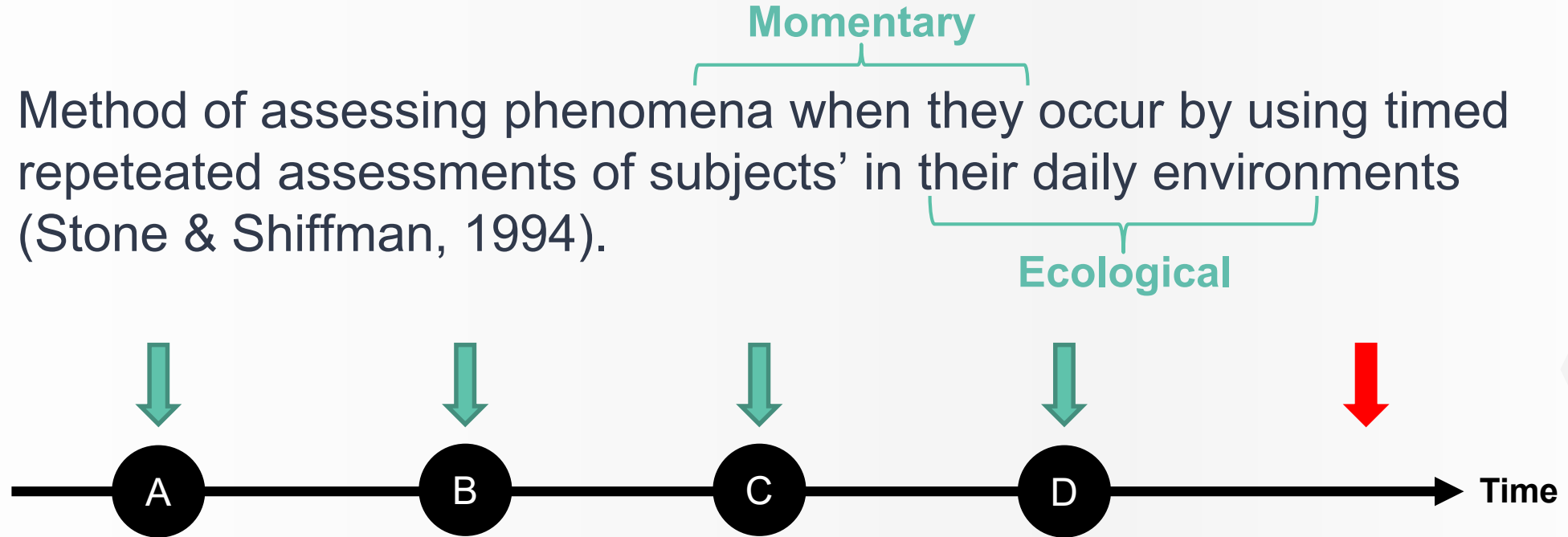
A Collaboration between:



WSAudiology

Ecological Momentary Assessment (EMA)

- Method of assessing phenomena when they occur by using timed repeated assessments of subjects' in their daily environments (Stone & Shiffman, 1994).



— Retrospective report

— EMA

- ✓ Ecologically valid
- ✓ Context sensitive
- ✓ Minimizes recall bias
- ✓ Record Temporal Sequences

Ecological Momentary Assessment (EMA)

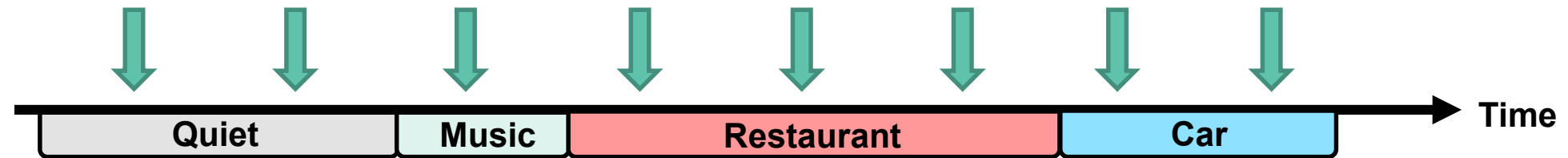
- Widely used in health monitoring & behavioral research (pain, mood, smoking behavior etc.)
- Recently gaining popularity in hearing aid research



Problem

- EMA is assumed to be representative for everyday life

— Assessment



- In a study with 20 German participants, Schinkel-Bielefeld et al.(2020) found that **social situations** are the main reason for missed questionnaires and **speech in noise (SIN) situations are underrepresented** in both objective and subjective data collected by EMA app
- If specific situations are systematically missed, biases are introduced and reliability of results decreases!

Smartphone Usage in Singapore and Germany

Smartphone adoption rate

(IMDA, 2019, Pew Research Center, 2019)



Time spent on internet using mobile phone

(Hootsuite & We are Social, 2020)



Difficulty in stopping mobile phone usage (Scale of 1-5)

(Limelight Networks, 2019)



Aims

- Collaboration with Schinkel-Bielefeld et al.(2020) to replicate study in Singapore considering cultural differences and smartphone usage norms

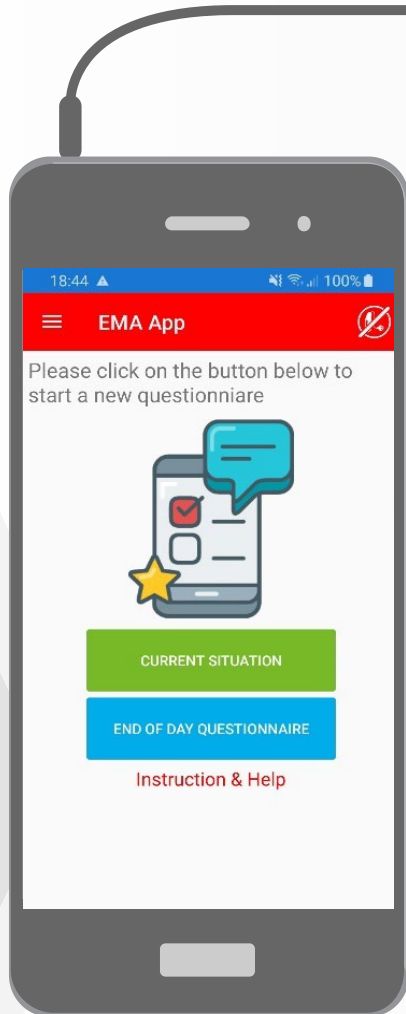
01

Assess the effectiveness of their EMA application in terms of compliance, acceptance and coverage of daily listening situations in Singapore particularly during SIN situations

02

Compare data collected in Singapore with the previous study in Germany

Sivantos EMA App



Triggers

1. Random

- 8 times a day
- Random intervals

2. Loud Environment

- Mean broadband level >65dB SPL for 5 min
- Max 4 per day

3. Self-trigger

- Anytime
- To fill out 5 per day

* Min 15 min between all questionnaires

Questionnaires

1. Current Situation

- Short (6qn)
- Optional long (+22qn)
- Listening experience, satisfaction, intent etc.
- 15 min timeout

2. Missed Trigger

- After missed current situation
- Why missed

3. End of Day(18qn)

- 1 per day
- Connection problems, HA/phone usage etc.

Additional features

1. 'Do not Disturb'

- No questionnaires triggered
- Configure for sleep

2. Delayed reporting

- Questionnaires terminate 30 mins after initiation
- Allow retrospective reporting

3. Bluetooth

- Timestamp
- Acoustic class (HA)
- 15min packages

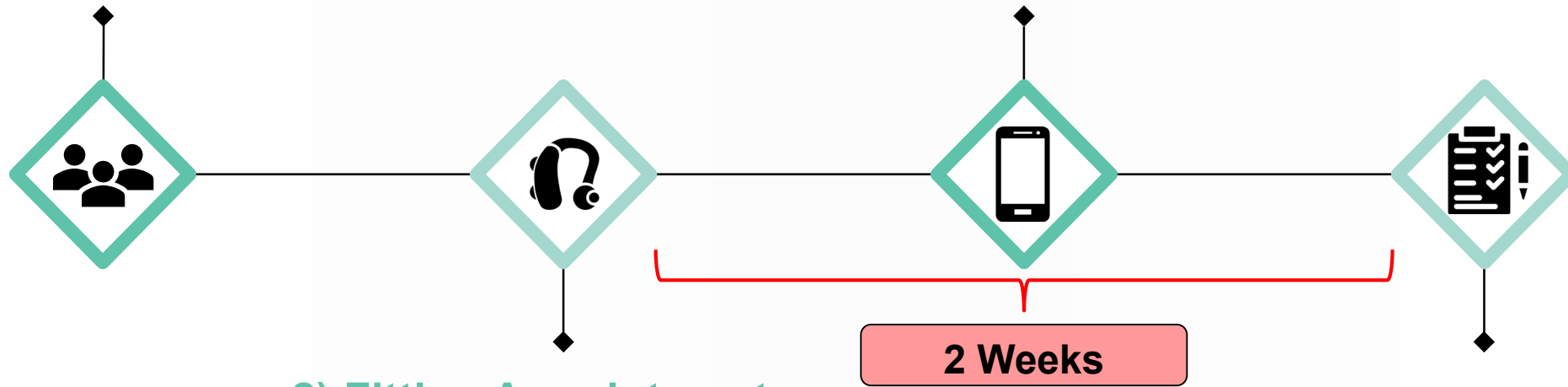
Methodology

1) Participants

- 10 adults (47-73 years of age)
- Mean hearing loss 57.5 ± 11.5 dBHL
- ≥ 1 year of bilateral HA experience

3) Follow-up Call

- Monitor compliance
- Reminders



2) Fitting Appointment

- Signia Pure 312 7X
- X Fit formula, experienced
- Issued smartphones
- Oral & written brief on EMA App
- Encouraged to fill ALL questionnaires triggered
- Familiarization

4) Final appointment

- Collection of devices
- 'End of Study' questionnaire (Acceptance & burden of EMA protocol)
- Reimbursement (up to \$50 per subject)

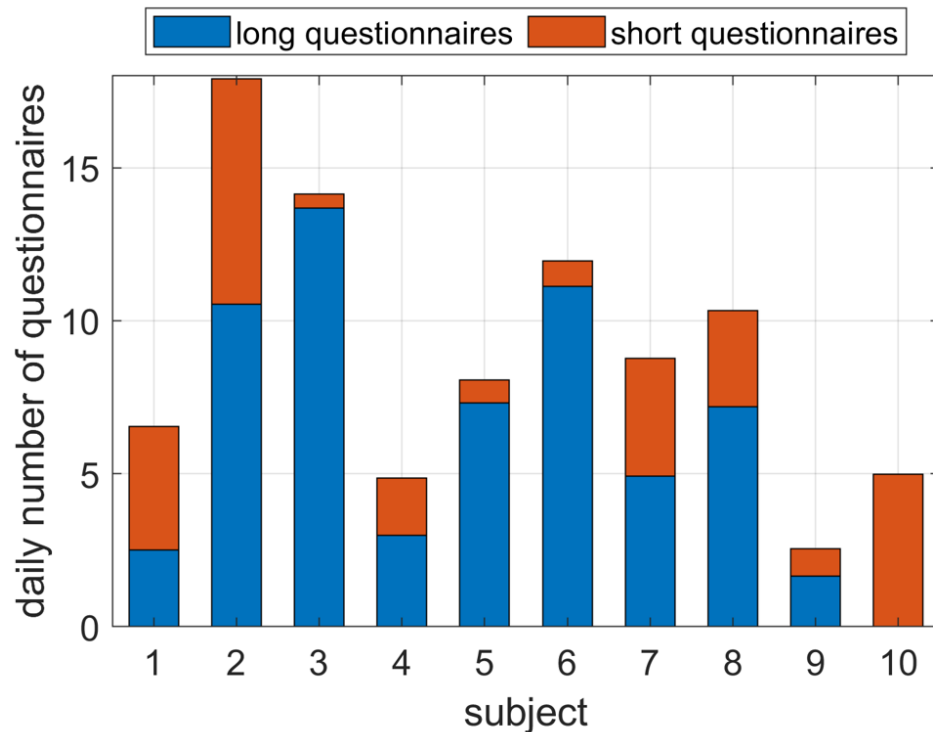
Data Analysis

- Distributions calculated individually then averaged across subjects
- One-sided paired permutation testing (Fisher, 1935)
- Significance level $p \leq 0.05$
- MATLAB R2020a

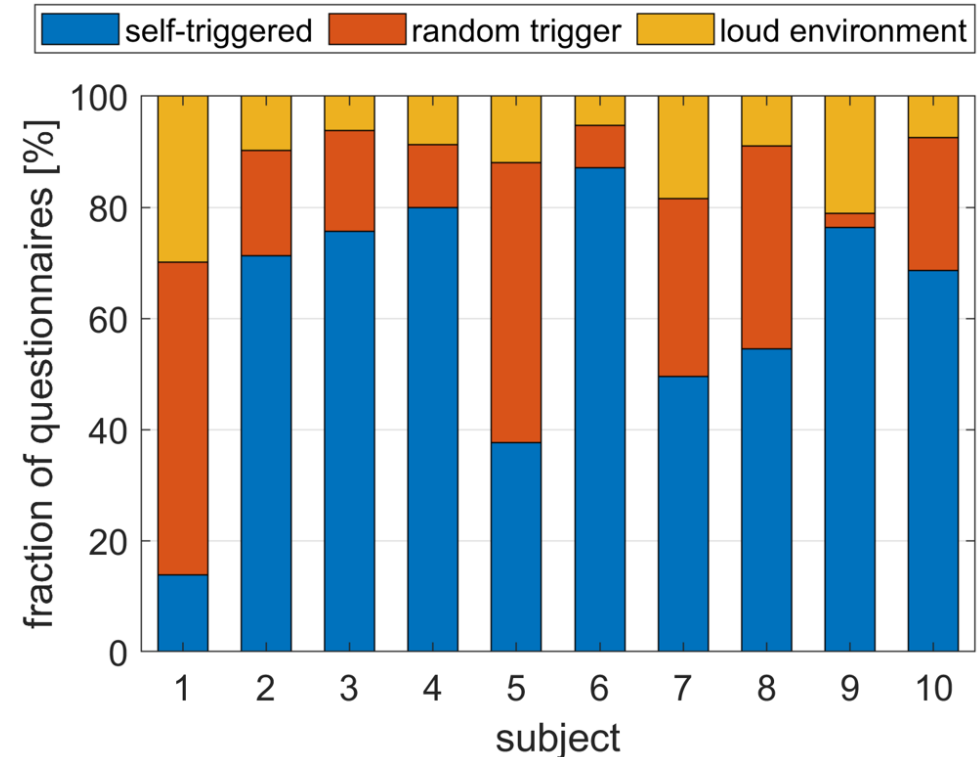
```
58 for i = 1:Subjects_No
59     %Get index of loud, self
60     num = Index_1st_week(i); %
61     Loud = subjects(i).EMAAnswer;
62     Self = subjects(i).EMAAnswers;
63     Random = subjects(i).EMAAnswer;
64     Loud_index = []; Self_index = [];
65     Loud_time = []; Self_time = [];
66     Starttimes = subjects(i).EMAAnswer;
67     for j = 1:num
68         if Loud(j)==1 %&& subjects(i).EMA
69             Loud_index = [Loud_index, j];
70             Loud_time = [Loud_time, Startti
71         end
72         if Self(j)==1 %&& subjects(i).EMAAns
73             Self_index = [Self_index, j];
74             Self_time = [Self_time, Startt
75         end
76         if Random(j)==1 %&& subjects(i).
77             Random_index = [Random_inde
78             Random_time = [Random_time
79         end
80     end
81
82     Env_timestamp = subjects(i).
83     LoudEnv_index = []; SelfEnv
84     %INDEX OF FITBIT CLASSIFI
85     for j = 1:length(Loud_ti
86     A = find((Env_timestamp
87     if length(A)>0
```

EMA Participation

- Total current situation questionnaires collected: 1244 (8.4 per day)
- Compliance to triggered questionnaires : 72.7%

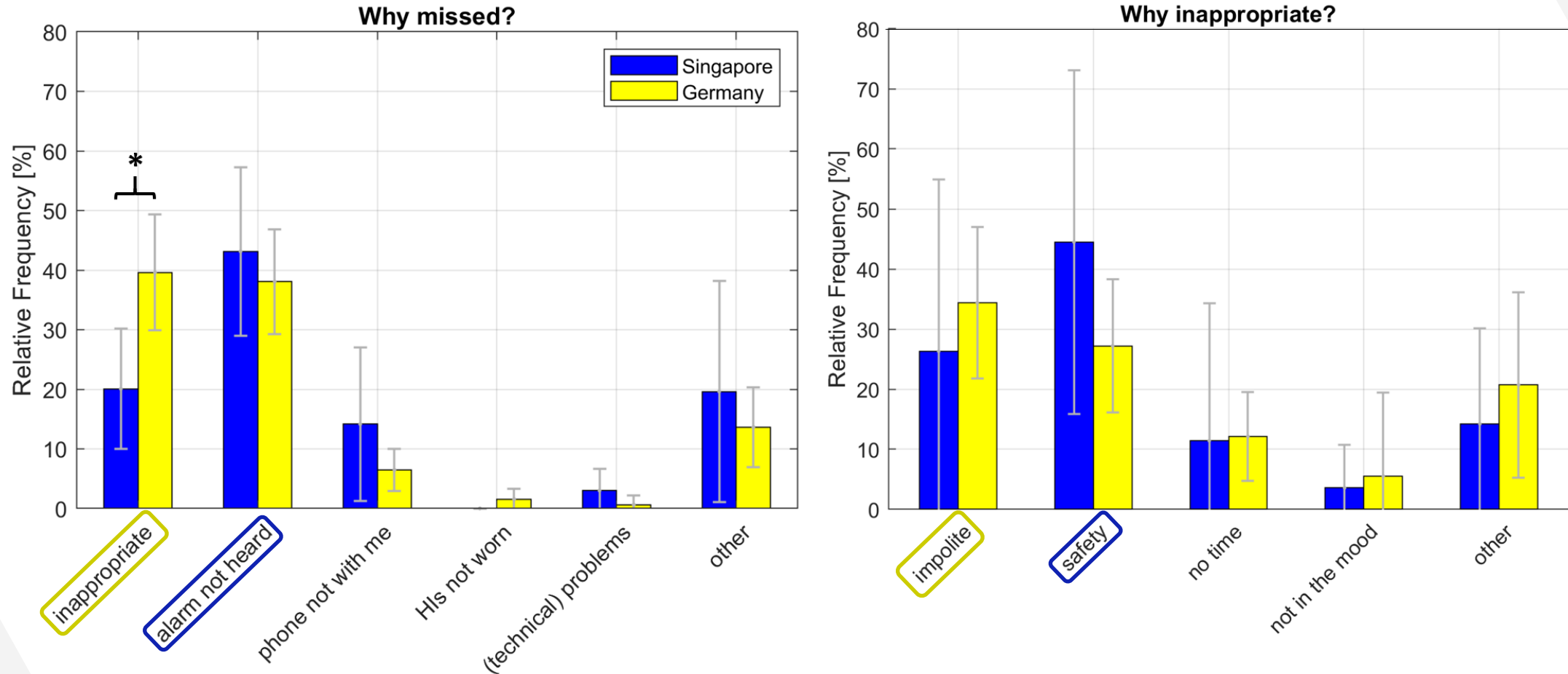


Short questionnaires : 31.3%
Long questionnaires: 68.7%



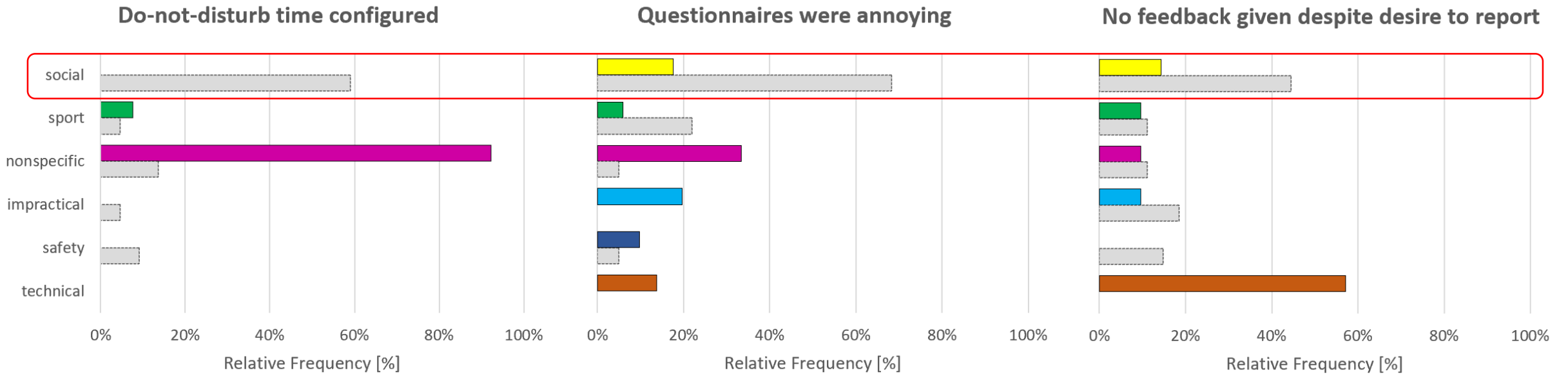
Self: 61.0%
Random: 26.2%
Loud environment: 12.8%



Missing Subjective Data



Significantly lower proportion ($p \leq 0.05$) of missed questionnaires due to inappropriate situations in Singapore compared to Germany

Missing Subjective Data

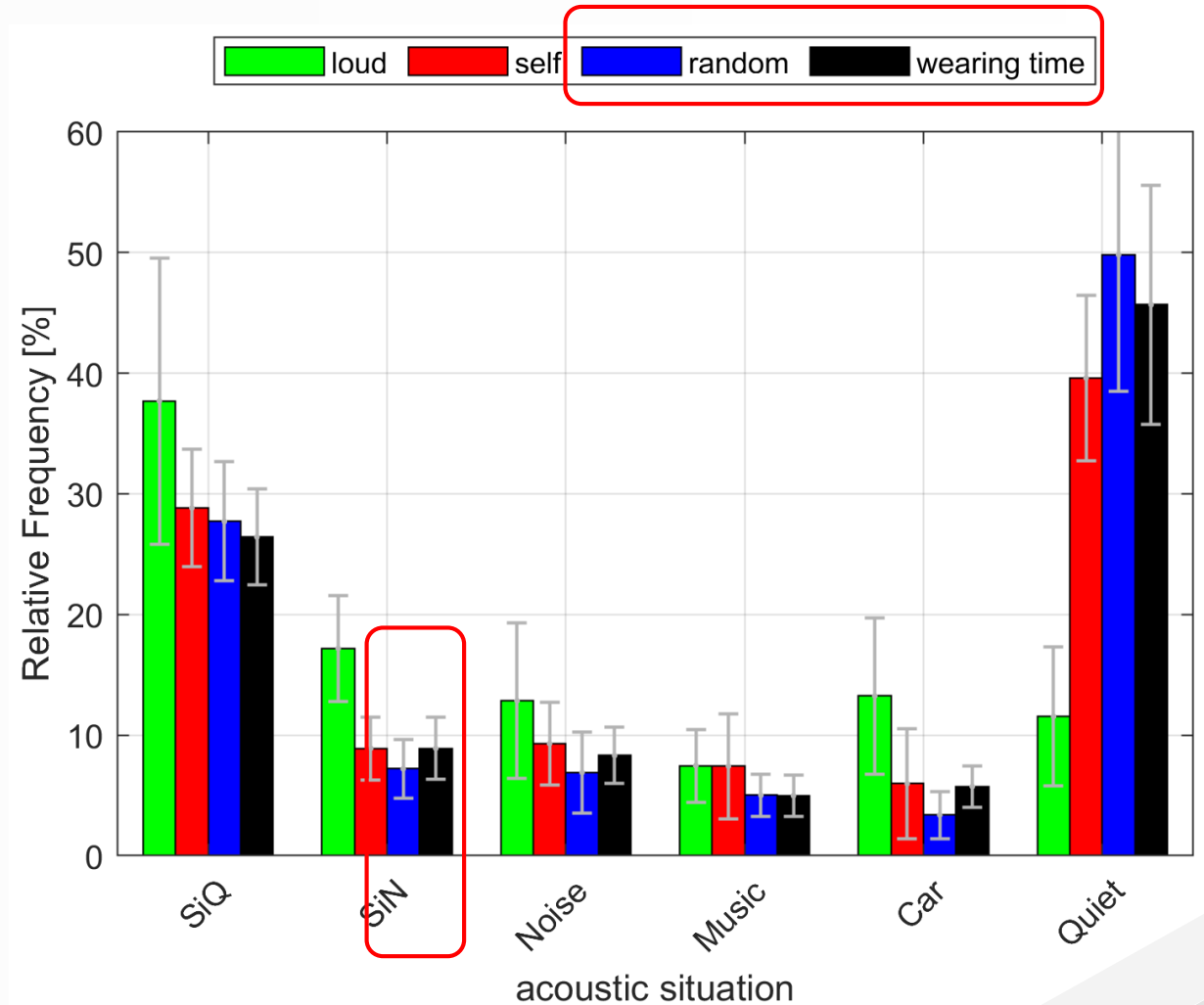


 Mostly non-specific or technical reasons
 Social reasons main reason for missing subjective data

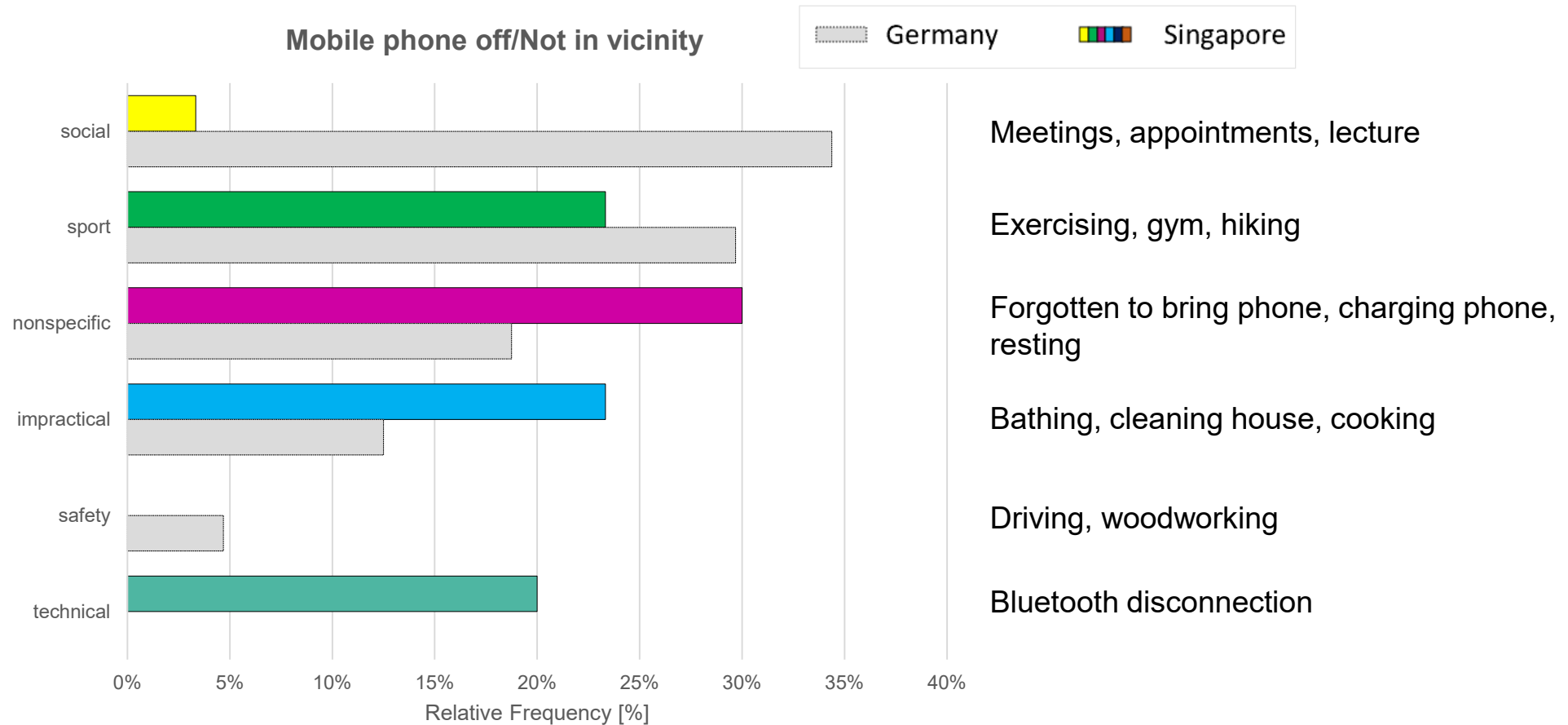
Subjective Data Coverage

Previous study showed significant underrepresentation ($p \leq 0.05$, Hedges' $g = 0.80$) of random triggers compared to wearing time recorded by EMA in SIN situations

No significant underrepresentation ($p > 0.05$) of any acoustic situation in random triggers.





Missing Objective Data

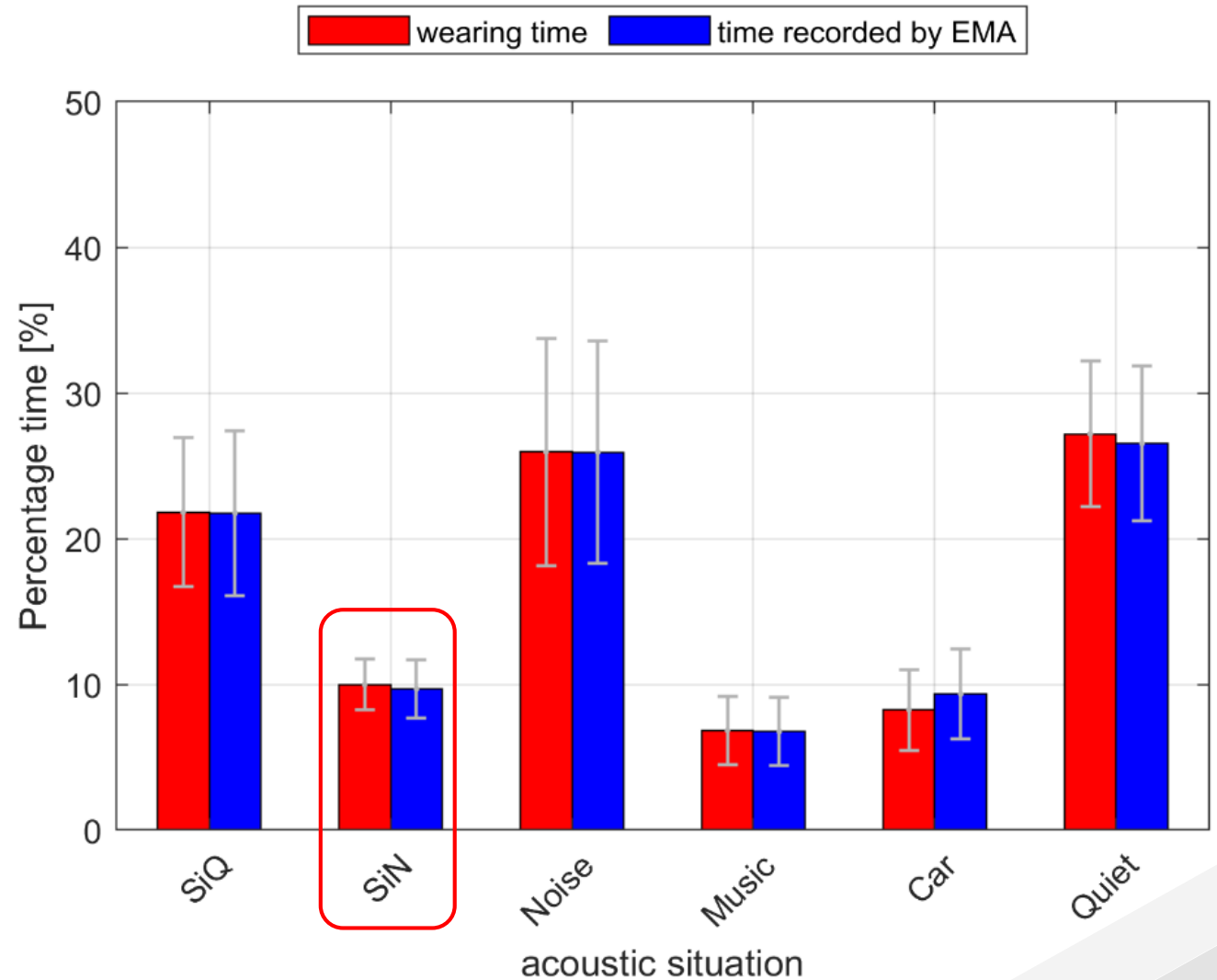


Social reasons (3.3%) one of the least common
Social reasons (34.4%) main reason for missing
objective data

Objective Data Coverage

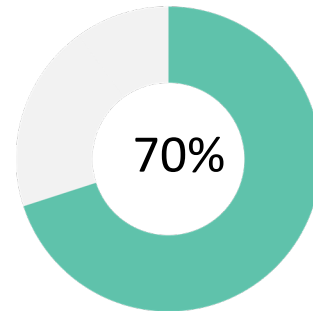
 Previous study showed significant underrepresentation ($p \leq 0.05$, Hedges' $g = 0.22$) of SIN situations in EMA data compared to total HA wearing time

 No significant underrepresentation ($p > 0.05$) of any acoustic class in EMA data

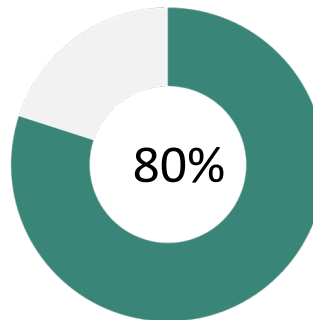


Acceptance

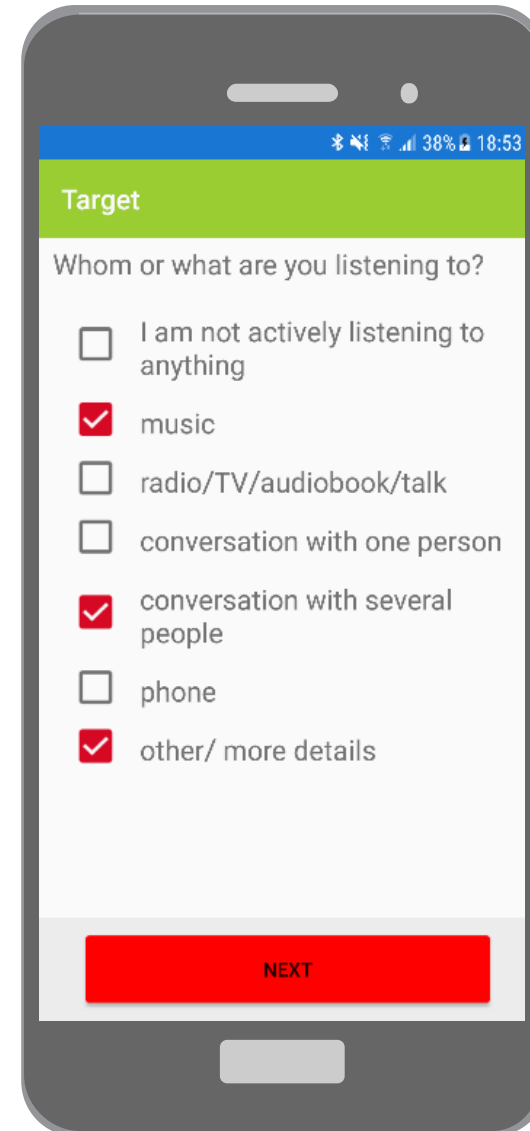
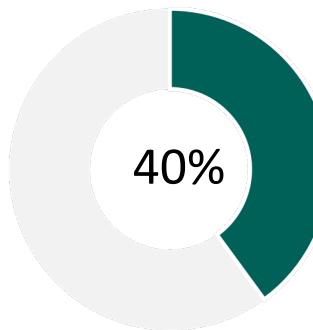
Questionnaire
triggers were too
often



Number of questions
was exactly right



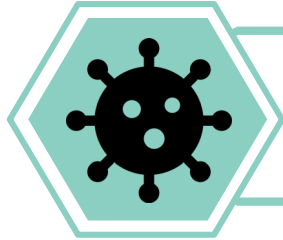
Carrying the study
phone was not
annoying



Discussion



Incentive Structure (Tier-based vs per survey)



COVID-19 restrictions



Study Duration



Sample size and characteristics

Conclusion

Further optimisation of EMA protocol is required to minimize burden on participants

EMA can serve as an effective tool to collect both subjective and objective information representative of HA users' experiences.

EMA studies targeting social situations may be more reliable in populations with frequent mobile usage, such as in the case of Singapore

**Thank
you**

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