



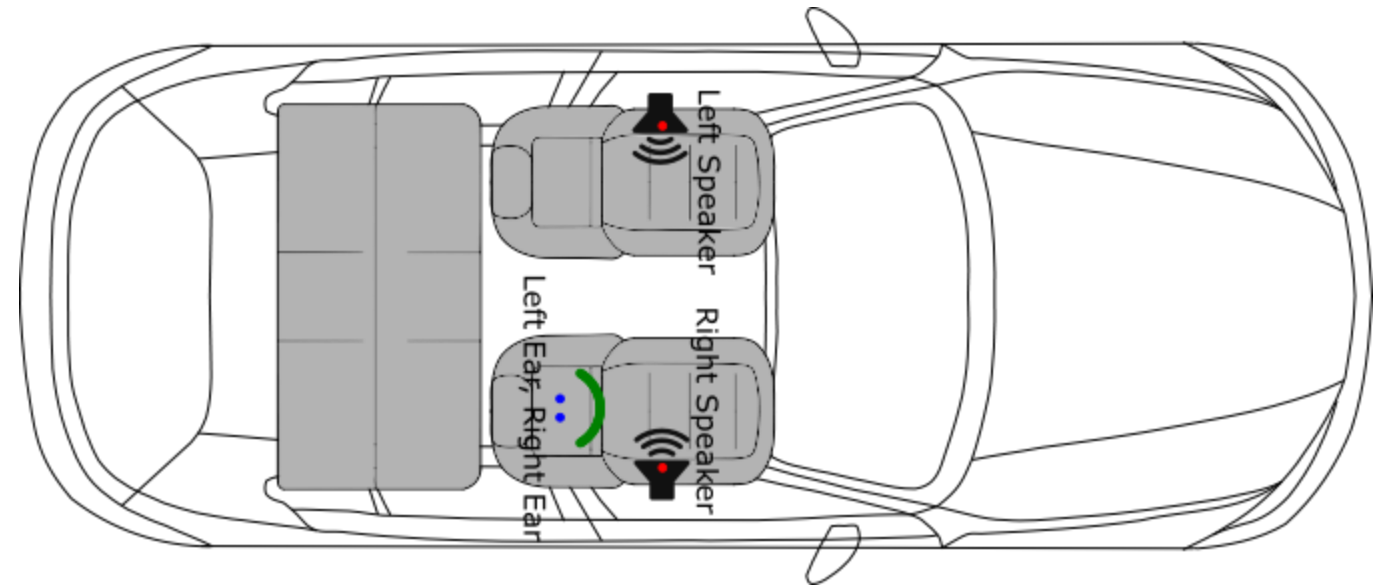
The 1st Cadenza Challenge: Improving Music for Those With Hearing Loss

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<http://cadenzachallenge.org/>

Tasks

1. **Listening over headphones**
2. Listening in the car in the presence of noise



Audio Quality



Imagine listening to the same music track:

1. A low quality mp3 via a cheap cell phone
2. A high quality wav via studio-grade loudspeaker monitors.

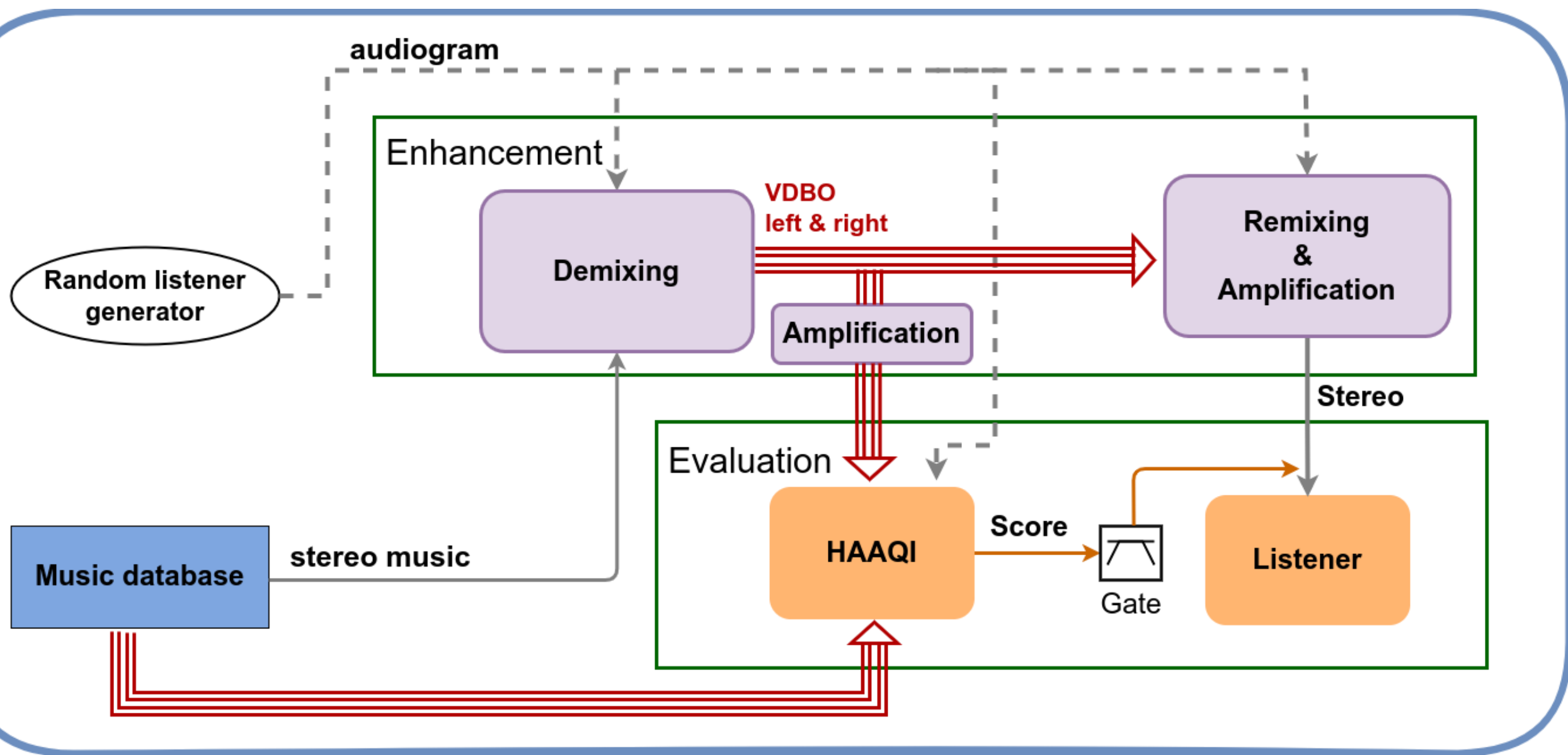
The underlying music is the same in both cases, but the *audio quality* is very different.



Description of the Problem

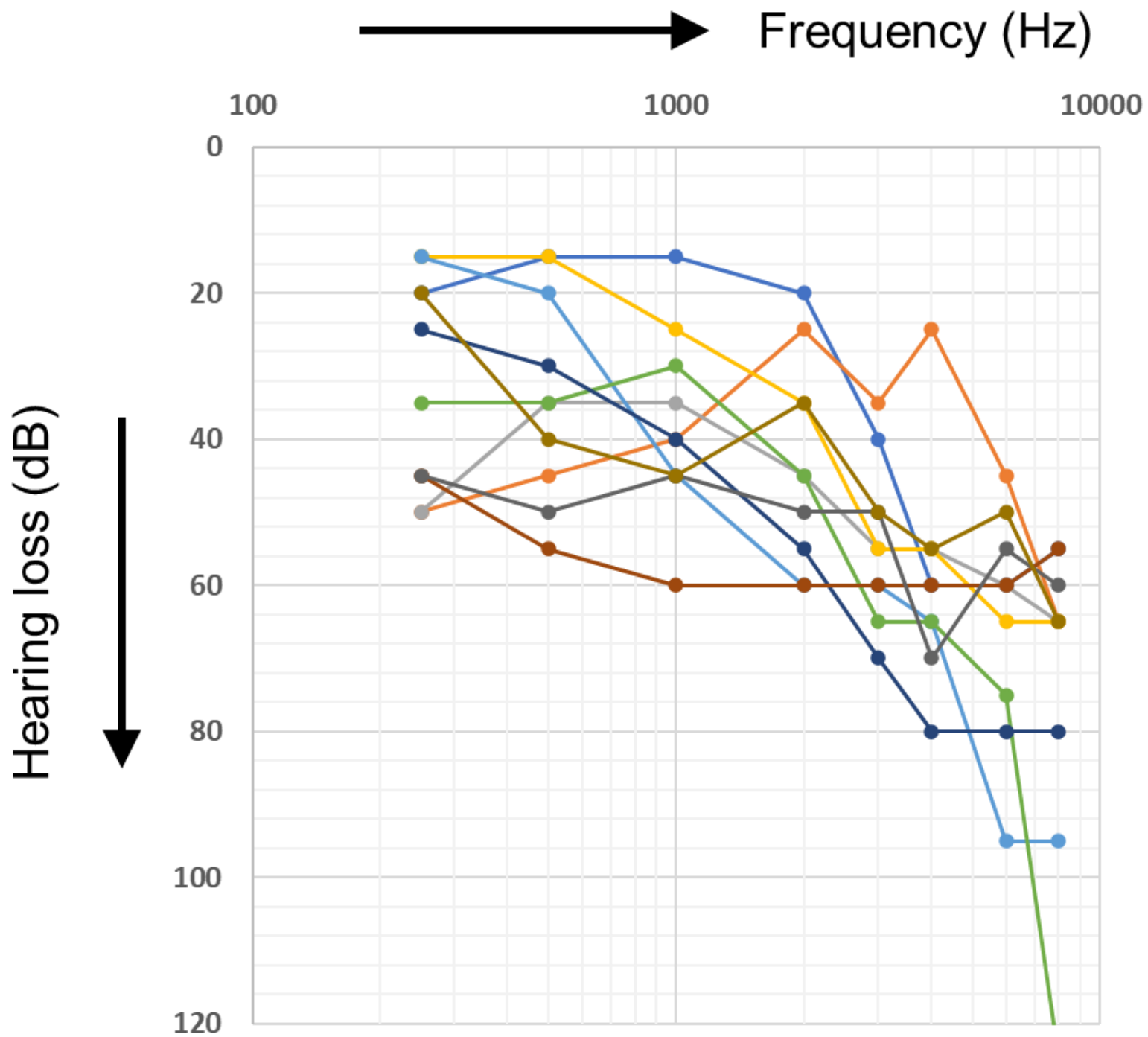
- A person with a hearing loss is listening to music via headphones. They're not using their hearing aids.
- Decompose a stereo song into a VDBO (vocal, drums, bass and other) representation.
 - (Allows a personalised remixing – not part of the challenge)
- Downmix the VDBO to recreate stereo
- Evaluation using:
 - HAAQI (Hearing Aid Audio Quality Index)
 - VDBO and downmix stereo
 - Listening panel
 - downmix stereo

Baseline



Materials

- Datasets
 - MUSDB18-HQ dataset
 - Listener audiogram
- Baseline
 - Demucs
 - Open-UnMix
- Rules
 - Non-causal or causal



HAAQI – objective

BAQ – listener rating of basic audio quality



System	HAAQI (VDBO)	HAAQI (Remix)	BAQ (Remix)
Baseline Demucs	0.255	0.711	41.23
Baseline Open-Unmix	0.225	0.638	-
Music NAL-R (Internal Submission)	0.203	0.524	32.92
Mid-Side (Internal Submission)	0.236	0.274	41.70
Do Nothing (Reference Signal)	0.421	0.429	43.47
System E005	0.094	0.691	41.42
System E016	0.135	0.263	39.27
System E012	0.255	0.686	40.84
System E022	0.195	0.228	36.04

Listener Panel Overview



Listener Panel: 53 hearing-aid users

200 trials (25 music samples x 8 systems)

Attributes (0-100):

- *Basic Audio Quality*
- *Clarity*
- *Harshness*
- *Distortion*
- *Frequency Balance (bassy, balanced, trebly)*
- *Likeability*

Trial #1 of 200

0:00 / 0:15

Audio Quality questions

Clarity

Very Unclear Very Clear

Harshness

Not Harsh Very Harsh

Distortion

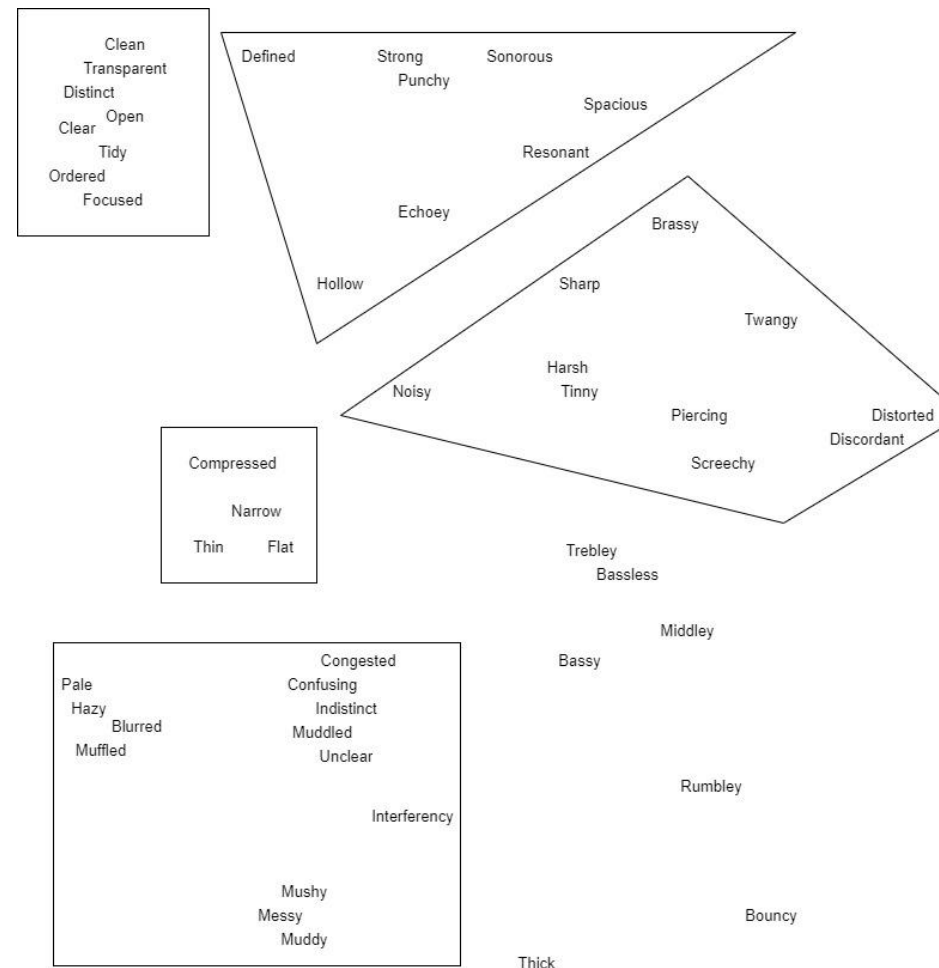
Not Distorted Very Distorted

A screenshot of a trial interface for audio quality assessment. It shows a play button, a progress bar at 0:00 / 0:15, and three sliders for 'Clarity', 'Harshness', and 'Distortion'. Each slider has a label on the left and right end, and a central slider knob.



cadenza

Unfocused Warm Unbalanced Spacious Thick
 Spiky Solid Recognisable Slow Screechy
 Subtle Quiet Piercing Narrow
 Pale Middley Melodic Hollow Soft
 Tinny Indistinct Harsh Gentle Distorted Painful
 Resonant Distinct Congested Coherent Opaque
 Trebley Mushy Dull Clear Bouncy Full Messy
 Sharp Hazy Blurred Bassless Echoey
 Muffled Hard Balanced Defined Noisy
 Shouty Discordant Bassy Blended Good
 Raucous Edgy Brassy Bright Flat Loud Rumbley
 Shrill Compressed Distant Confused Poor Rich
 Punchy Flowing Fuzzy Mellow Washed
 Wide Interferencey Hissing Jazzy Muddled Thin
 Percussive Muddy Okay Rhythmic
 Smooth Plaintive Reverberant Sweet
 Sonorous Twangy Unclear



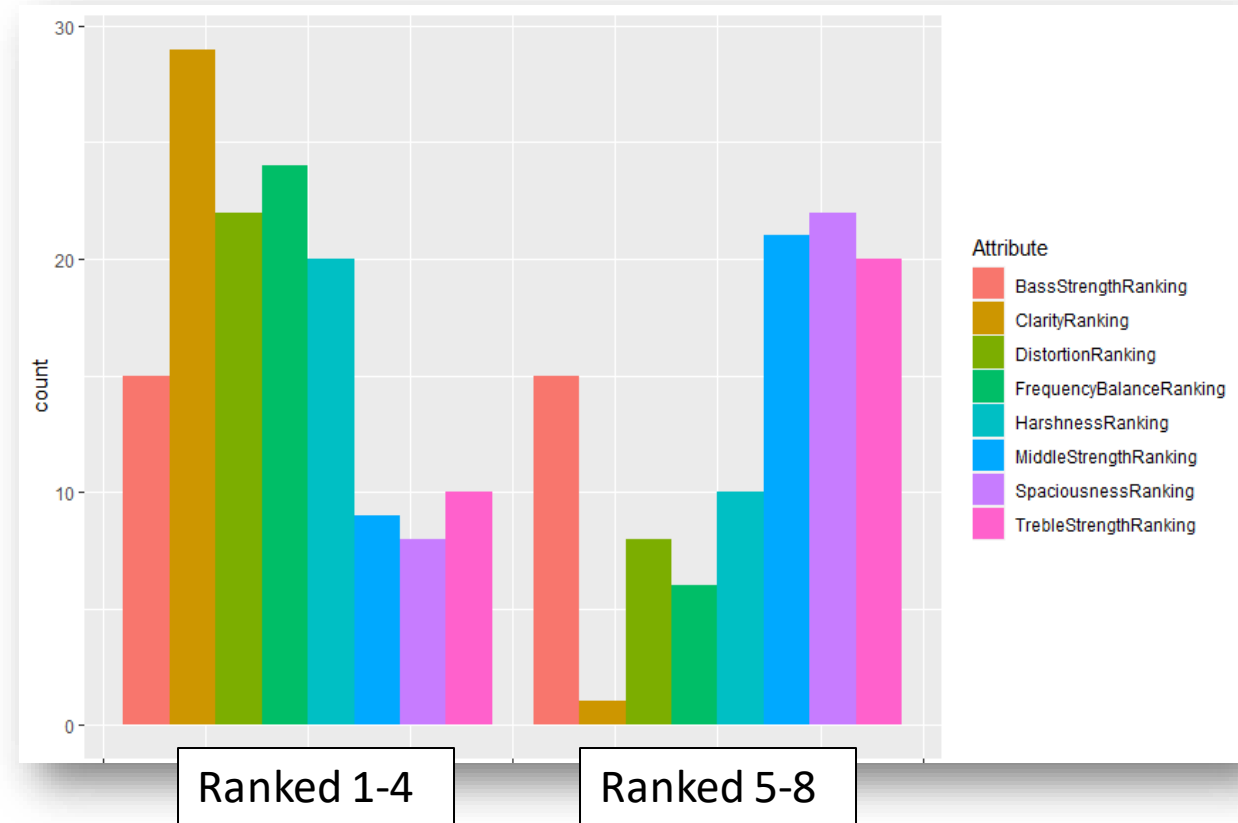
Pilot Testing ($N=34$)



20 music samples

Attributes (0-100):

- *Bass Strength*
- *Clarity*
- *Distortion*
- *Frequency Balance*
- *Harshness*
- *Middle Strength*
- *Spaciousness*
- *Treble Strength*



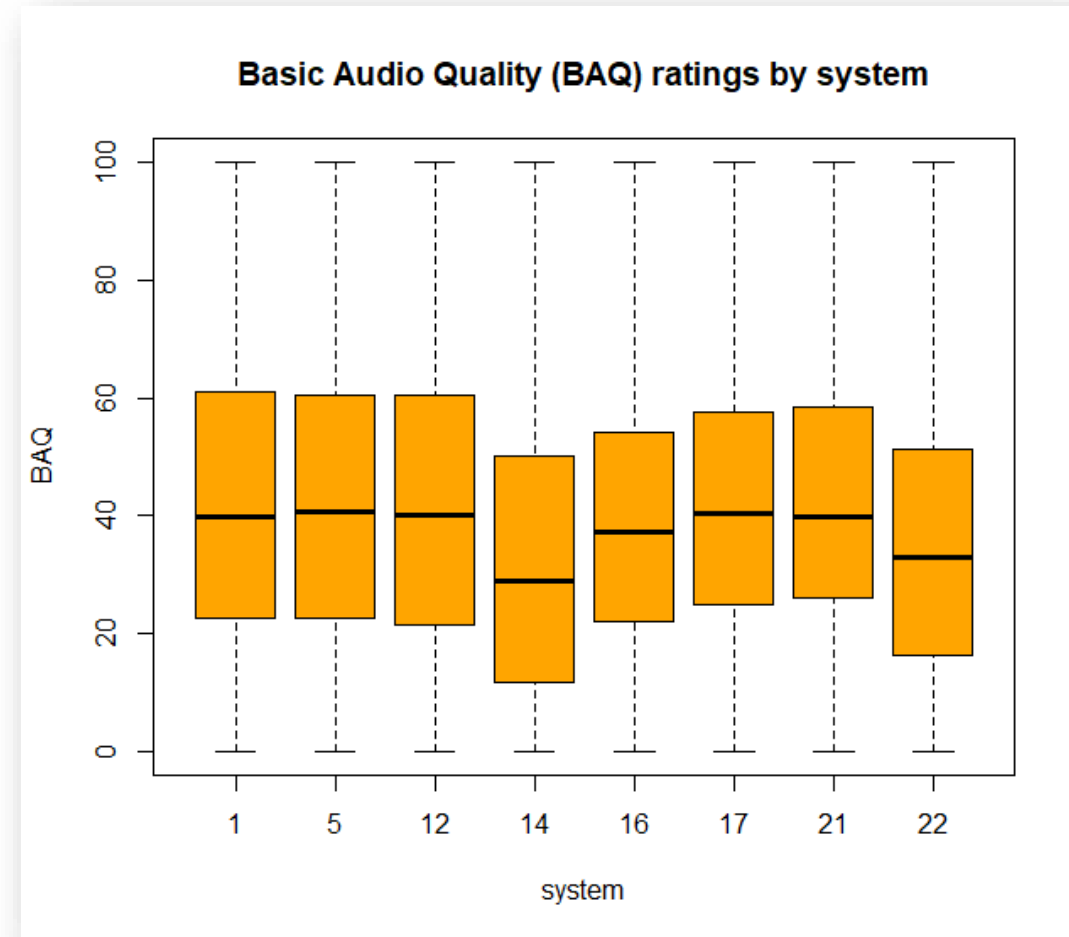
Ranked attributes in terms of importance for their perceptual experience

BAQ Across Systems

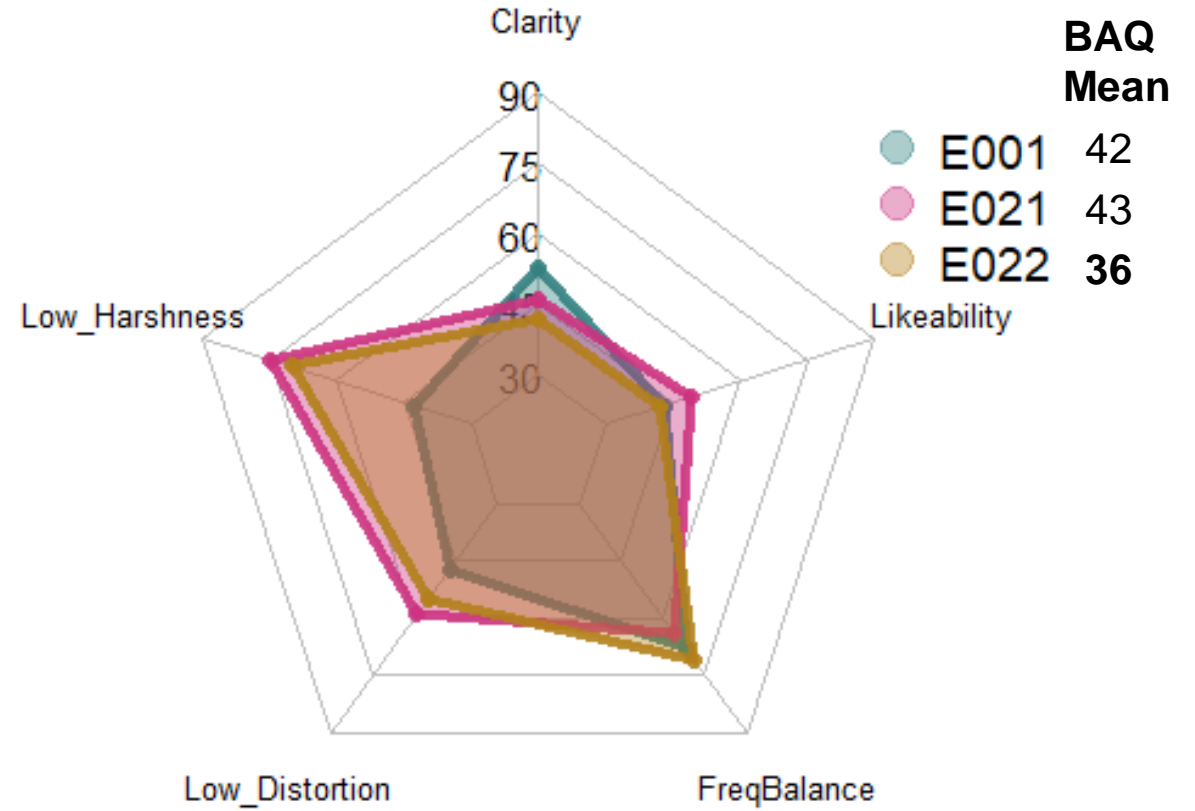
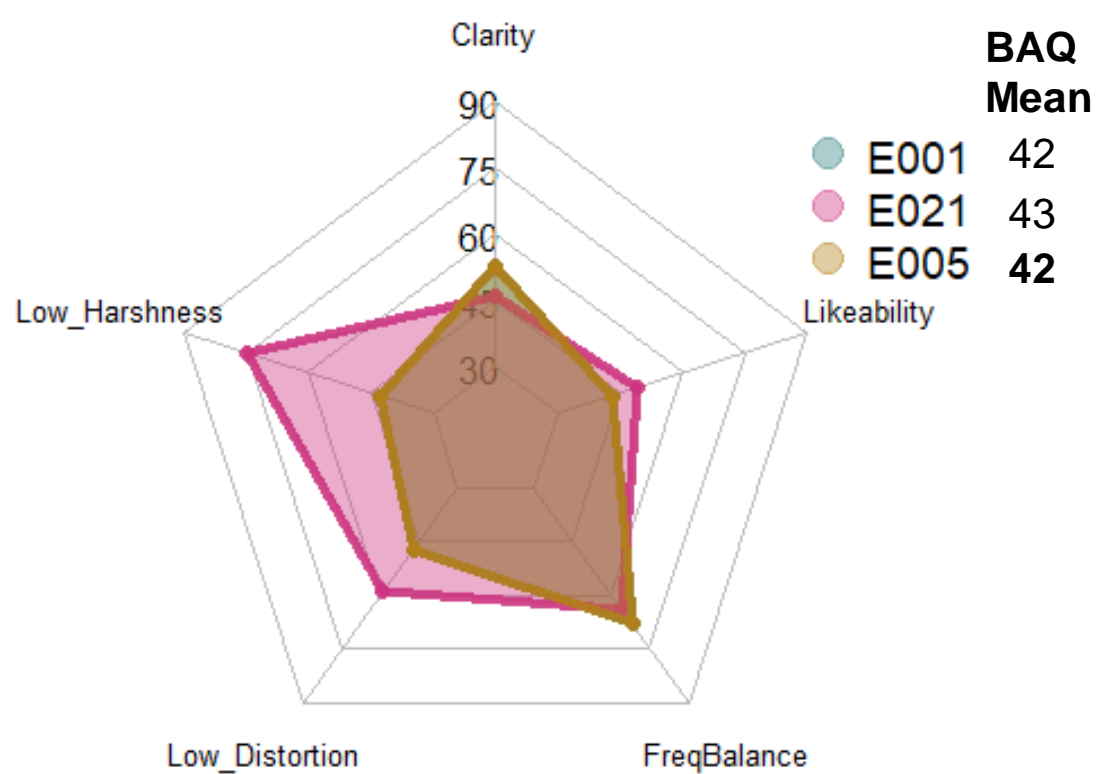


- Results from judgments of the sound of the music, in relation to a person's expectations of how the music should ideally sound to them.
- (1) Cadenza baseline system
- (21) Cadenza reference system

This is across all music samples!



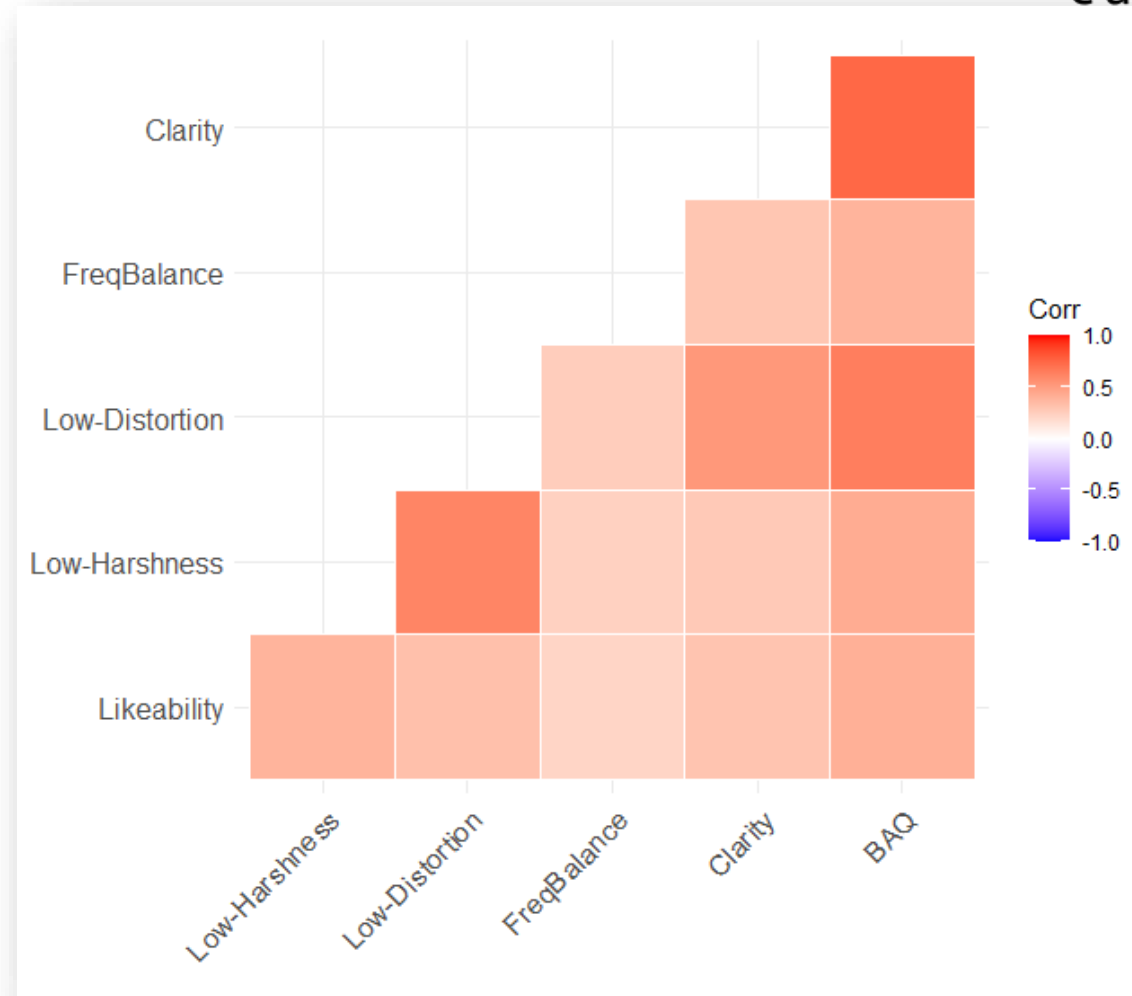
BAQ + Attributes – Radar Charts



BAQ + Attributes – Correlations

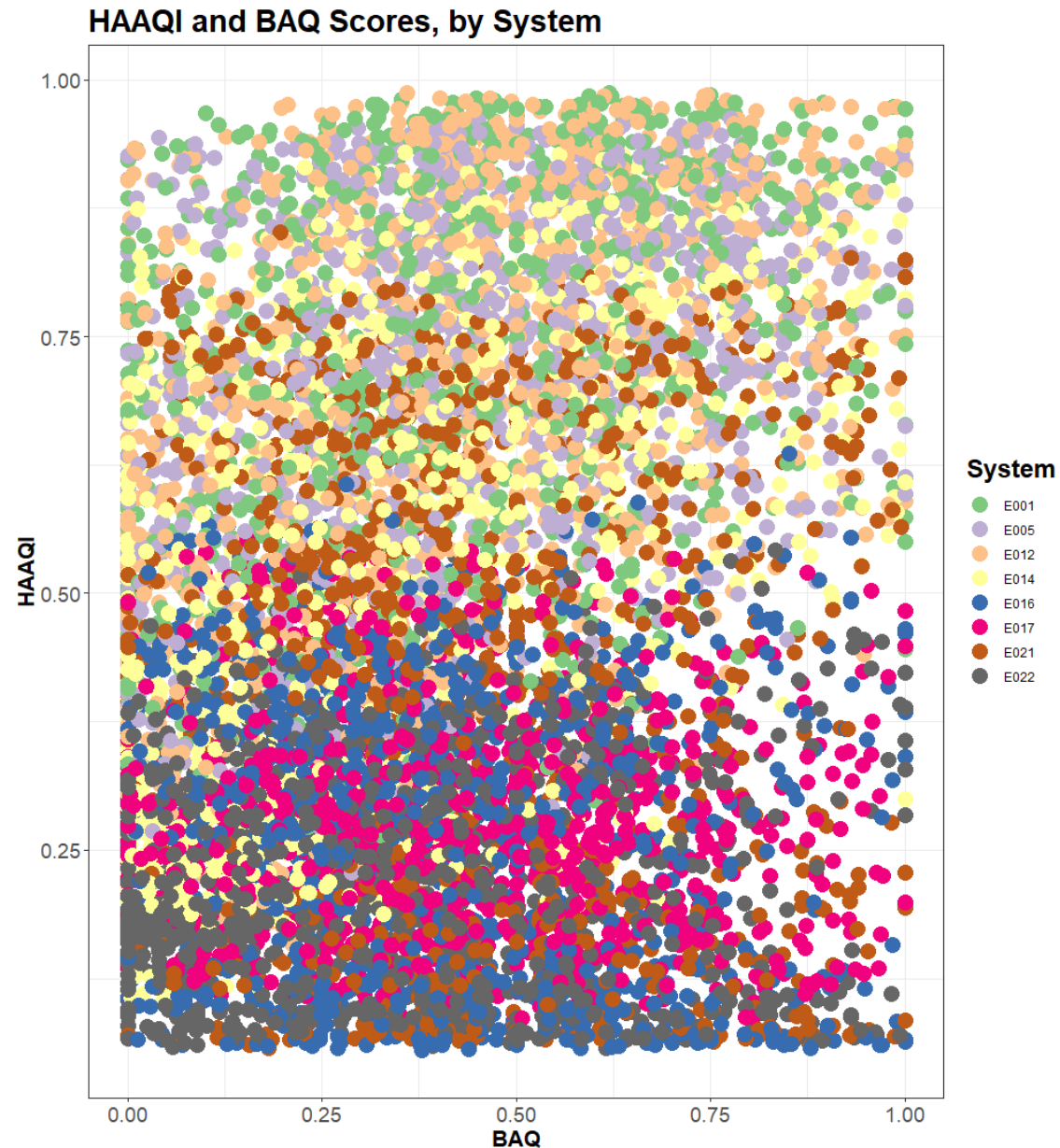


- Clarity and Low Distortion are strongly related to BAQ
- Low-Harshness and Low-Distortion are strongly correlated
- Likeability is also related to BAQ



BAQ vs. HAAQI

- Substantial amount of data
- Noisy relationship between BAQ and HAAQI scores
- Different systems tiered by HAAQI, less so by BAQ?



BAQ vs. HAAQI

- 50% of systems suggest relationship between BAQ + HAAQI
- Is there consistent behaviour / strategy that explains this?
- Much to be analysed!

