



HeAL 2026
Hearing Across the Lifespan

June 4-6, 2026

Padova Conference Center, Italy

www.heal2026.org

ASSESSING PATIENT'S PREFERENCES FOR DISTINCT HEARING AID SOUND DESIGNS TO INFORM HEARING AID RECOMMENDATION

FREDERIC MARMEL¹, DINA LELIC¹, MICHAEL NILSEN², SEBASTIAN BEST³, LAURA WINTHER BALLING²

¹ORCA Labs, DK; ²WSAudiology, DK, ³WSAudiology, DE

Conflict of Interest - I have the following potential conflict(s) of interest to report:
(i.e.) all authors have declared an industry affiliation

Individual preferences for two distinct sound designs: an online study

Personal preferences are everywhere...

Sensory preferences (e.g., gustation, olfaction)



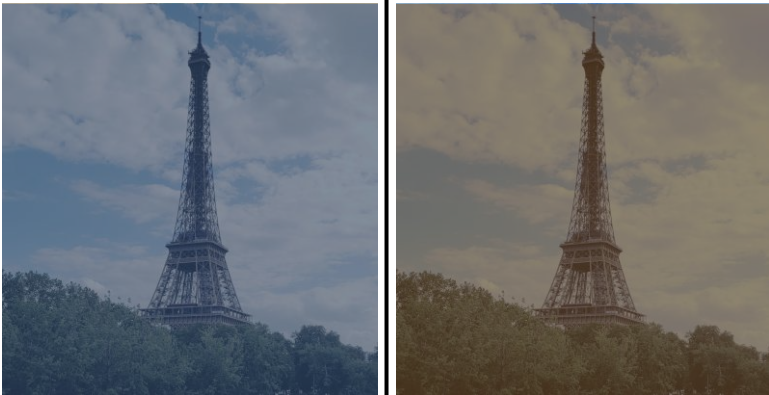
Individual preferences for two distinct sound designs: an online study

Personal preferences are everywhere...

Sensory preferences (e.g., gustation, olfaction)



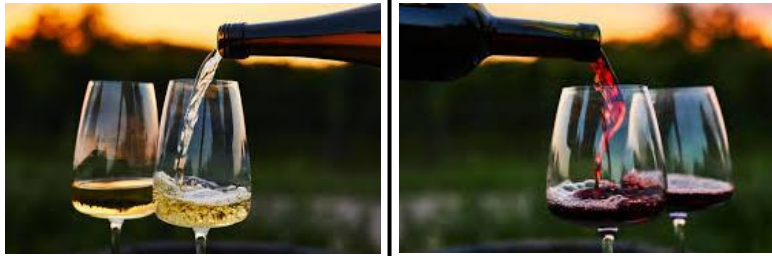
Sensory processing preferences (e.g., sunglasses with blue lenses vs. brown lenses)



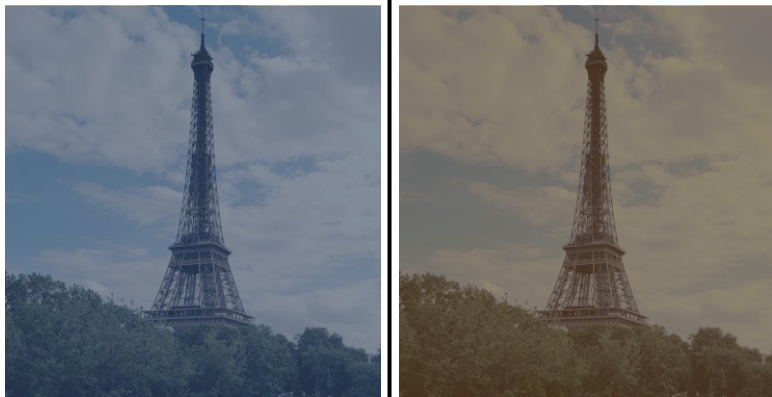
Individual preferences for two distinct sound designs: an online study

Personal preferences are everywhere...

Sensory preferences (e.g., gustation, olfaction)



Sensory processing preferences (e.g., sunglasses with blue lenses vs. brown lenses)



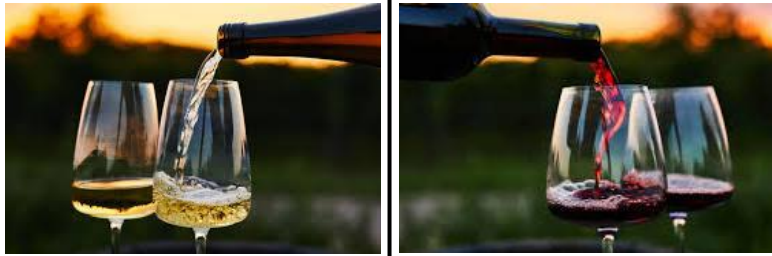
What about preferences for hearing aid sound?

- Many processing choices determine how hearing aids sound, resulting in different sound designs

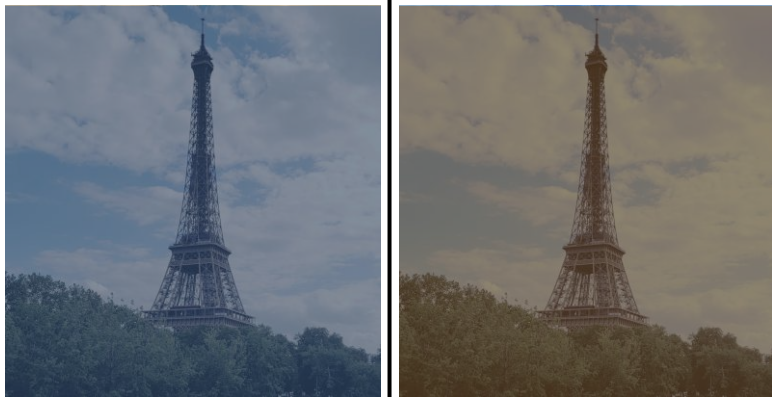
Individual preferences for two distinct sound designs: an online study

Personal preferences are everywhere...

Sensory preferences (e.g., gustation, olfaction)



Sensory processing preferences (e.g., sunglasses with blue lenses vs. brown lenses)



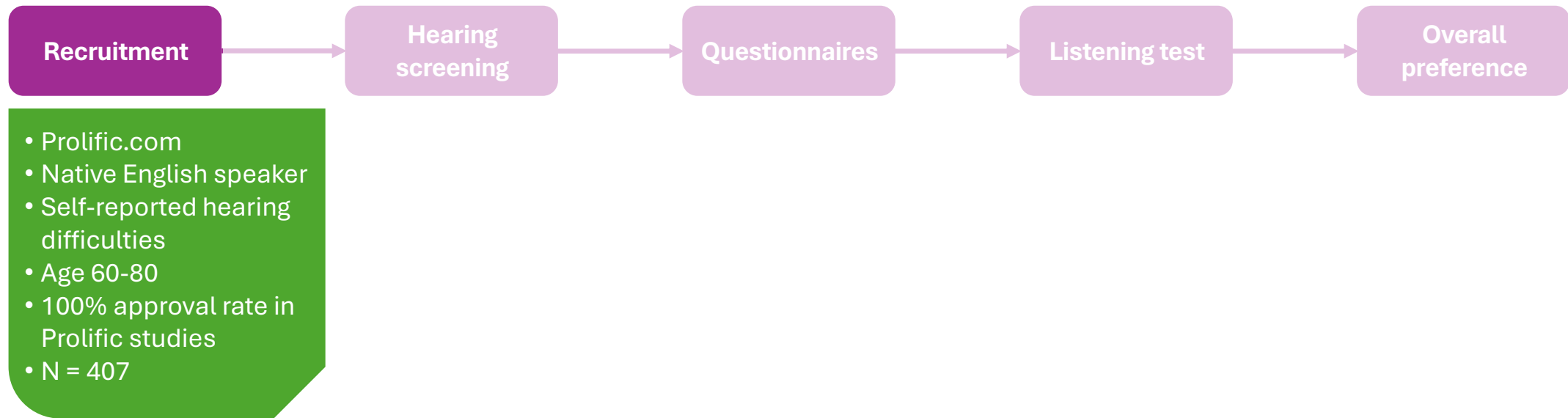
What about preferences for hearing aid sound?

- Many processing choices determine how hearing aids sound, resulting in different sound designs

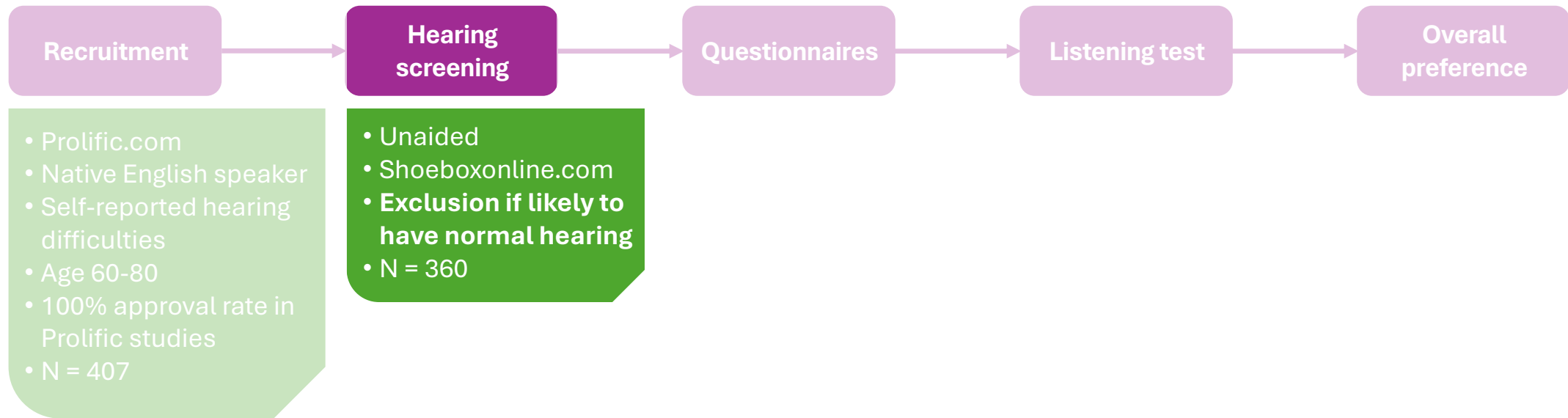
Research questions

- Do people have preferences for one sound design in particular?
- Do these preferences vary depending on the scene/scenario?
- Do people with different preferences have different hearing-related lifestyle and demands?
- Do people with different preferences have different hearing needs?
- Do people with different preferences give different reasons for their preference?

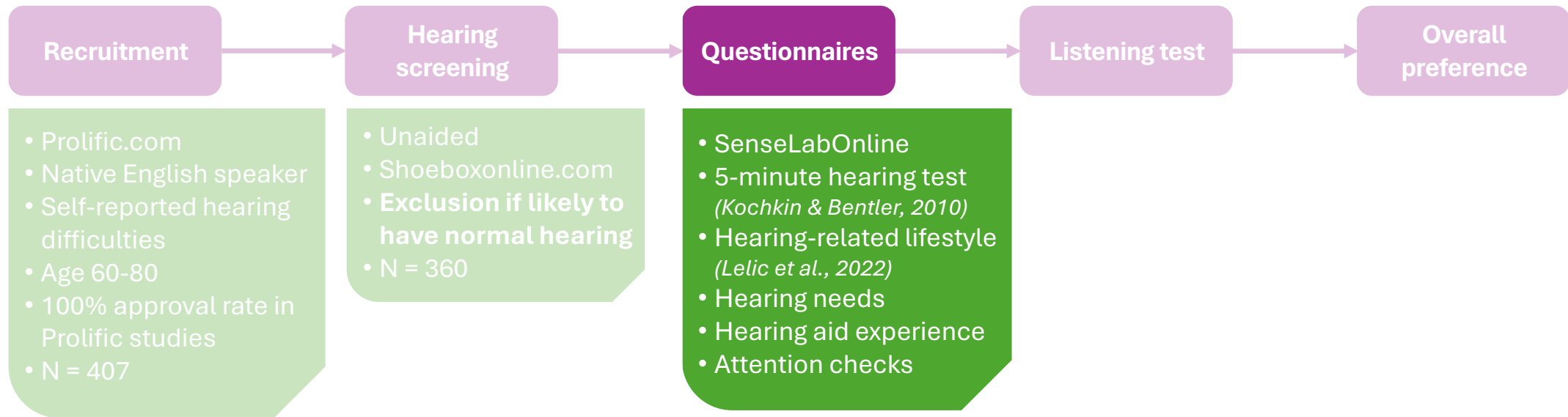
Online study workflow



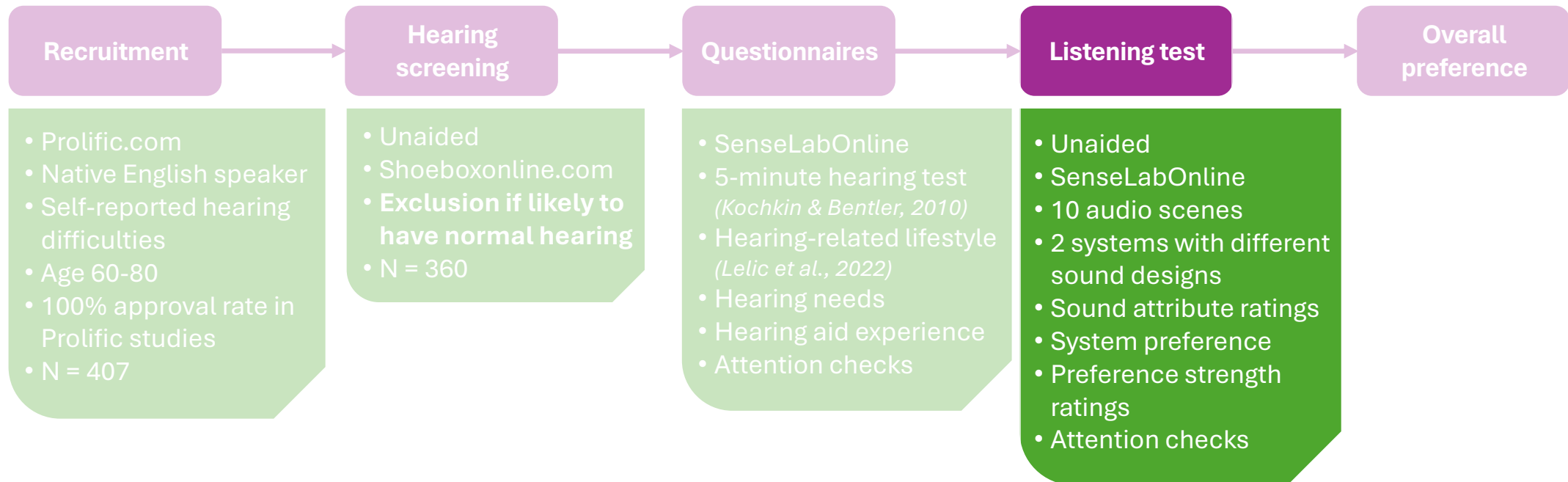
Online study workflow



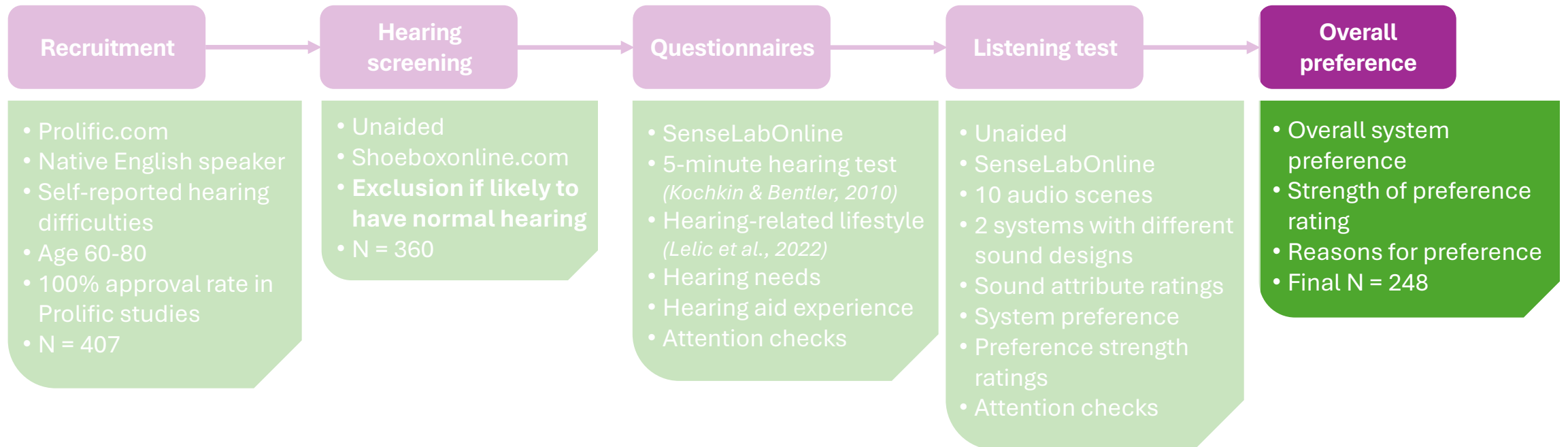
Online study workflow



Online study workflow



Online study workflow



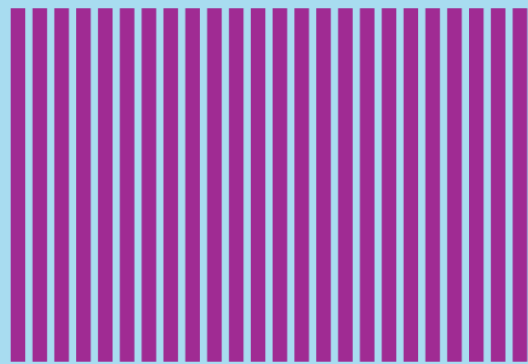
Hearing aid sound designs

Two different sound designs stemming from opposite signal processing choices

Frequency-domain filter bank

- Relatively narrow, uniformly spaced filters enable high-resolution parallel spectral analysis
- Efficient processing provides extra processing power

Amplitude (dBFS)

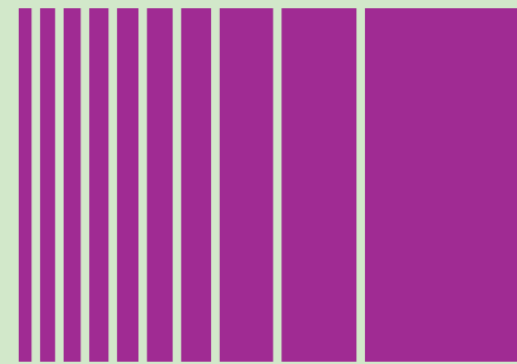


500 1000 1500 2000 2500 3000 3500+ Frequency (Hz)

Time-domain filter bank

- Variable-width filters mimic the logarithmic nature of the filters in the human cochlea
- Keeps signal processing delay low

Amplitude (dBFS)



500 1000 1500 2000 2500 3000 3500+ Frequency (Hz)

Hearing aid recordings, listening scenarios, listening tasks

Hearing aids

- Time-domain system: Widex Allure RIC
- Frequency-domain system: Signia IX Pure C&G



Fitting & Recording

- KEMAR manikin, M-receivers & Instant Sleeve Vented eartips
- Proprietary fitting rationales to N3 hearing loss (*Bisgaard et al., 2010*)
- Default fitting flow with settings for experienced users
- 45-channel loudspeaker array using 4th-order Ambisonics
- KEMAR recordings corrected to facilitate headset listening

Hearing aid recordings, listening scenarios, listening tasks

Hearing aids

- Time-domain system: Widex Allure RIC
- Frequency-domain system: Signia IX Pure C&G



Fitting & Recording

- KEMAR manikin, M-receivers & Instant Sleeve Vented eartips
- Proprietary fitting rationales to N3 hearing loss (*Bisgaard et al., 2010*)
- Default fitting flow with settings for experienced users
- 45-channel loudspeaker array using 4th-order Ambisonics
- KEMAR recordings corrected to facilitate headset listening

Scenes:

- Music – *instrumental pop/easy listening*
- Restaurant – *away from occupied tables*
- Restaurant – *at an occupied table (no target speech)*
- Restaurant – *target speech*
- Sounds of nature - *rain*
- Fitness room with music
- Speech in quiet
- School classroom – *teacher speaking (target speech)*
- School classroom – *students chatting (no target speech)*
- Beer hall – *target speech at very low SNR*

Hearing aid recordings, listening scenarios, listening tasks

Hearing aids

- Time-domain system: Widex Allure RIC
- Frequency-domain system: Signia IX Pure C&G



Fitting & Recording

- KEMAR manikin, M-receivers & Instant Sleeve Vented eartips
- Proprietary fitting rationales to N3 hearing loss (Bisgaard et al., 2010)
- Default fitting flow with settings for experienced users
- 45-channel loudspeaker array using 4th-order Ambisonics
- KEMAR recordings corrected to facilitate headset listening

Scenes:

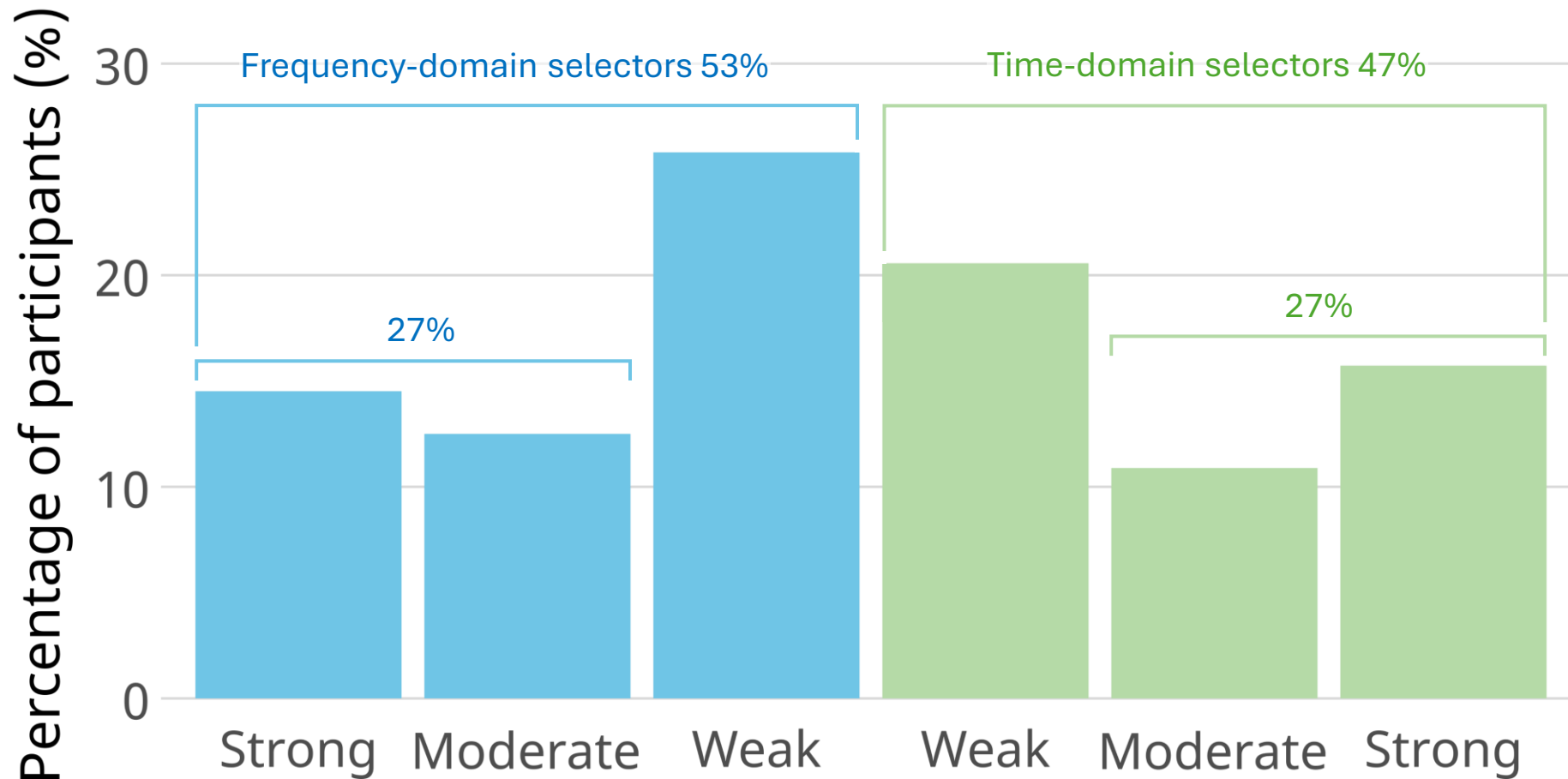
- Music – *instrumental pop/easy listening*
- Restaurant – *away from occupied tables*
- Restaurant – *at an occupied table (no target speech)*
- Restaurant – *target speech*
- Sounds of nature - *rain*
- Fitness room with music
- Speech in quiet
- School classroom – *teacher speaking (target speech)*
- School classroom – *students chatting (no target speech)*
- Beer hall – *target speech at very low SNR*

Tasks:

- **Attribute ratings:** speech clarity (*scenarios with foreground speech*), naturalness (*of background sounds if relevant, of overall scenario if not*), sound quality
- **Preference ratings:**
 - Which sound do you prefer? (**forced choice**)
 - How strong is your preference? (*weak/moderate/strong*)

Overall preference distribution

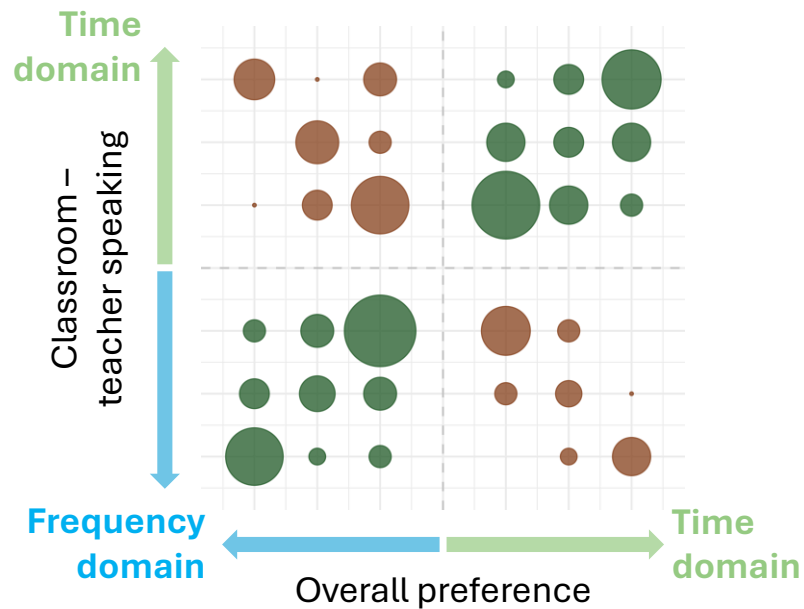
- **54%** of participants have **moderate or strong overall preference for one sound design**, equally split between the time-domain and the frequency-domain systems
- Weak preferences are hard to interpret because of the forced preference choice



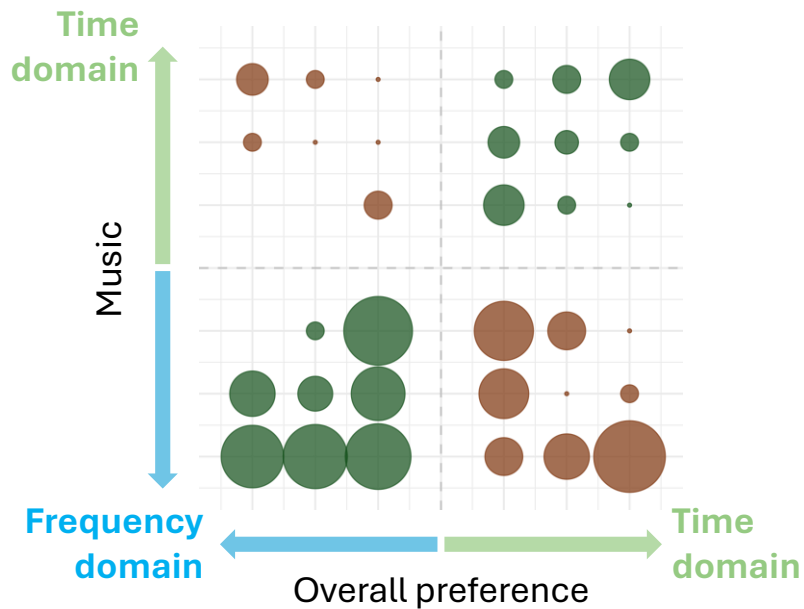
By-scenario preferences: agreement with overall preferences

- **Moderate within-participant agreement** between preferred system overall and “majority preference” (system chosen in a majority of the scenes)
 - ❖ proportion of agreement = 76%; Cohen’s Kappa = 0.52
- **Variability across scenes** – 3 cases:

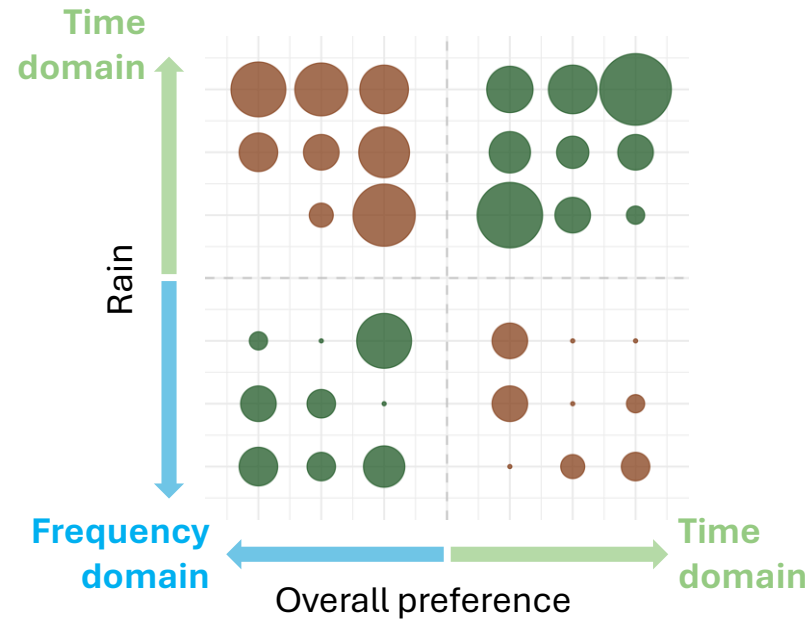
Moderate agreement: Overall preferences vs. “Classroom – teacher speaking”



Majority frequency-domain preference for “Music”, irrespective of overall preference



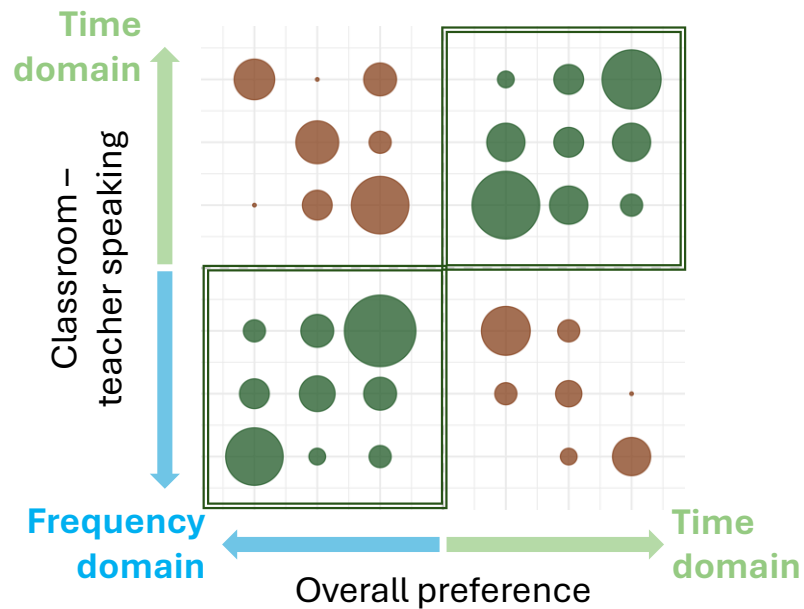
Majority time-domain preference for “Rain”, irrespective of overall preference



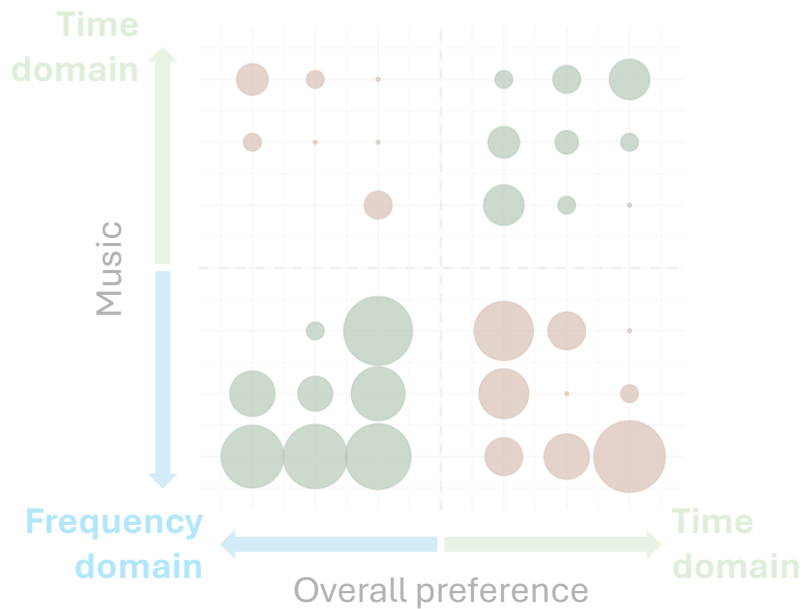
By-scenario preferences: agreement with overall preferences

- **Moderate within-participant agreement** between preferred system overall and “majority preference” (system chosen in a majority of the scenes)
 - ❖ proportion of agreement = 76%; Cohen’s Kappa = 0.52
- **Variability across scenes** – 3 cases:

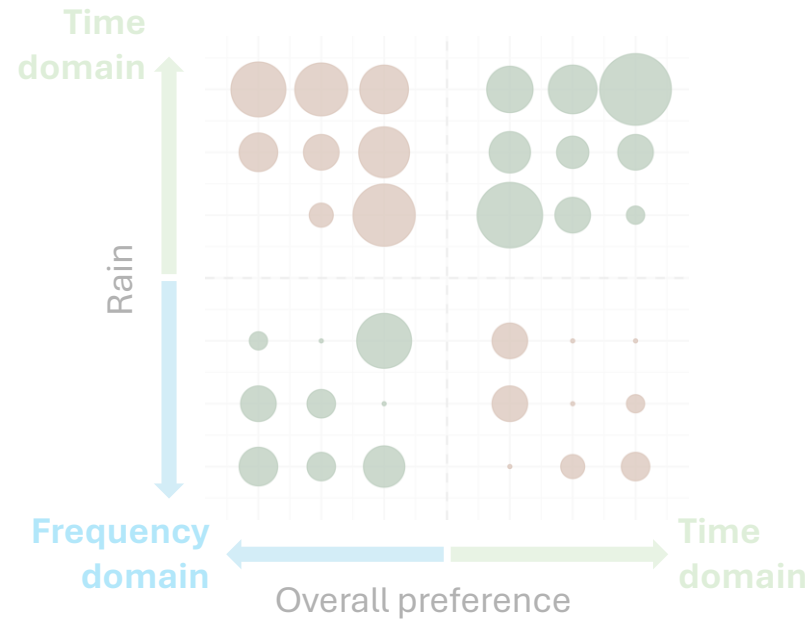
Moderate agreement: Overall preferences vs. “Classroom – teacher speaking”



Majority frequency-domain preference for “Music”, irrespective of overall preference



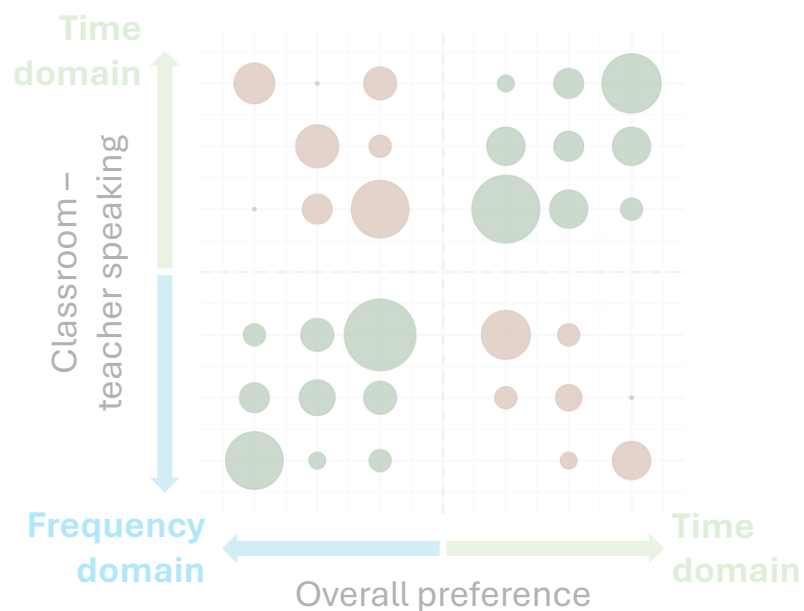
Majority time-domain preference for “Rain”, irrespective of overall preference



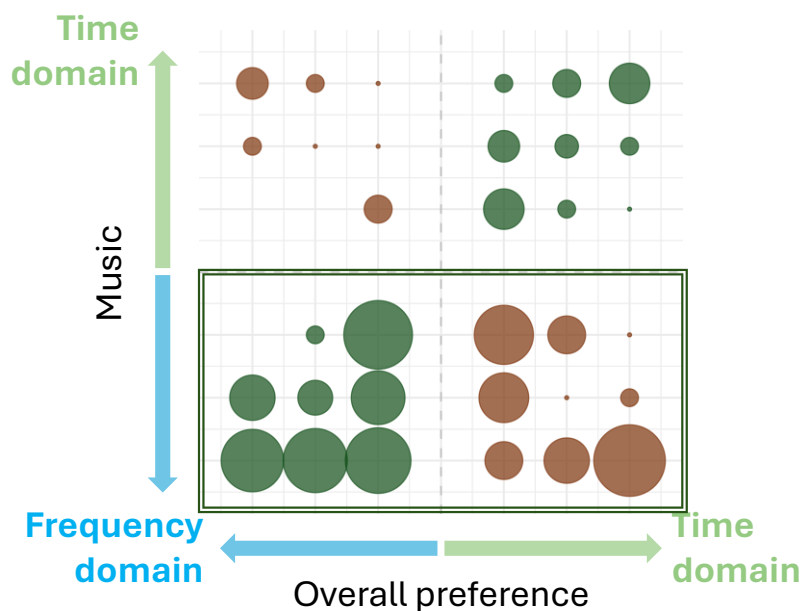
By-scenario preferences: agreement with overall preferences

- **Moderate within-participant agreement** between preferred system overall and “majority preference” (system chosen in a majority of the scenes)
 - ❖ proportion of agreement = 76%; Cohen’s Kappa = 0.52
- **Variability across scenes** – 3 cases:

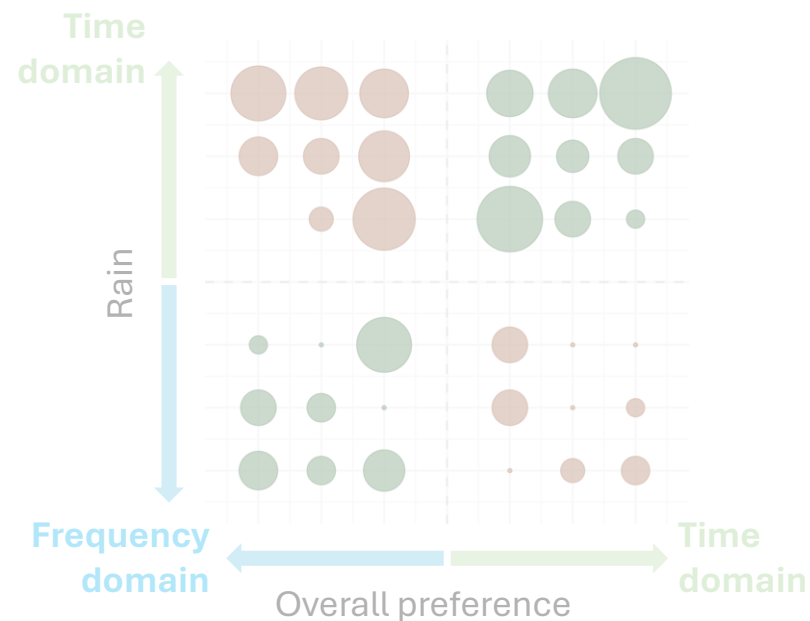
Moderate agreement: Overall preferences vs. “Classroom – teacher speaking”



Majority frequency-domain preference for “Music”, irrespective of overall preference



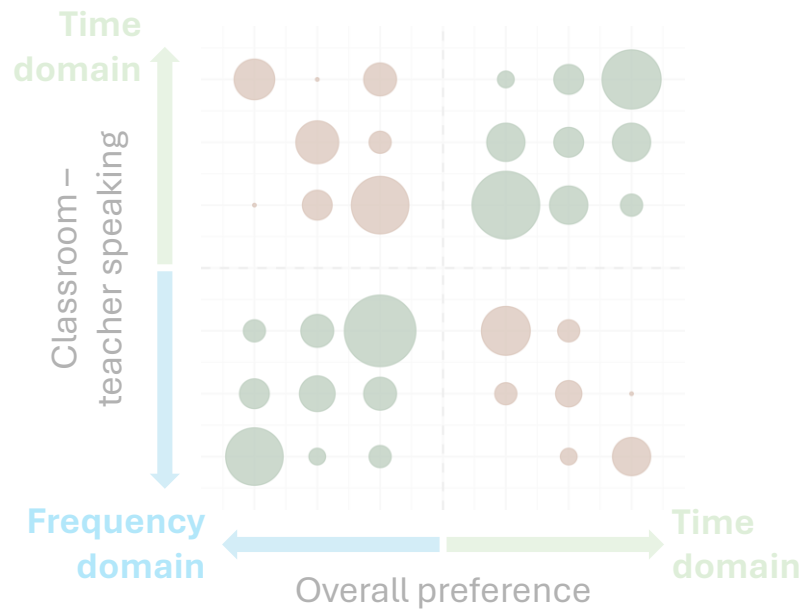
Majority time-domain preference for “Rain”, irrespective of overall preference



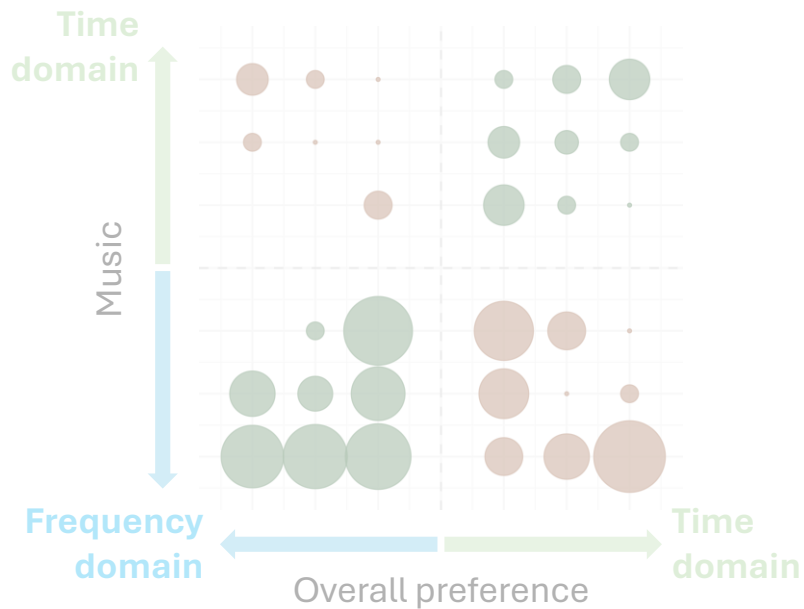
By-scenario preferences: agreement with overall preferences

- **Moderate within-participant agreement** between preferred system overall and “majority preference” (system chosen in a majority of the scenes)
 - ❖ proportion of agreement = 76%; Cohen’s Kappa = 0.52
- **Variability across scenes** – 3 cases:

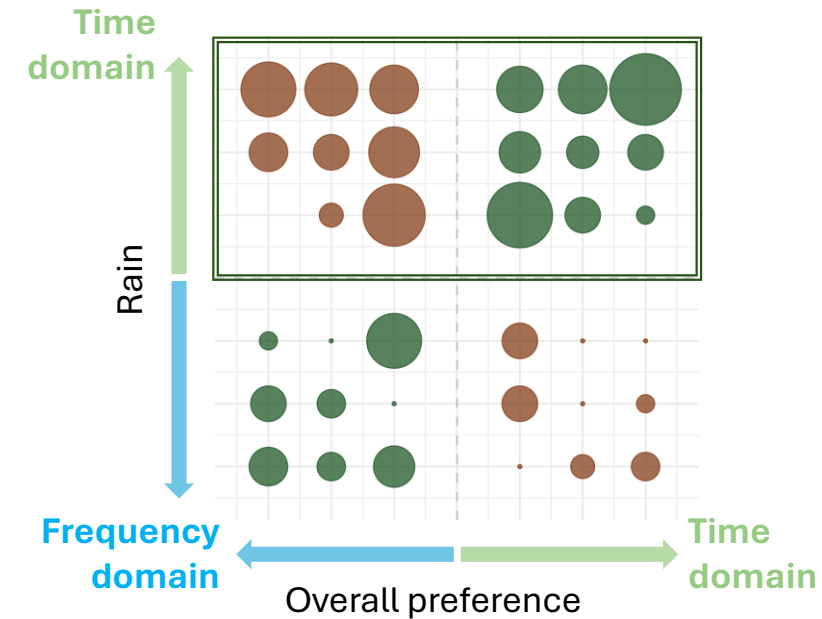
Moderate agreement: Overall preferences vs. “Classroom – teacher speaking”



Majority frequency-domain preference for “Music”, irrespective of overall preference

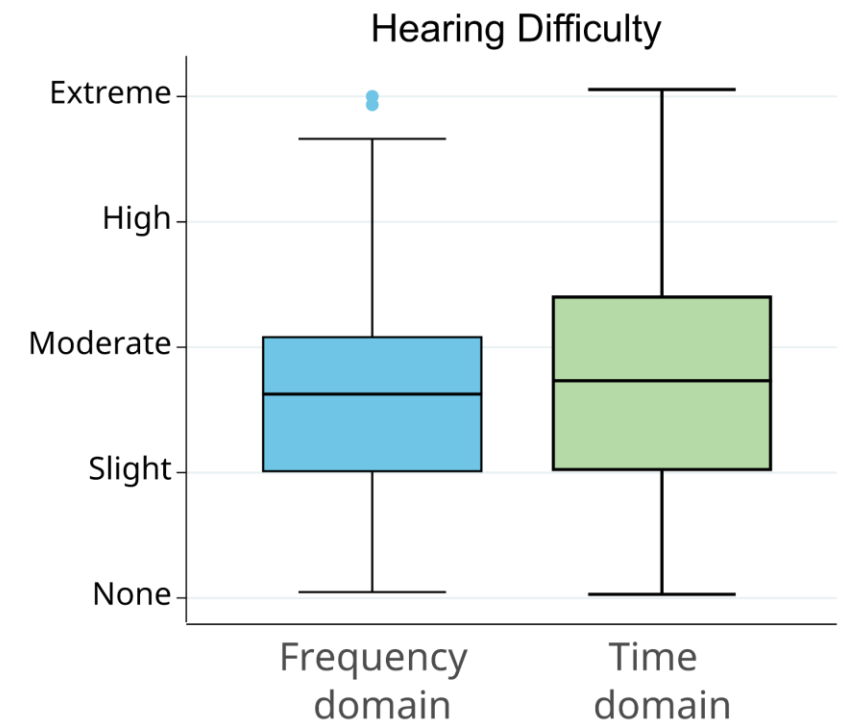
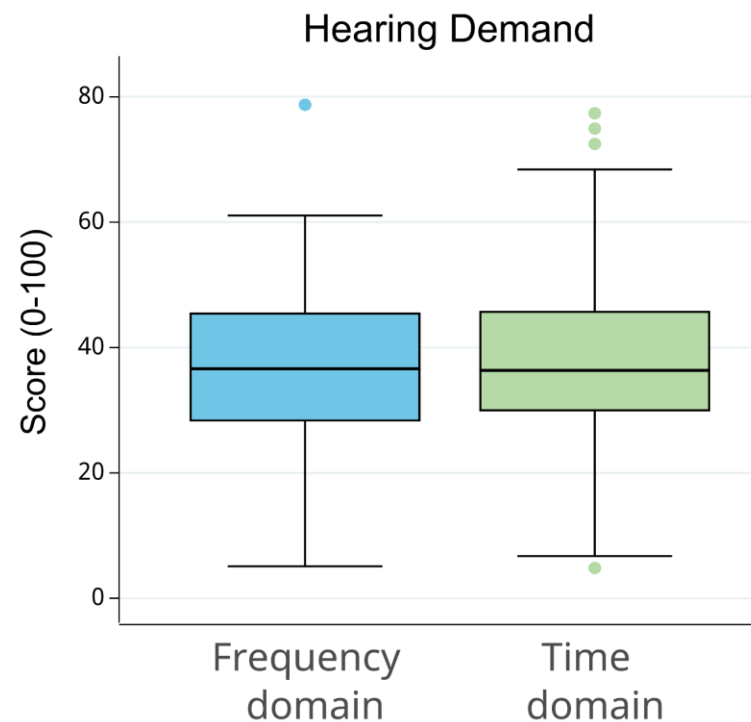
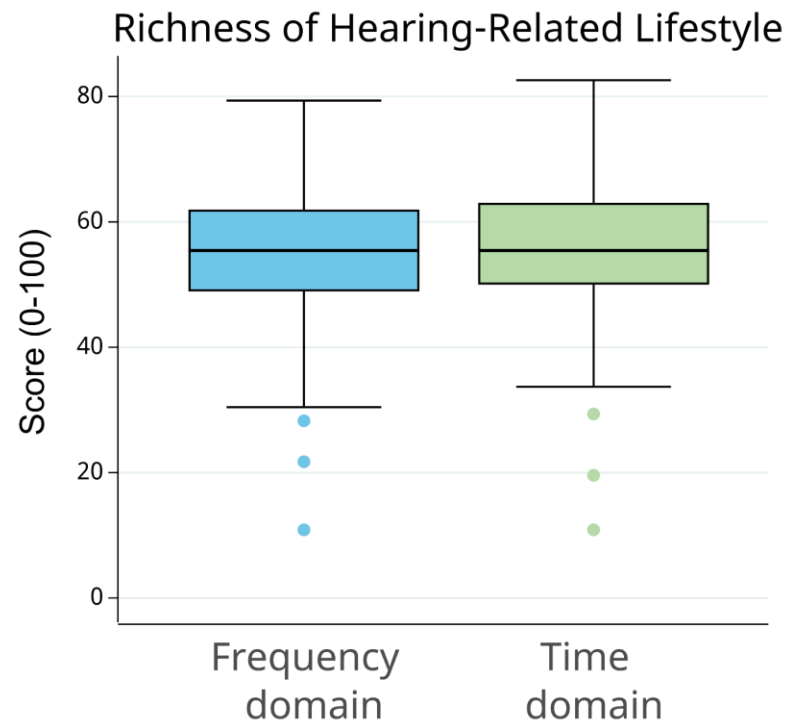


Majority time-domain preference for “Rain”, irrespective of overall preference



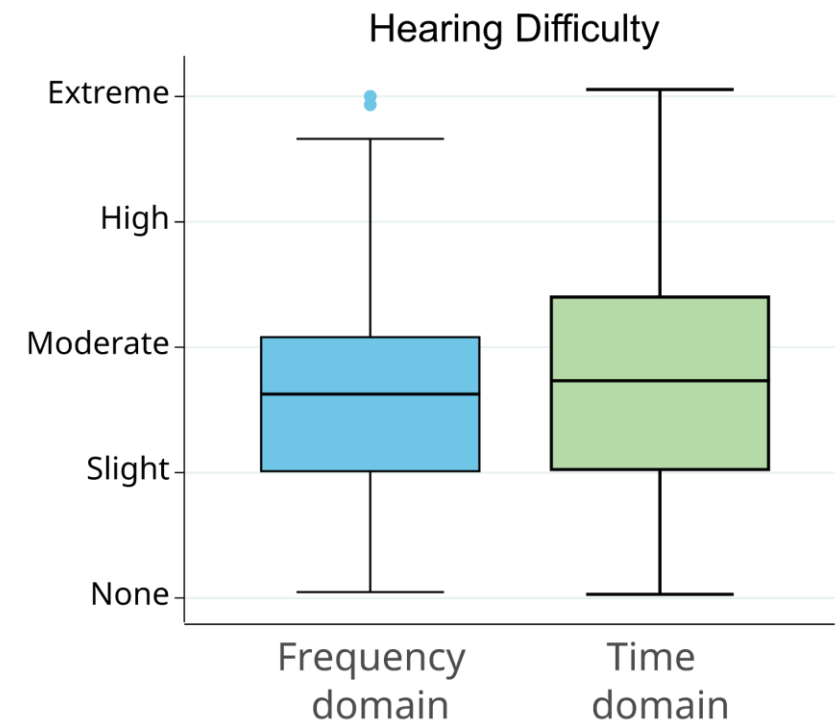
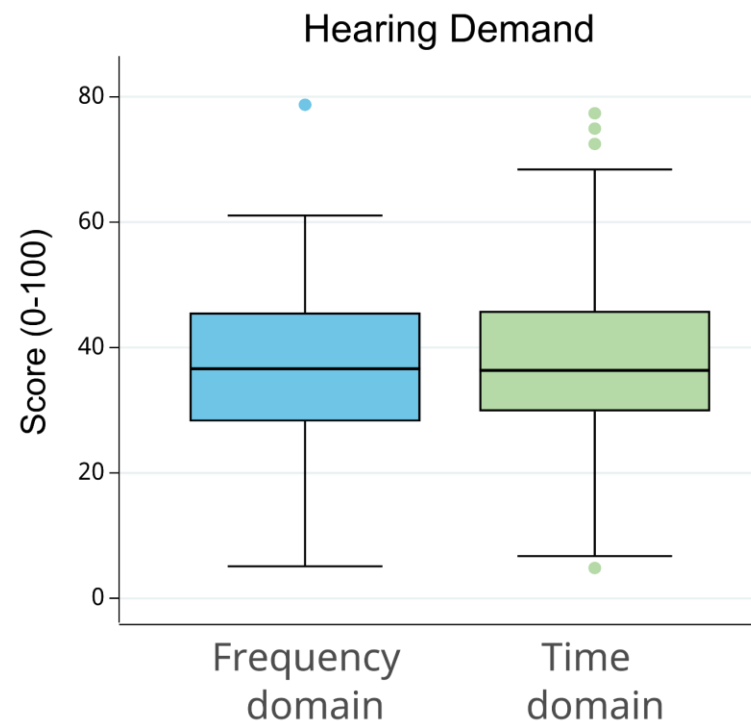
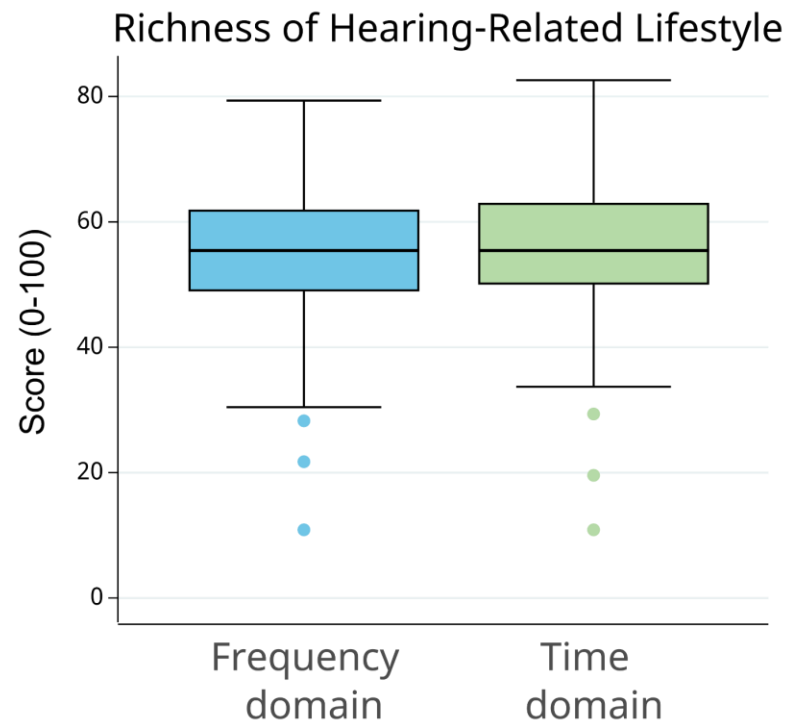
Hearing-related lifestyle and demands

- Hearing-related lifestyle questionnaire (*HEARLI-Q: Lelic et al., 2022*):
 - ❖ Asks frequency of occurrence, importance and difficulty of 23 everyday listening situations
 - ❖ Evaluates richness of lifestyle (frequency of occurrence), hearing demands (occurrence * importance), and hearing difficulties



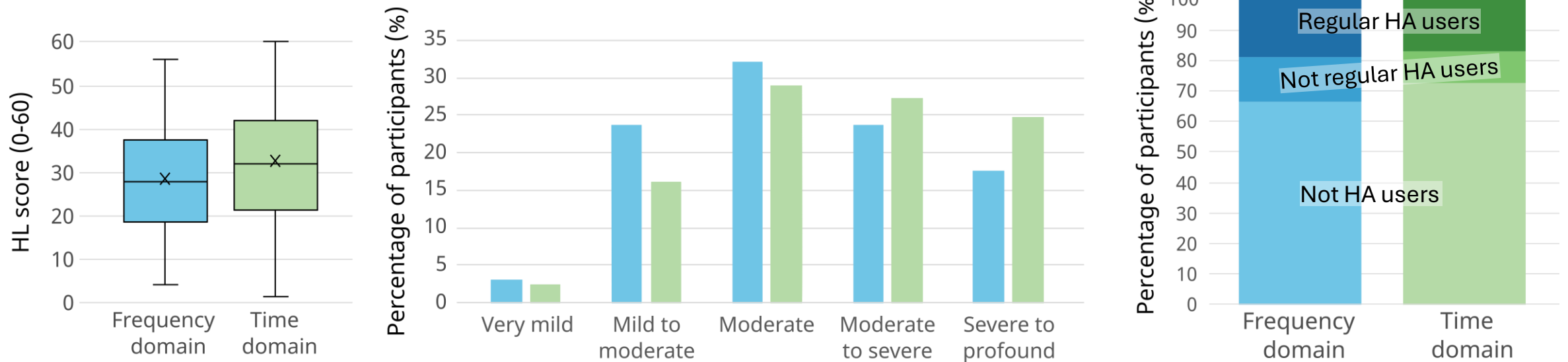
Hearing-related lifestyle and demands

- Hearing-related lifestyle questionnaire (*HEARLI-Q: Lelic et al., 2022*):
 - ❖ Asks frequency of occurrence, importance and difficulty of 23 everyday listening situations
 - ❖ Evaluates richness of lifestyle (frequency of occurrence), hearing demands (occurrence * importance), and hearing difficulties
- **No differences between selectors** of the two sound designs, **no ability to predict preferences**



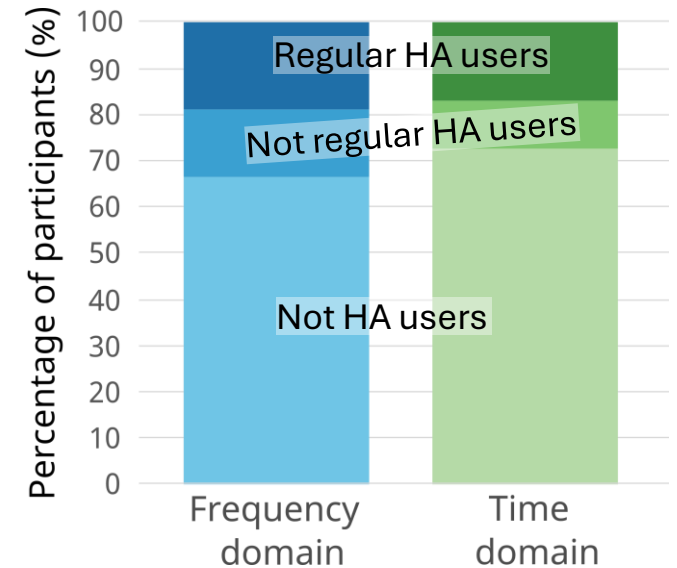
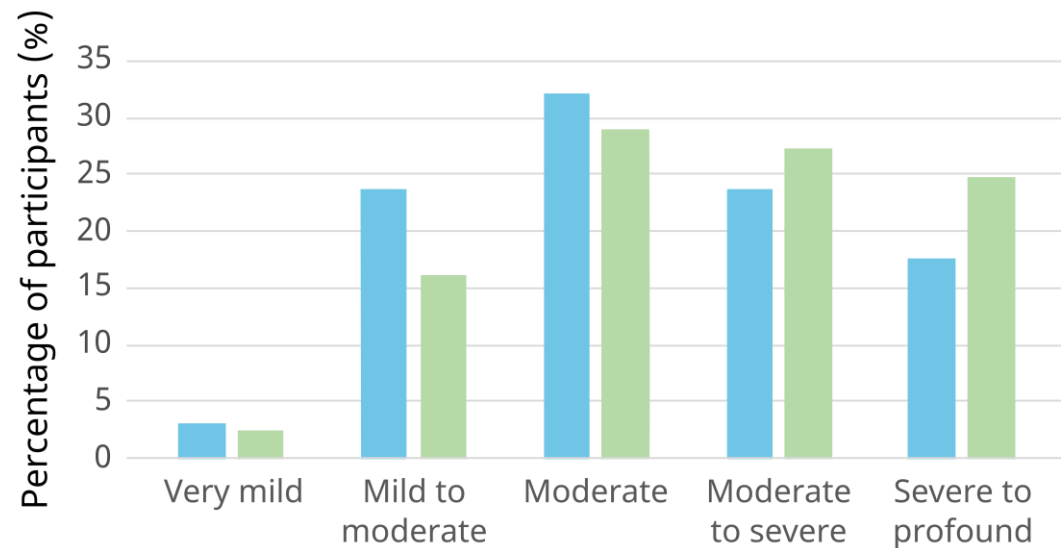
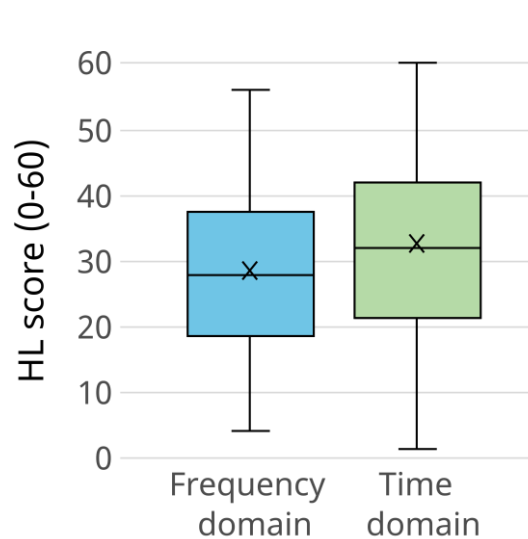
Hearing loss severity, hearing aid use

- Lack of control on participants' hearing loss and hearing aid use (online study)
- Hearing loss estimated from questionnaire (*Kochkin & Bentler, 2010; Koike et al., 1994*)



Hearing loss severity, hearing aid use

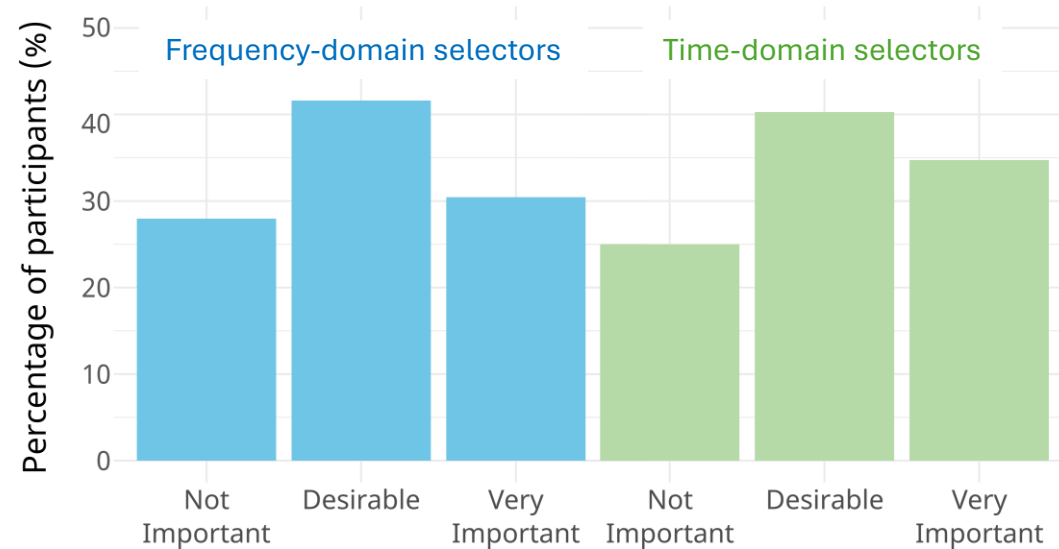
- Lack of control on participants' hearing loss and hearing aid use (online study)
- Hearing loss estimated from questionnaire (*Kochkin & Bentler, 2010; Koike et al., 1994*)
- **Slightly more severe hearing loss and lower hearing aid use for time-domain selectors**
- But hearing loss severity and hearing aid aid use did not predict preferences



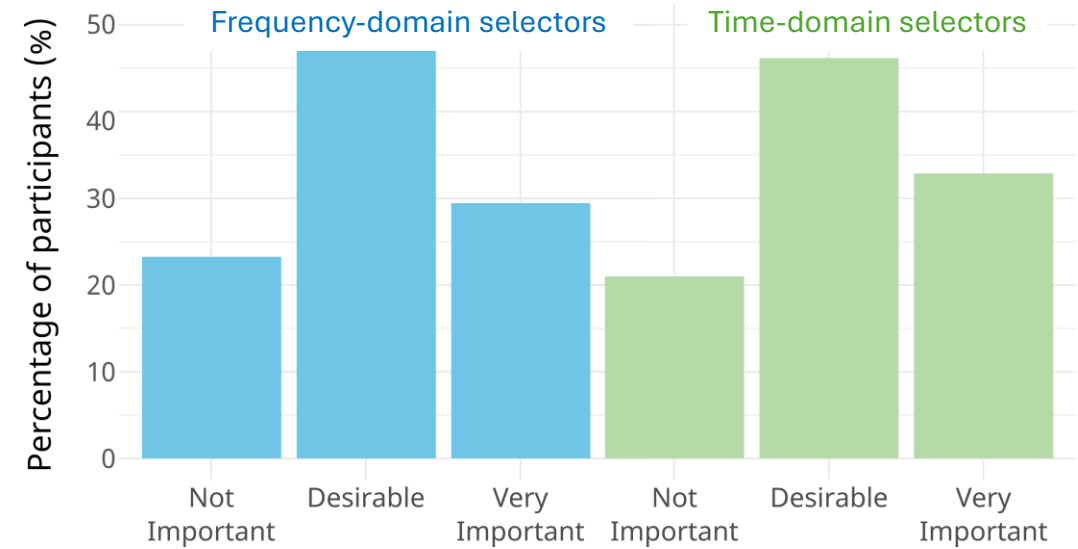
Hearing needs

- Hearing needs assessment of social/occupational needs (in what situations/for what purpose are hearing aids needed) and technological needs (functionalities/level of technology needed in hearing aids)

Importance of Social / Occupational needs



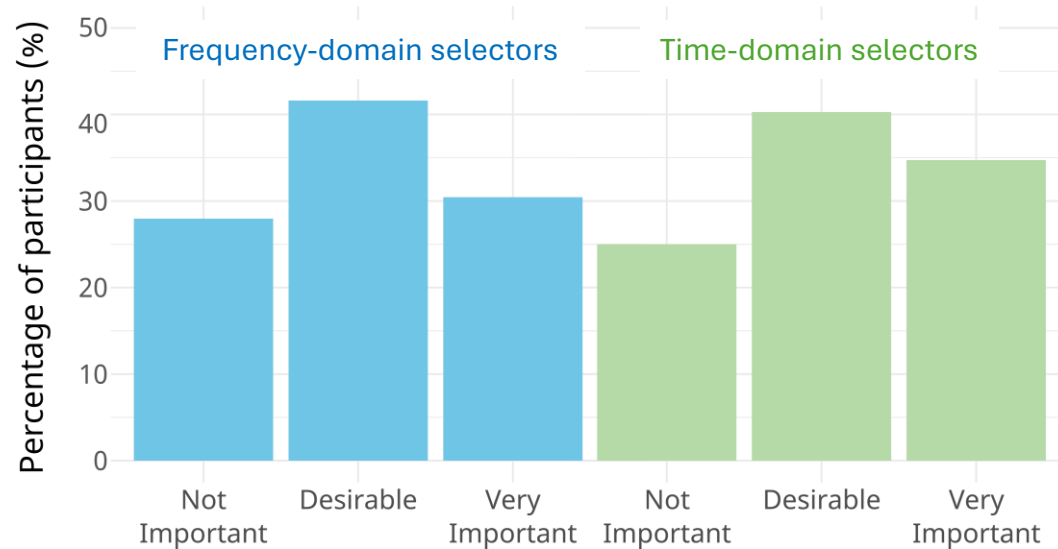
Importance of Technological needs



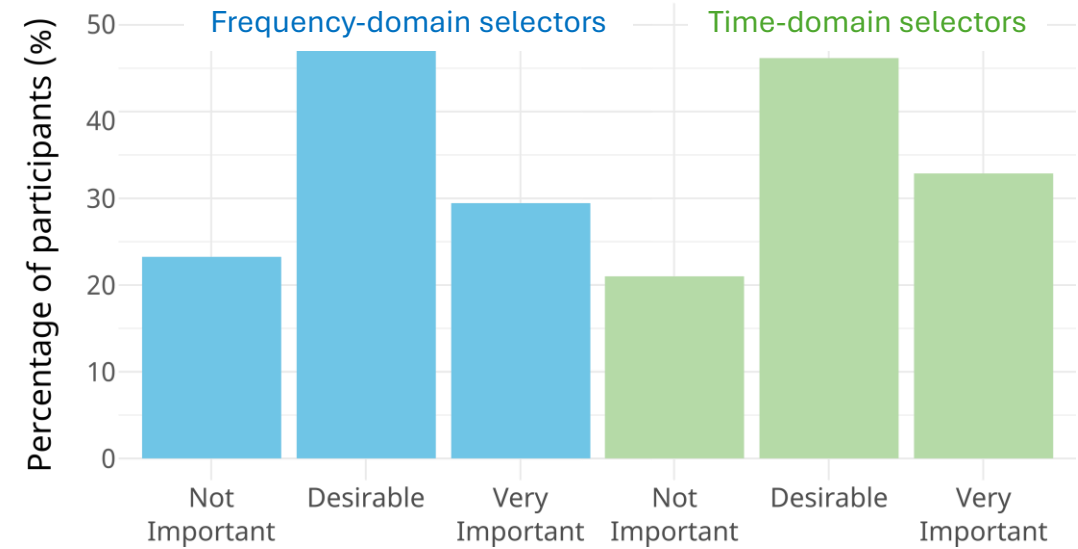
Hearing needs

- Hearing needs assessment of social/occupational needs (in what situations/for what purpose are hearing aids needed) and technological needs (functionalities/level of technology needed in hearing aids)
- **No differences** between frequency-domain and time-domain selectors

Importance of Social / Occupational needs



Importance of Technological needs



Reponses to the research questions

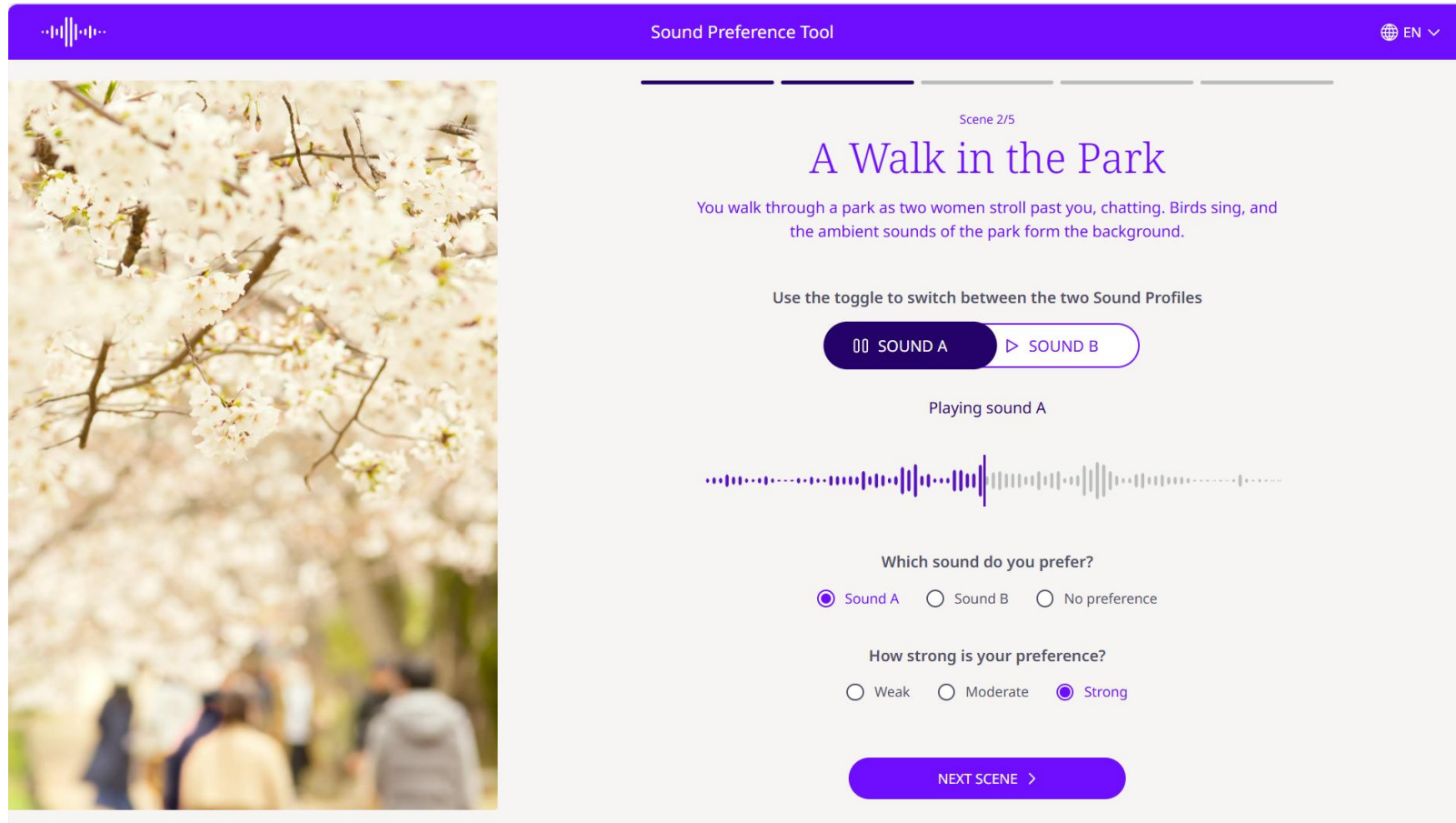
- 54% of participants had moderate or strong overall preference for a sound design, equally split between the two sound designs
- Preferences varied depending on the scene. Moderate agreement between overall preference and by-scene preferences
- What reasons did people give for their preferences? Coming up in the next presentation 😊

Reponses to the research questions

- 54% of participants had moderate or strong overall preference for a sound design, equally split between the two sound designs
- Preferences varied depending on the scene. Moderate agreement between overall preference and by-scene preferences
- What reasons did people give for their preferences? Coming up in the next presentation 😊
- Hearing lifestyle, hearing needs, and demographics did not predict preferences
 - ➔ Exposure to sounds might be needed to determine sound preference

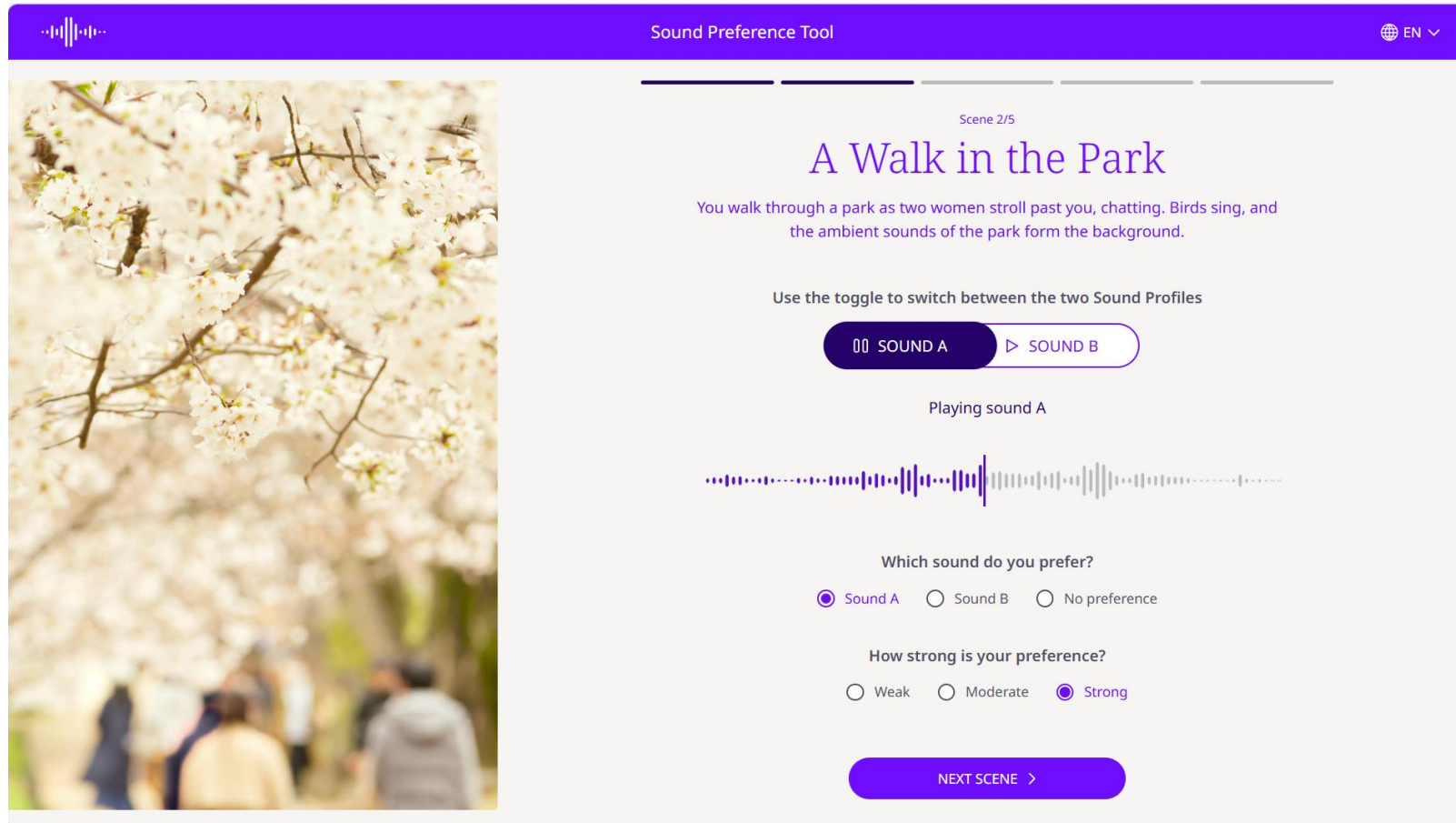
Clinical application: development of a Sound Preference Tool

- Based on insights from the online study, we developed an online preference tool: soundpreference.net



Clinical application: development of a Sound Preference Tool

- Based on insights from the online study, we developed an online preference tool: soundpreference.net



- Part of a wider approach to:
 - Identify preference
 - Enable conversations
 - Empower hearing-care professionals and users

Clinical application: development of a Sound Preference Tool

- 5 audio scenes presented with **idealized renderings for the two sound designs**:
 - ❖ Results not tied to specific devices
 - ❖ Precisely illustrates the differences between how each sound design would present a scene
 - ❖ Limitation: renderings tailored for N3 hearing loss (*Bisgaard et al., 2010*)



Going for a Drive



A Walk in the Park



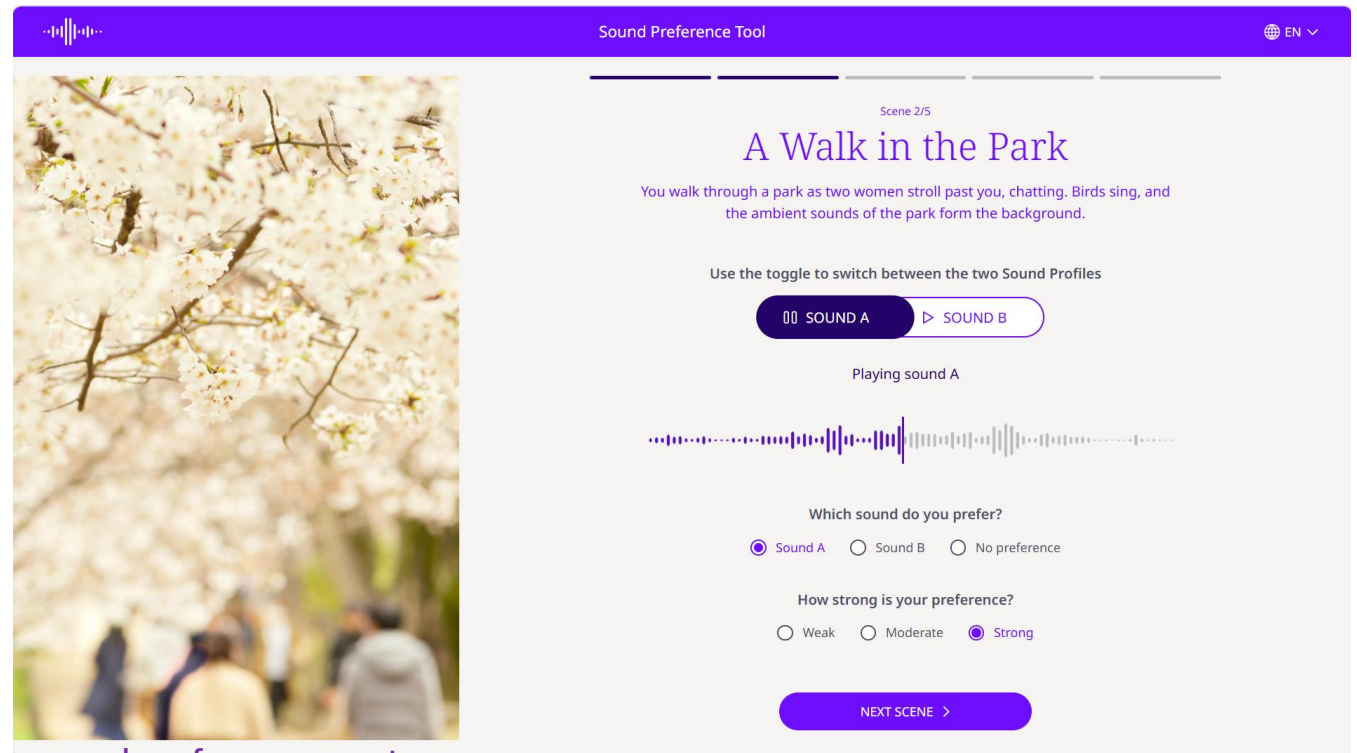
Cooking in the Kitchen



Enjoying a Night Out



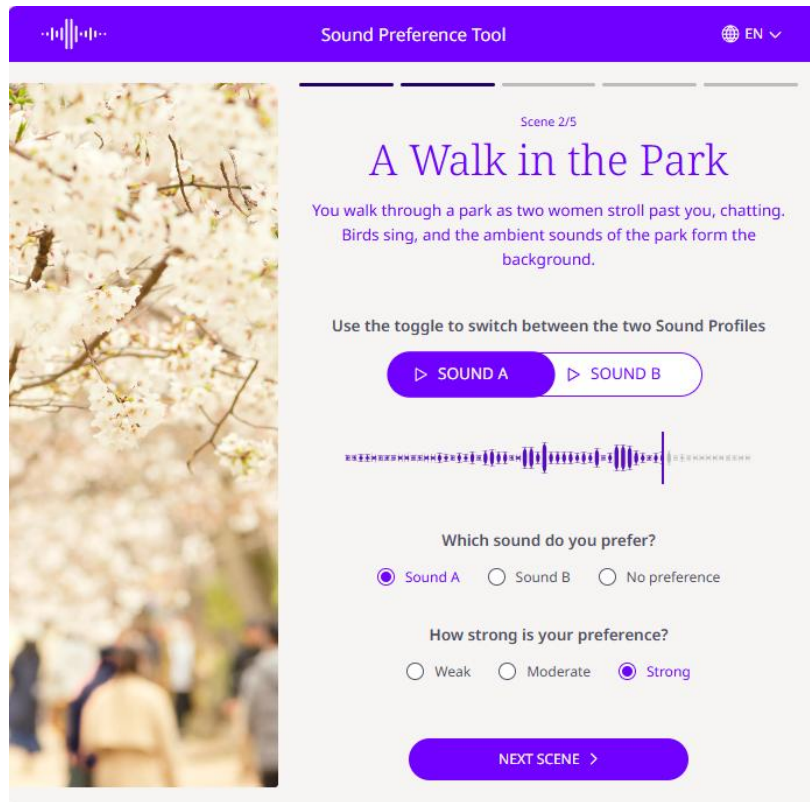
Solo Piano



soundpreference.net

Clinical application: development of a Sound Preference Tool

- 5 audio scenes presented with **idealized renderings for the two sound designs**:
 - ❖ Results not tied to specific devices
 - ❖ Precisely illustrates the differences between how each sound design would present a scene
 - ❖ Limitation: renderings tailored for N3 hearing loss (*Bisgaard et al., 2010*)



- “**No preference**” option included to give clients autonomy
- Instructions focus on making the tool **pleasant to use** and encouraging clients to **listen carefully** to the **aspects of the sounds** that are **relevant** to them **personally**
- All judging all scenes, clients reminded of their by-scene preferences before giving their **overall preference**
- At the end, **soft recommendation issued** in the form of summary statement about expressed preferences and **nudge to share preferences with hearing care professional**
- All outcomes can be used to **anchor conversation** about preference and experience
- Available in multiple languages

THANK YOU FOR LISTENING!

TRY WWW.SOUNDPREFERENCE.NET

