ESR13 – Visual enrichment

E9 Presentation

Gerard Llorach
Hörzentrum Oldenburg GmbH

Supervisor: Volker Hohmann

Motivation
Visual enrichments

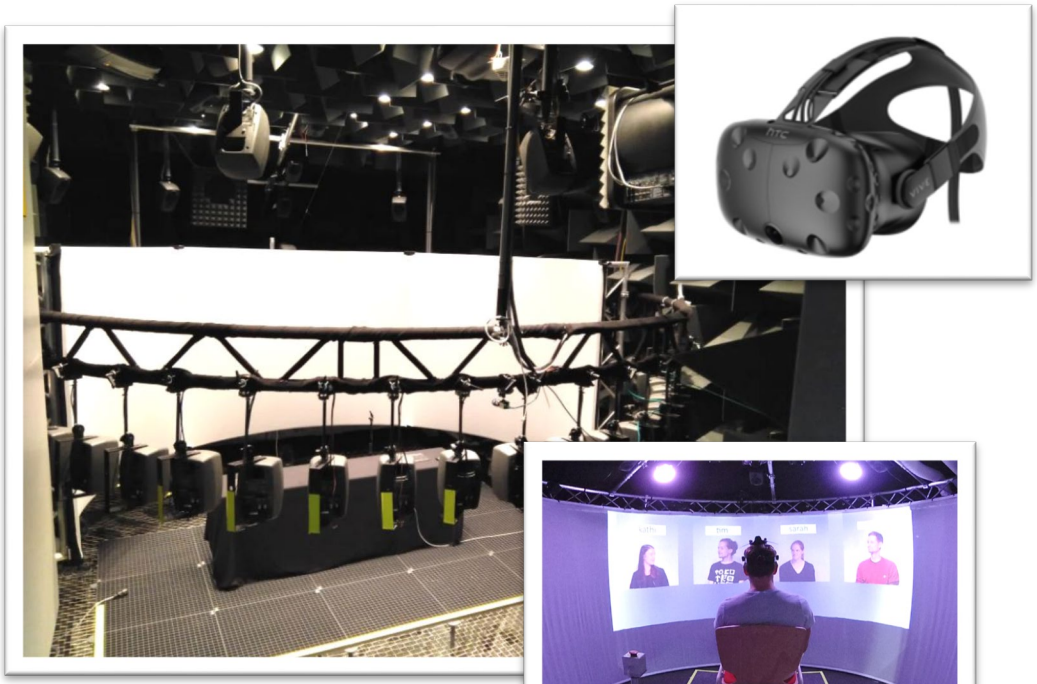
- Clinical audiological methods don't reflect real-life situations

≠

- Evaluation methods for new generations of hearing aids

Motivation
Visual enrichments

- Would immersive audiovisual simulations solve the issue?



3D audio

Immersive displays

Video recordings

Virtual characters

Motivation
Visual enrichments

- Would immersive audiovisual simulations solve the issue?

- Behavior (gaze and head)
- Preference
- Speech intelligibility
- Loudness perception

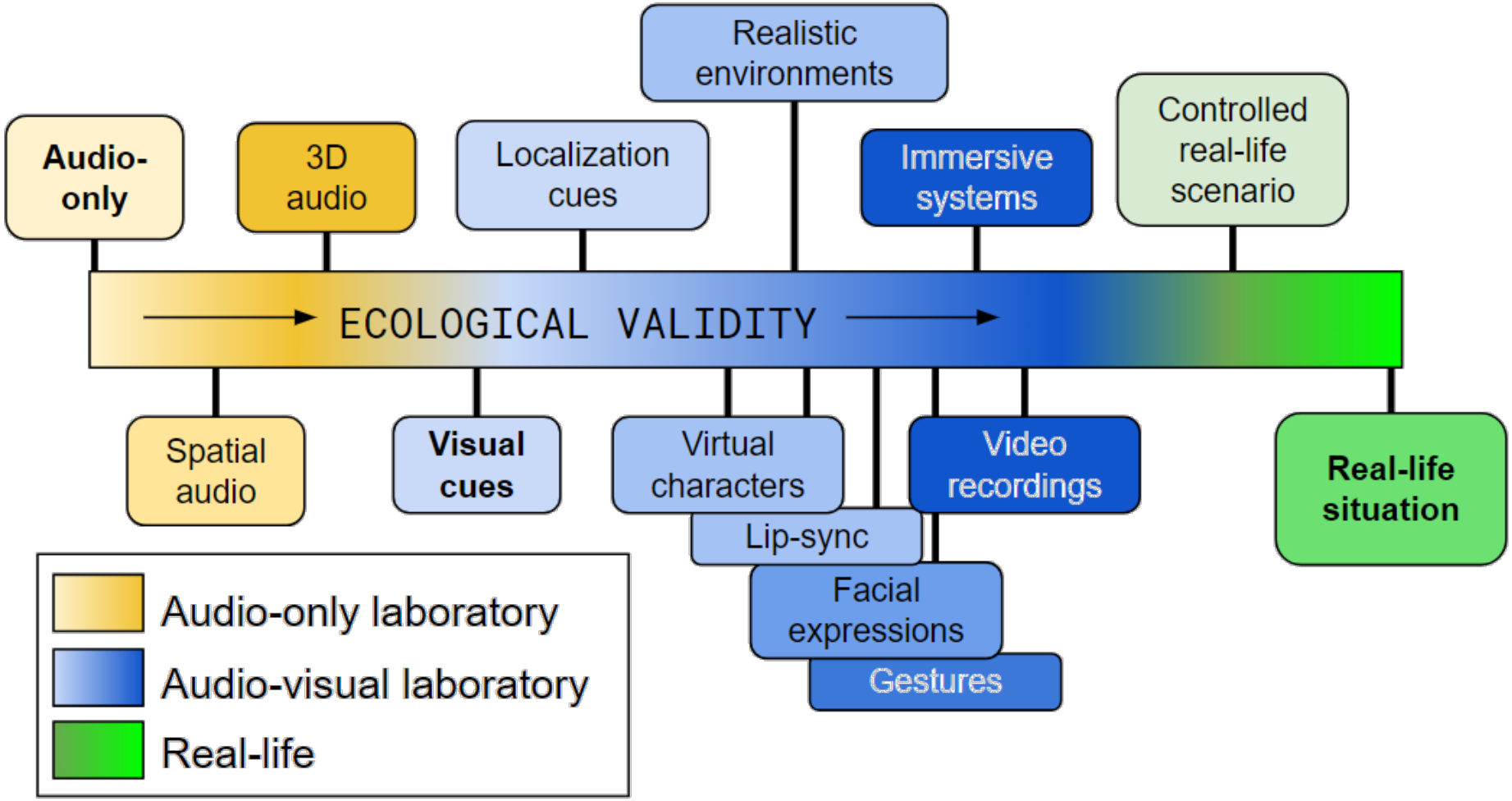
3D audio

Immersive displays

Video recordings

Virtual characters

Motivation
Visual enrichments



Experiments
Gaze and head behavior, lip-reading and loudness perception

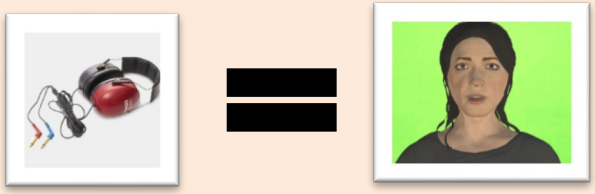
- *1. Influence of **visual cues** on head and eye movements (co-author)*
- 2. Influence of **displays** on head and eye movements and display acceptance
- *3. Head and eye movements in **realistic audiovisual environments** (co-author)*

- 4. Validation of newly recorded audiovisual speech intelligibility test (**Audiovisual OLSA**)
- 5. Lip-syncing intelligibility

- 6. **Loudness** perception - Lab vs Reality

Experiments 4 and 5
ENRICHMENT with lip cues
Speech Intelligibility and Lip-syncing

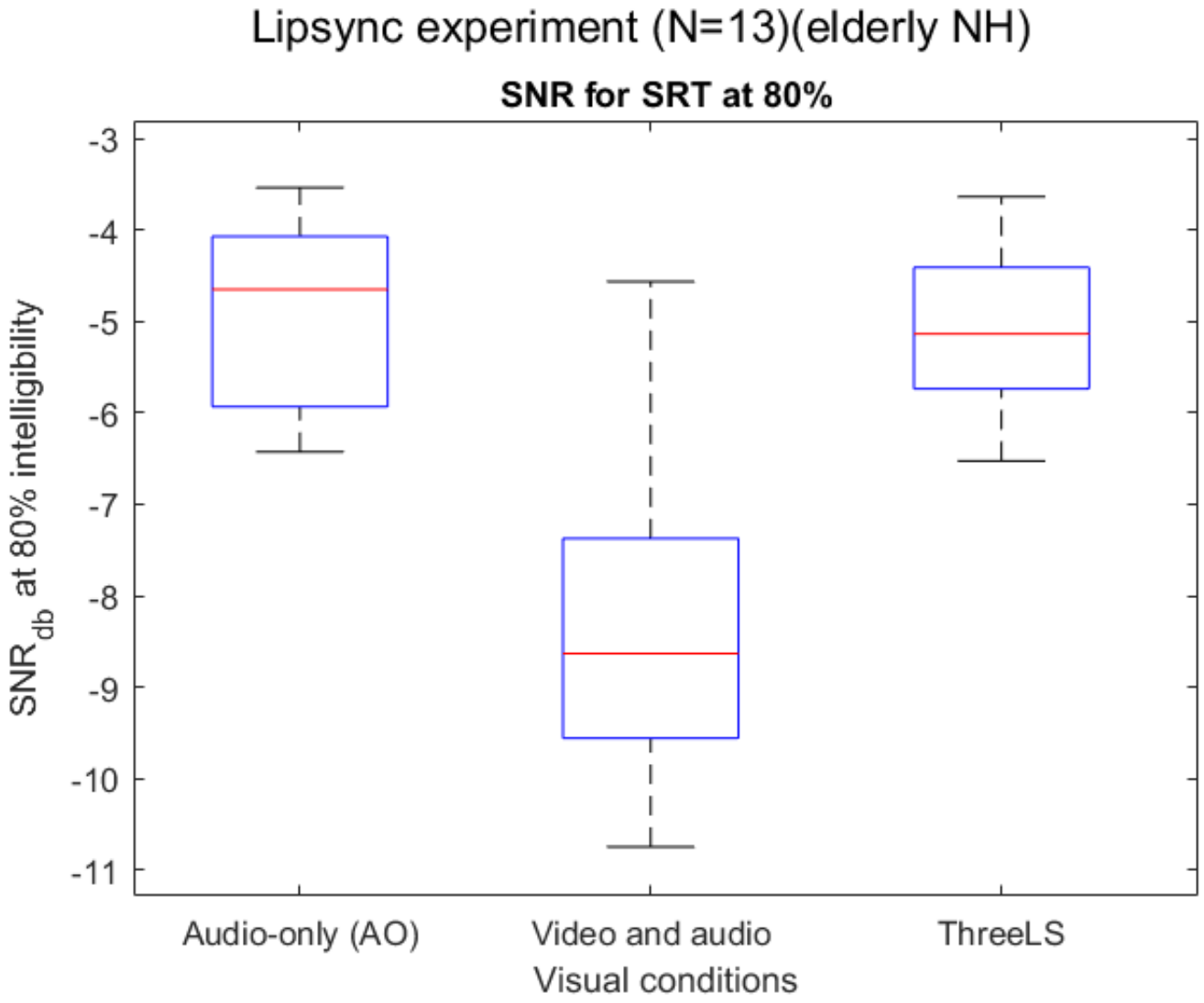
- Motivation:
  - Validation of lip-syncing
  - New audiovisual speech intelligibility test (AV-OLSA) – SNR? Equal word scoring?
- Method:
  - Speech reception thresholds with a close-set sentence test
  - 25 ENH for the lip-sync validation
  - 30 YNH for AV-OLSA validation
- Results
  - Lip-syncing method is **not enough**, similar results with audio-only.



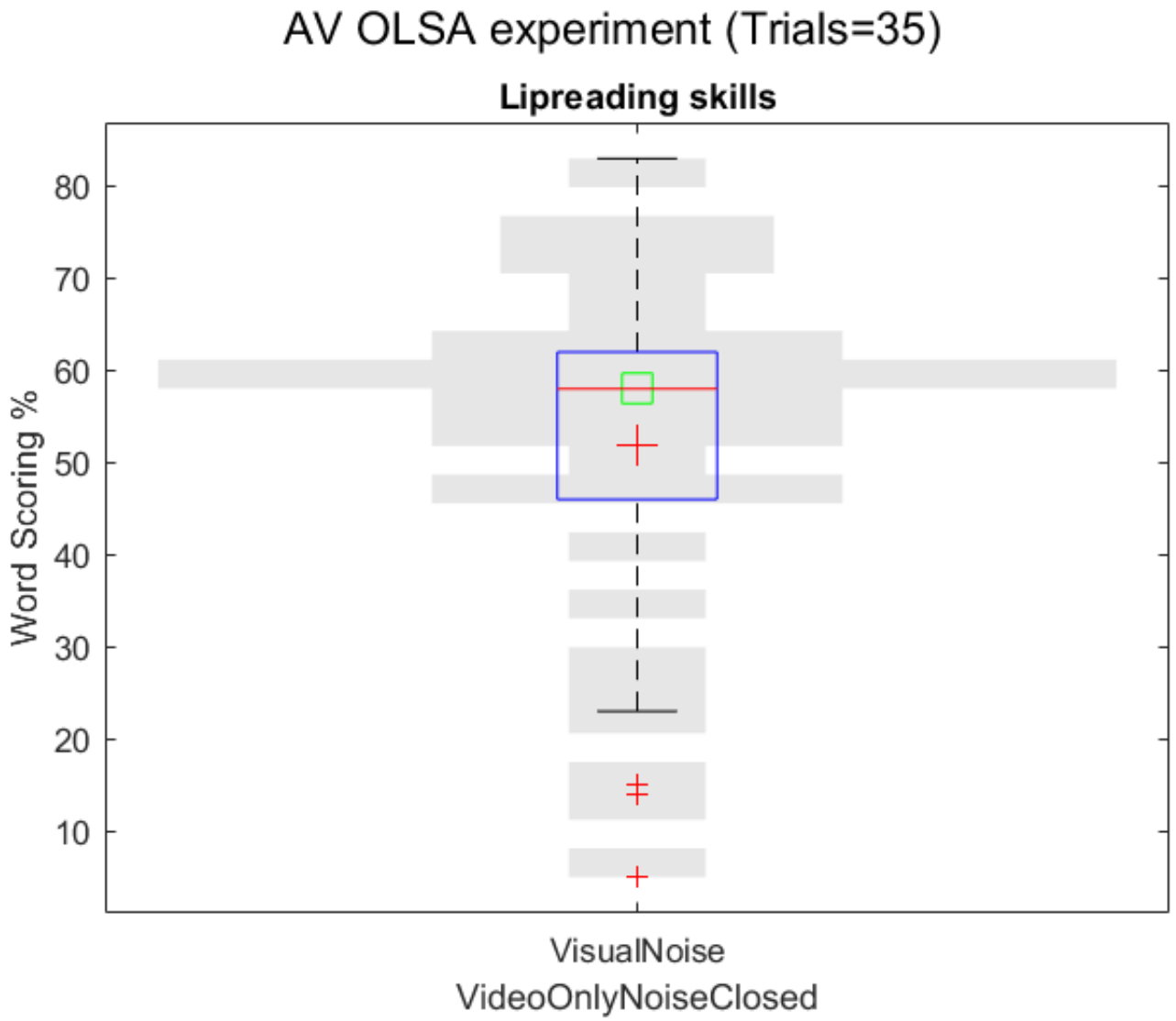
  - Video recordings permit lip-reading, up to **80% word recognition in some cases** (OLSA – 50 word set). Average SNR improvement (audio-only vs video recording) is ~4dB.
- References

  - G. Llorach, F. Kirschner, G. Grimm, M. Zokoll, K.C. Wagener, V. Hohmann. Development and evaluation of video recordings for the OLSA matrix sentence test. In preparation
  - G. Llorach, V. Hohmann. Word error and confusion patterns in an audiovisual German matrix sentence test (OLSA). In preparation (ICA)

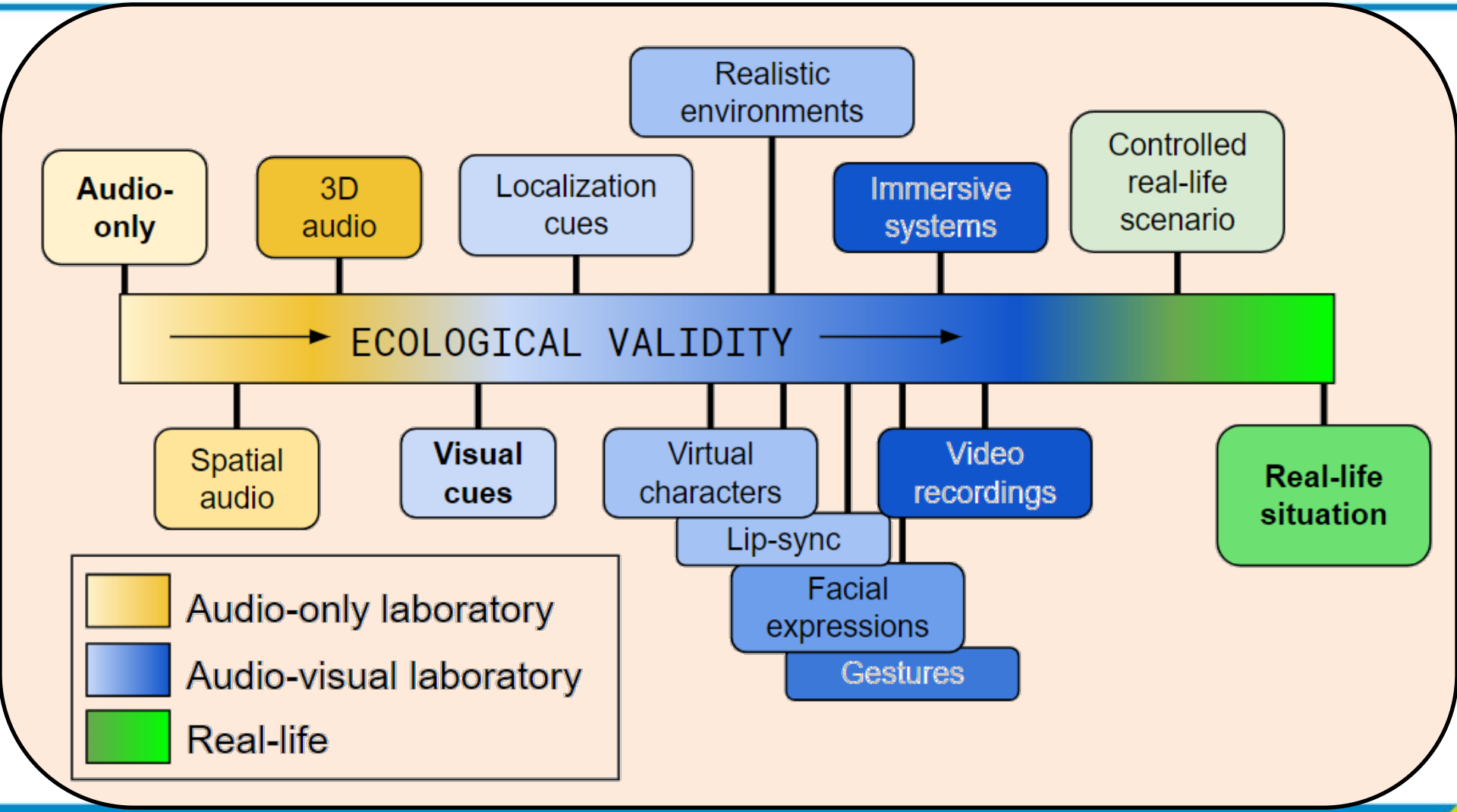
Experiments 4 – Lip-syncing



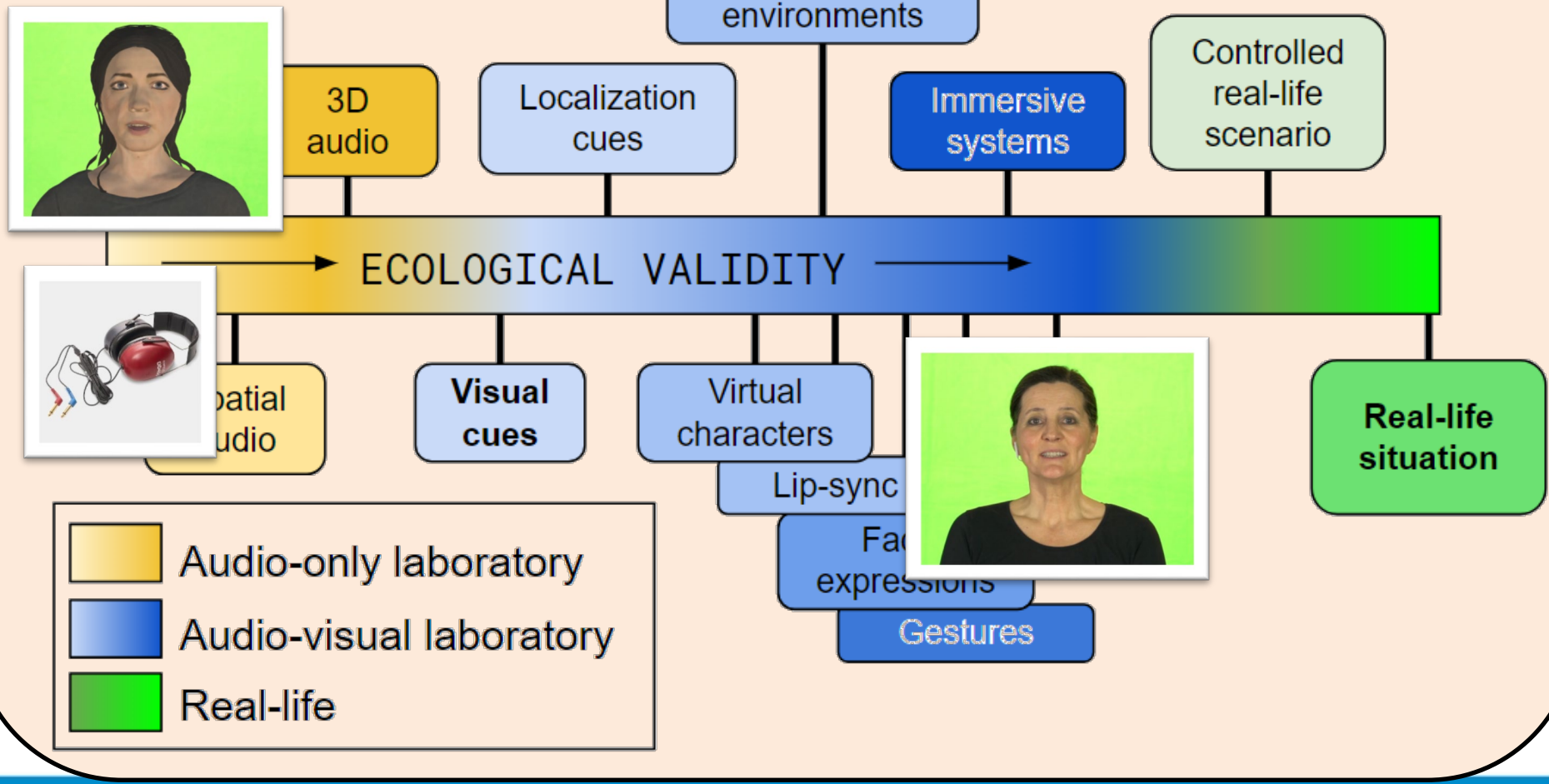
Experiment 5 – AV-OLSA



Experiments 4 and 5
Conclusions – Speech intelligibility

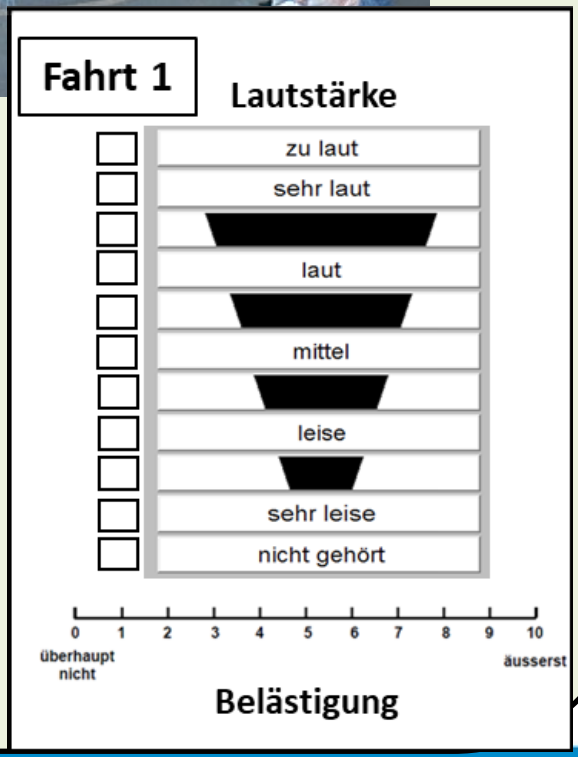


Experiments 4 and 5
Conclusions – Speech intelligibility

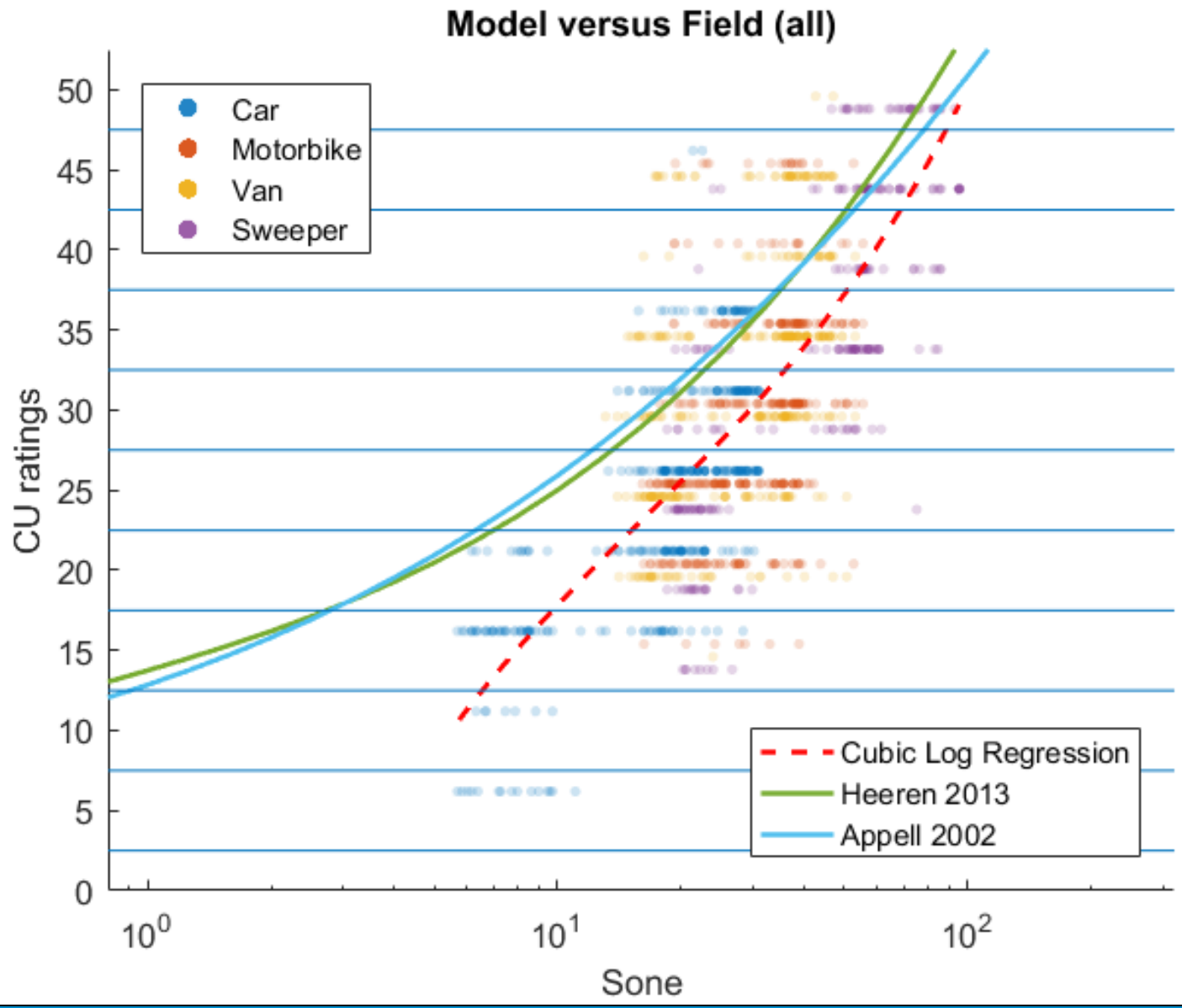


Experiment 6
ENRICHMENT for loudness perception in the lab

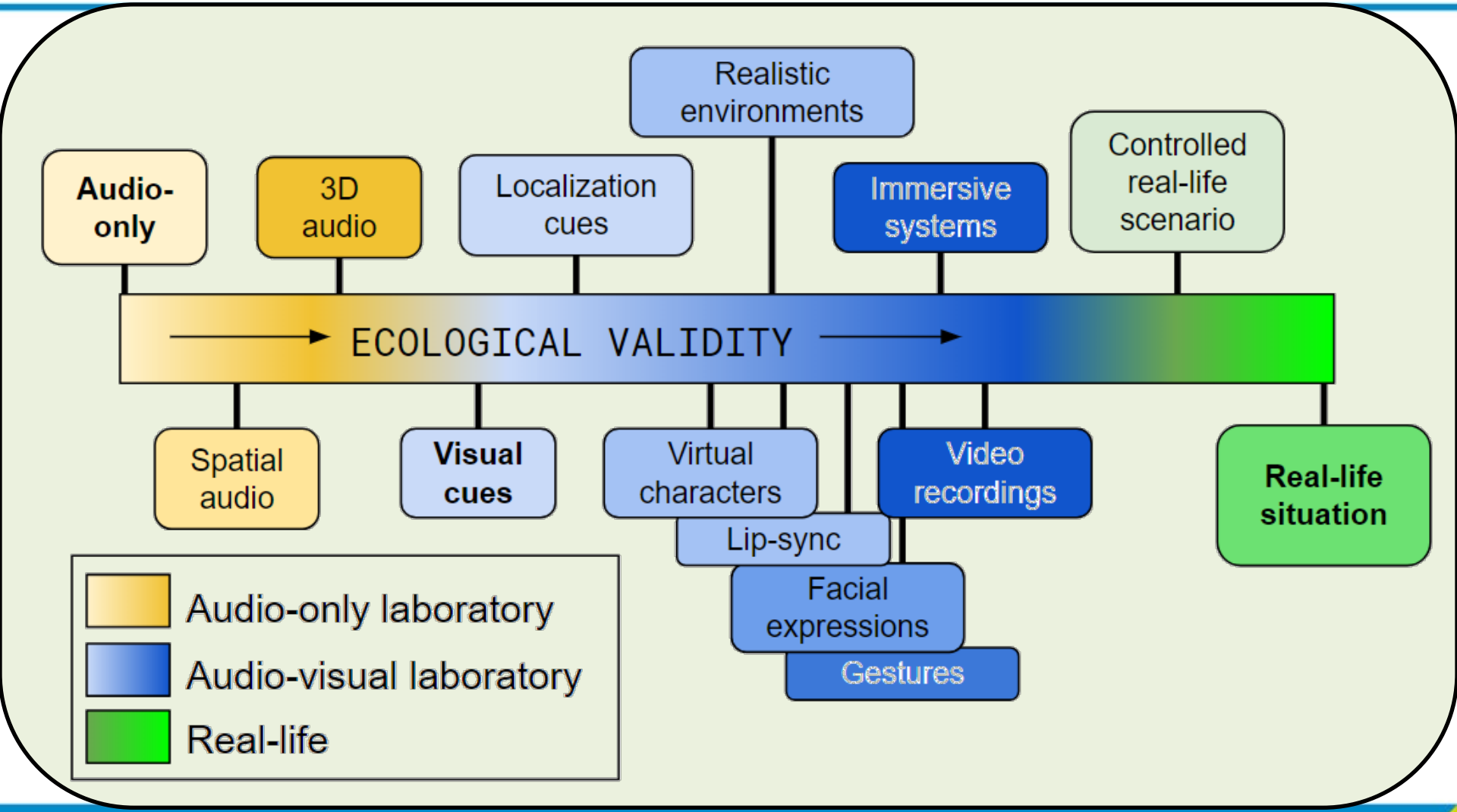
- Motivation:
  - Loudness perception in the lab
  - Hearing aid fitting
- Method:
  - Lab replication of real-life
    - HMD and stereo
    - Desktop display and stereo
    - Audio-only (mono)
  - Different vehicles and situations
  - **19 NH**, 20 HI
- Results (field):
  - Loudness ratings (categorical scale of loudness) are lower in the field than with the predicted models (NH)
- References
  - G. Llorach et al.. Road Vehicle Loudness: Normal Hearing Ratings, Loudness Models and Future Experiments With Audiovisual Immersive Simulations. Internoise 2019
  - G. Llorach, G. Grimm, M. M. E. Hendrikse, V. Hohmann. Towards Realistic Immersive Audiovisual Simulations for Hearing Research: Capture, virtual scenes and reproduction. ACMM AVSU 2018



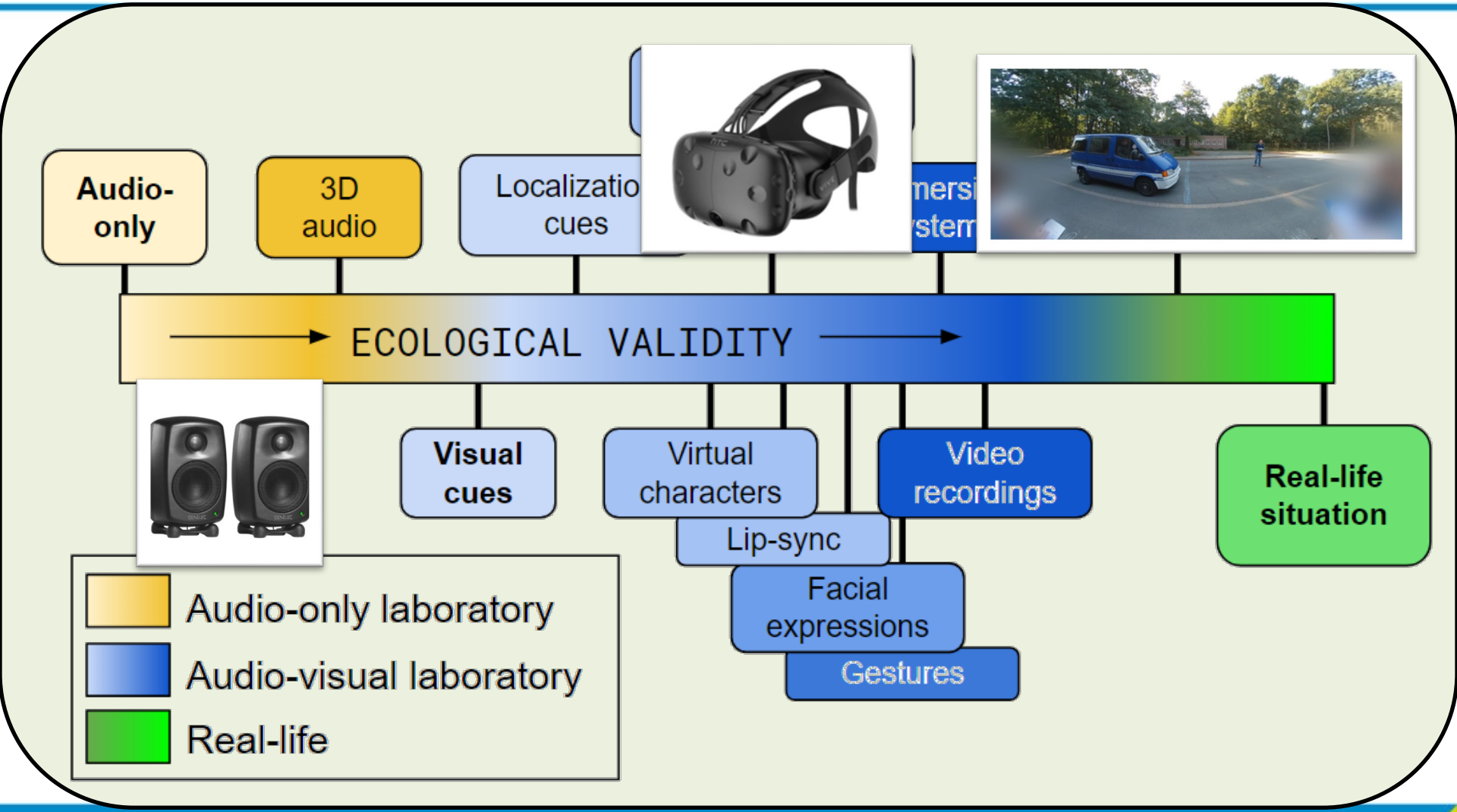
Experiment 6



Experiment 6
Conclusions – Loudness perception



Experiment 6
Conclusions – Loudness perception



Experiments 1, 2 and 3

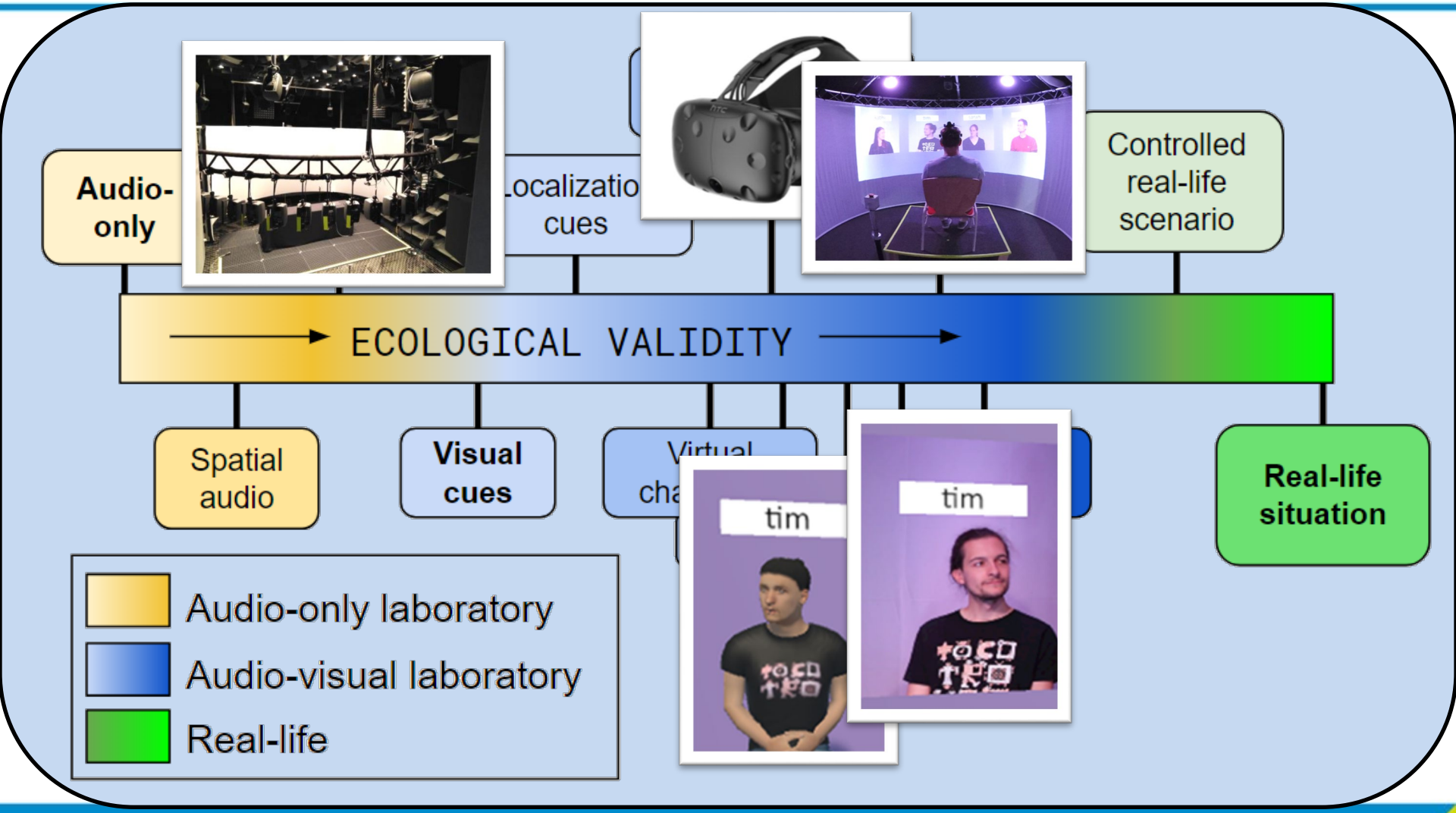
ENRICHMENT with video and virtual characters

Behavior, visual cues and displays

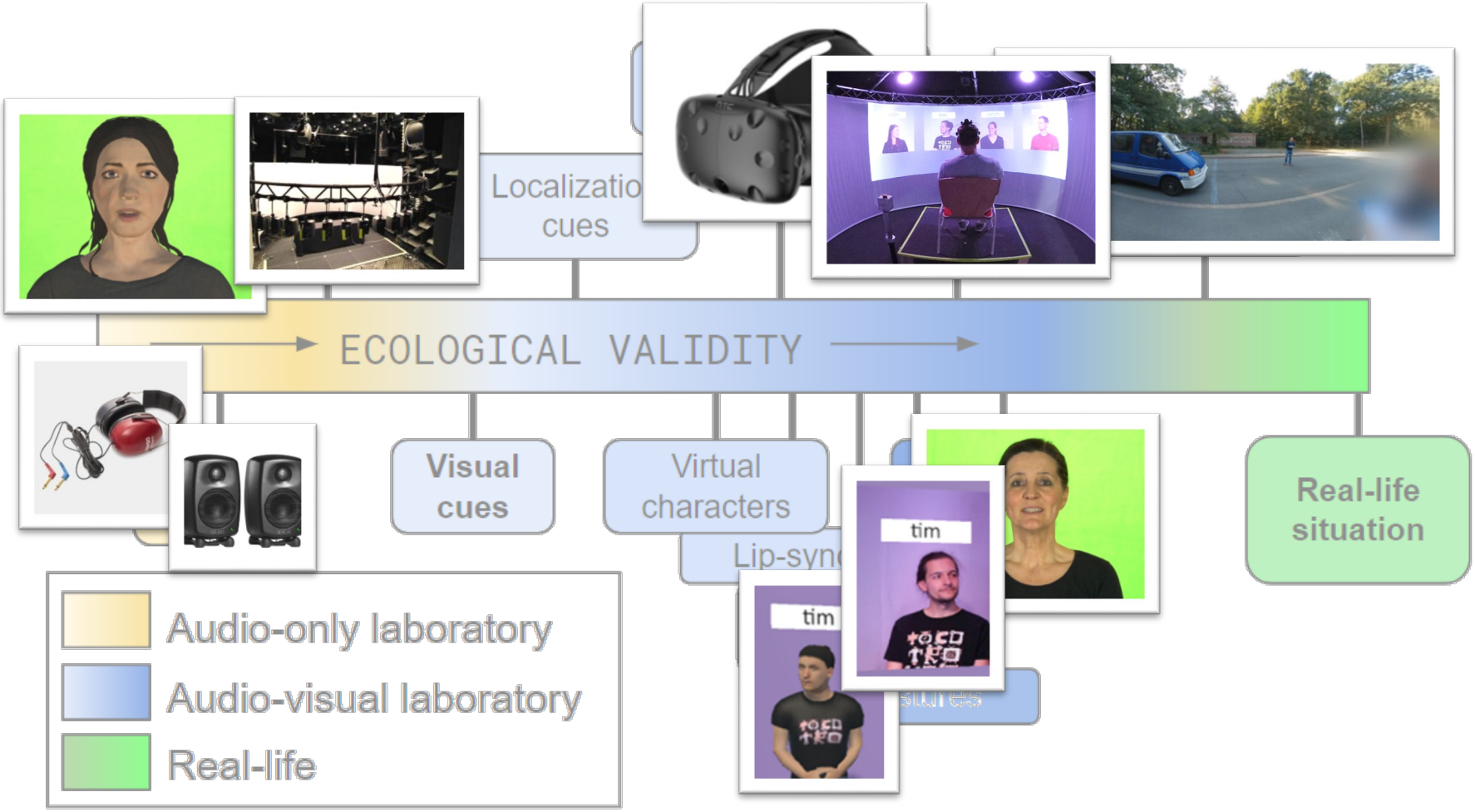
- Motivation
  - Visually guided hearing aids
  - Ecologically valid evaluation of hearing aids
- Method
  - Multi-talker conversations
  - Immersive realistic environments
    - Exp.1: 14YNH;
    - Exp. 2: 17 YNH, 11 ENH, 10 EHI
    - Exp 3: 22 YNH, 21 ENH
- Results
  - Differences between visual conditions
  - Differences between visual displays
- References

1. M. Hendrikse, G. Llorach, G. Grimm, V. Hohmann. Influence of visual cues on head and eye movements during listening tasks in multi-talker audiovisual environments with animated characters, in Speech Communication (2018)
2. G. Llorach, M. M. E. Hendrikse, G. Grimm, V. Hohmann. Comparison of a Head-Mounted Display and a Curved Screen in a Multi-Talker Audiovisual Listening Task. Accepted in JASA (ongoing revision)
3. M. Hendrikse, G. Llorach, G. Grimm, V. Hohmann. Movement and Gaze Behavior in Virtual Audiovisual Everyday-Life Listening Environments. Accepted in Trends in Hearing (ongoing revision)

Experiments 1, 2 and 3
Conclusions – Behavior and Preference



Summary


Localizatio
cues
ECOLOGICAL VALIDITY
Visual
cues
Virtual
characters
Lip-syn
Real-life
situation
tim
tim
Audio-only laboratory
Audio-visual laboratory
Real-life

Status

- German courses
  - 5h per day until end of March
  - 3.5h per day from April until July
- Secondment in BCBL July – September
- Master in Hearing Technology and Audiology (Fast Track PhD) starting in October
- 1 publication pending revision, 2 publications to write (experiments 5 and 6)

Thanks

This research has received funding from the EU‘s H2020 research and innovation programme under the MSCA GA 675324 (ENRICH ETN)