

Perception of Voice and Room Acoustics by Lecturers and Students: A Case Study at the University of Vienna

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Background

The use and perception of voice can be influenced by **reverberation time** (Rantala & Sala, 2007), **noisy environments** (Bottalico, Graetzer & Hunter, 2016) as well as architectural aspects, e.g. by increasing the amount of **early reflexions** in the room (Alambeigi et al. 2020). Adaption to reverberant speech mainly occurs in rooms with moderate reverb and is presumably made based on amplitude modulations of direct sound and reverberation (Tsironis et al. 2024).

Research Question and Method

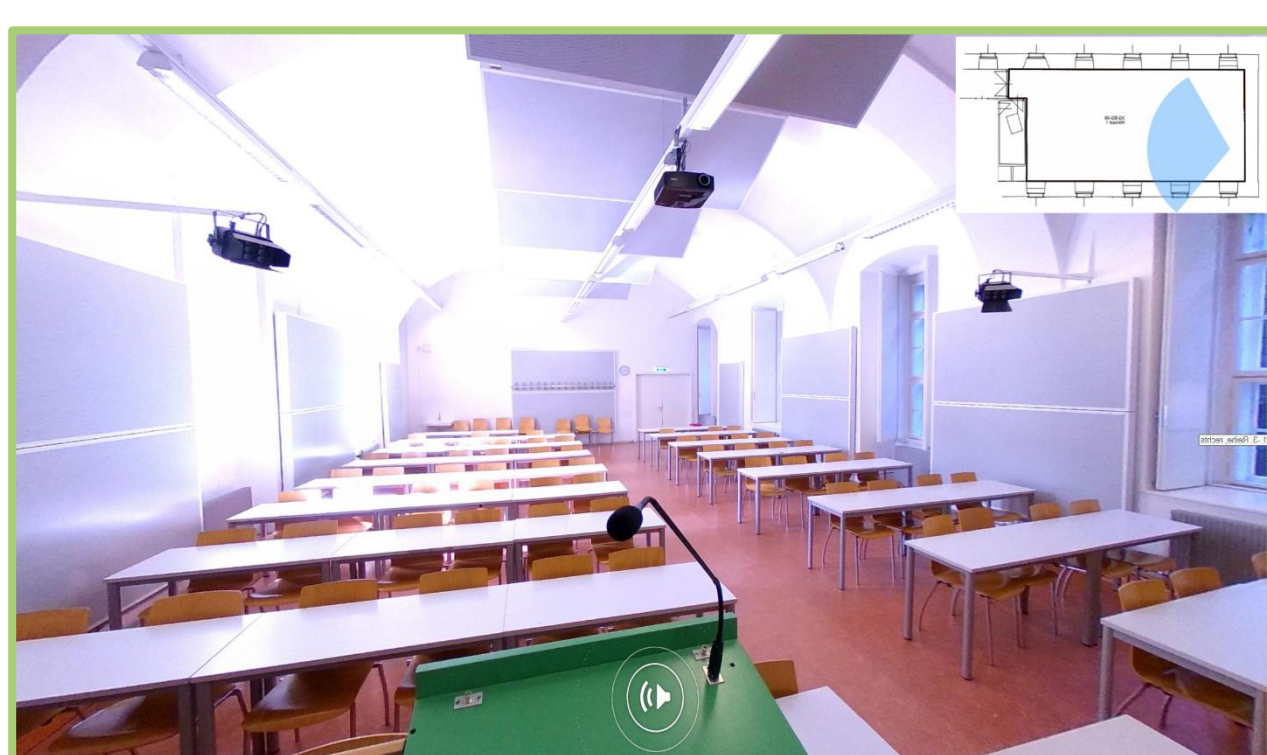
How do lecturers and students at the University of Vienna perceive the room acoustics of auditoriums and the voice of speakers?

An online questionnaire in German, consisting of room perception on four scales was developed based on previous studies regarding the perception of singers' voice (e.g. Redman et al. 2023) and sent to lecturers and students. Participants rated the **room atmosphere**, **spatial feeling**, **voice**, their **sound when speaking** as well as perceived **suitability of the auditorium**.

Besides room perception, **personality-** and **sensory-dependent** data (von Georgi & Herr, 2020) were asked to address possible differences. All room assessments were compared to room descriptors taken from impulse response measurements and resulting in reverberation times and theoretical strength. So far, **29 lecturers** (19♂, 10♀) – mostly with more than 10 years of lecture experience – and **28 students** (11♂, 15♀, 2♀) from the University of Vienna participated and rated overall 8 different auditoriums.

Exemplary, first results from the two groups (students and lecturers), who each evaluated two different auditoriums are presented.

2 Auditoriums rated by students



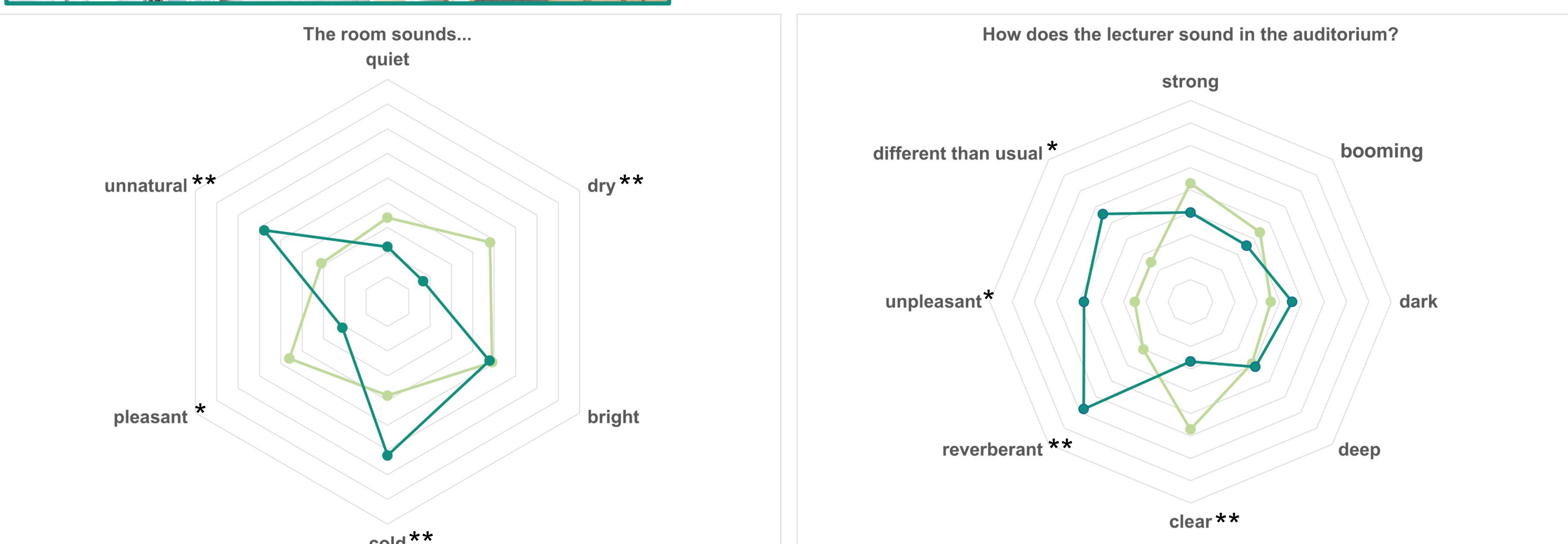
Auditorium 1

Room volume; spec.:	641 m ³ ; 4,9 m ³ /pp
T _{mean} (measured, unoccup.)	0,8 s (125 - 4kHz)
T specification acc. OIB5 (2019)	0,9 s (occup.)
Gtheo	16,5 dB



Auditorium 2

Room volume; spec.:	1080 m ³ ; 5,8 m ³ /pp
T _{mean} (measured, unoccup.)	2,2 s (125 - 4kHz)
T specification acc. OIB5 (2019)	0,98 s (occup.)
Gtheo	18,1 dB



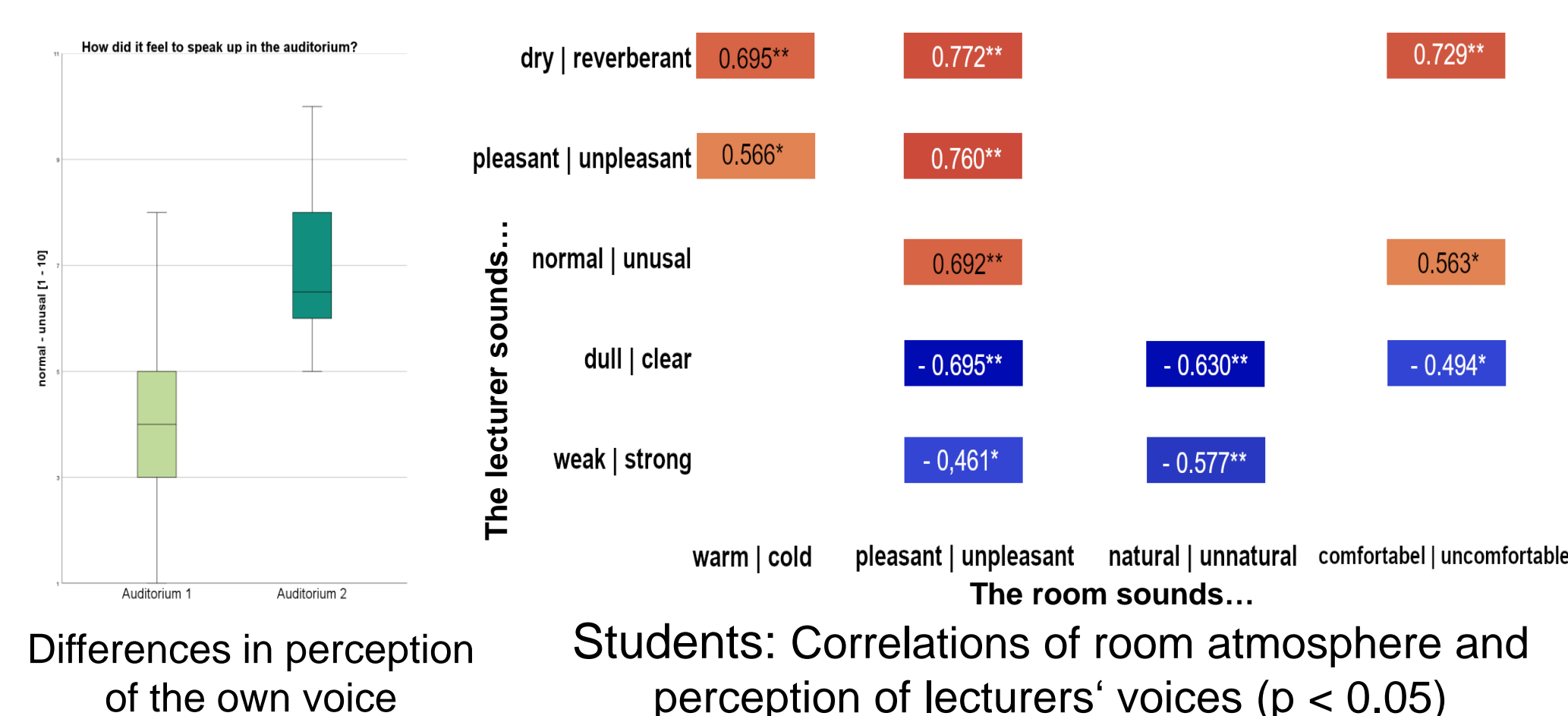
Students' perception of room atmosphere and the voice of a speaker (item opposites) in **Auditorium 1** and **Auditorium 2**

Speakers are perceived **duller**, more **reverberant** and **unpleasant** in the bigger auditorium with low alpha values of boundary surfaces

$t_{clear(19)} = -3,846$; $p < 0.001$; $Mann-Whitney_U_{reverb} = 87$; $p < 0.001$).

In addition, students more often perceive their own speaking as **unusual** compared to Auditorium 1.

($F_{(2,18)} = 5,995$; $p = 0.010$)



Differences in perception of the own voice

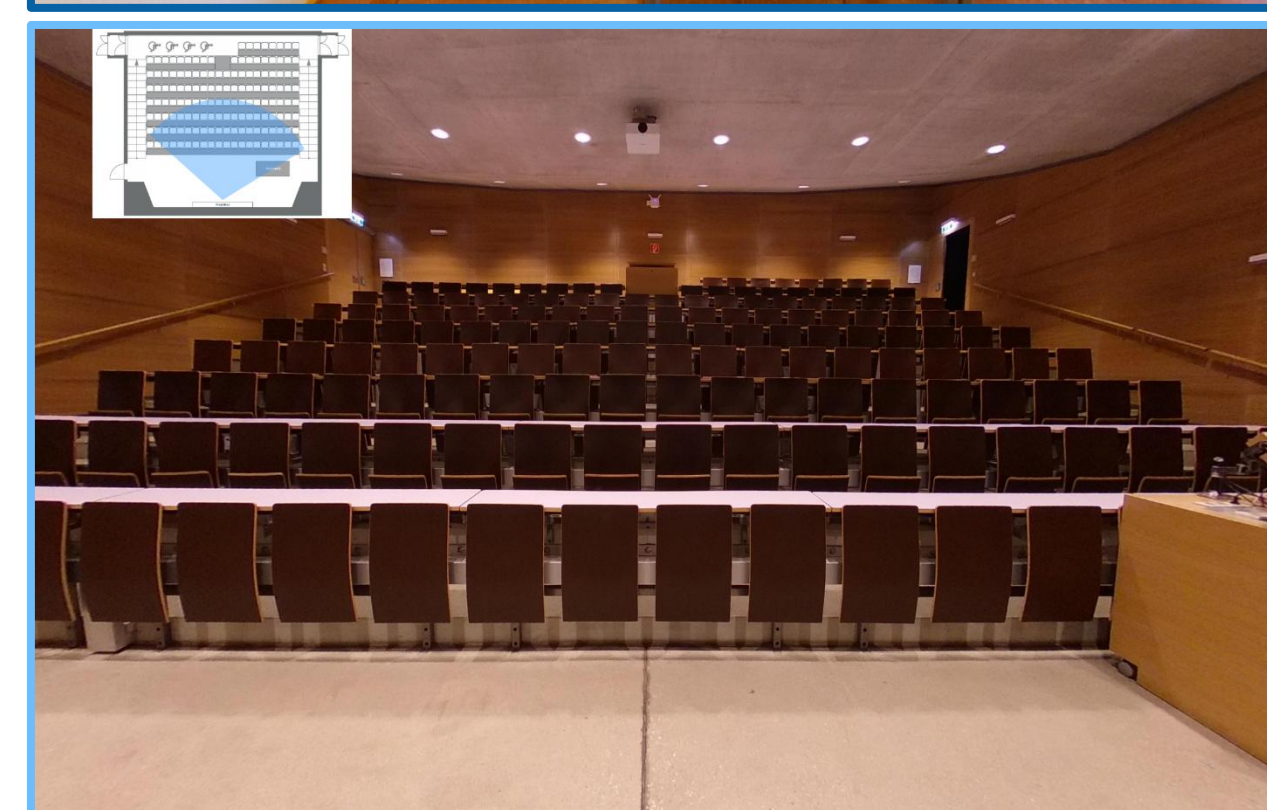
Students: Correlations of room atmosphere and perception of lecturers' voices ($p < 0.05$)

2 Auditoriums rated by lecturers



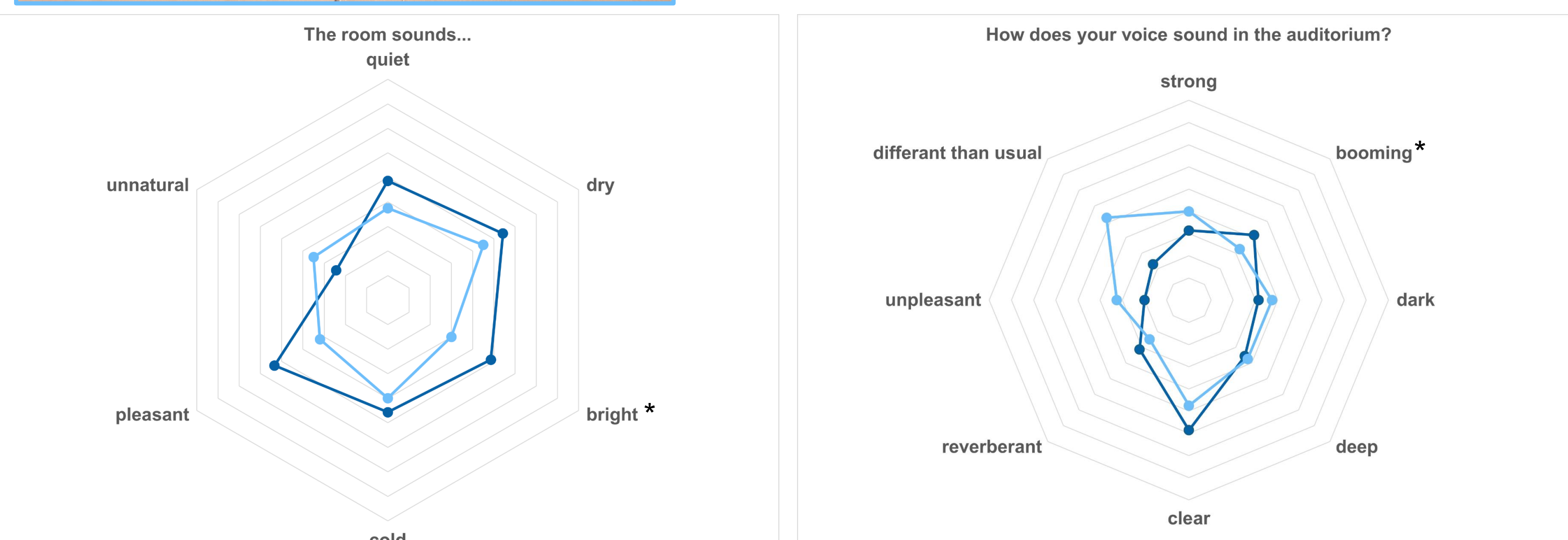
Auditorium 3

Room volume; spec.:	351 m ³ ; 5,8 m ³ /pp
T _{mean} (measured, halfoccup.)	0,6 s (125 - 4kHz)
T specification acc. OIB5 (2019)	0,77 s (occup.)
Gtheo	17,3 dB



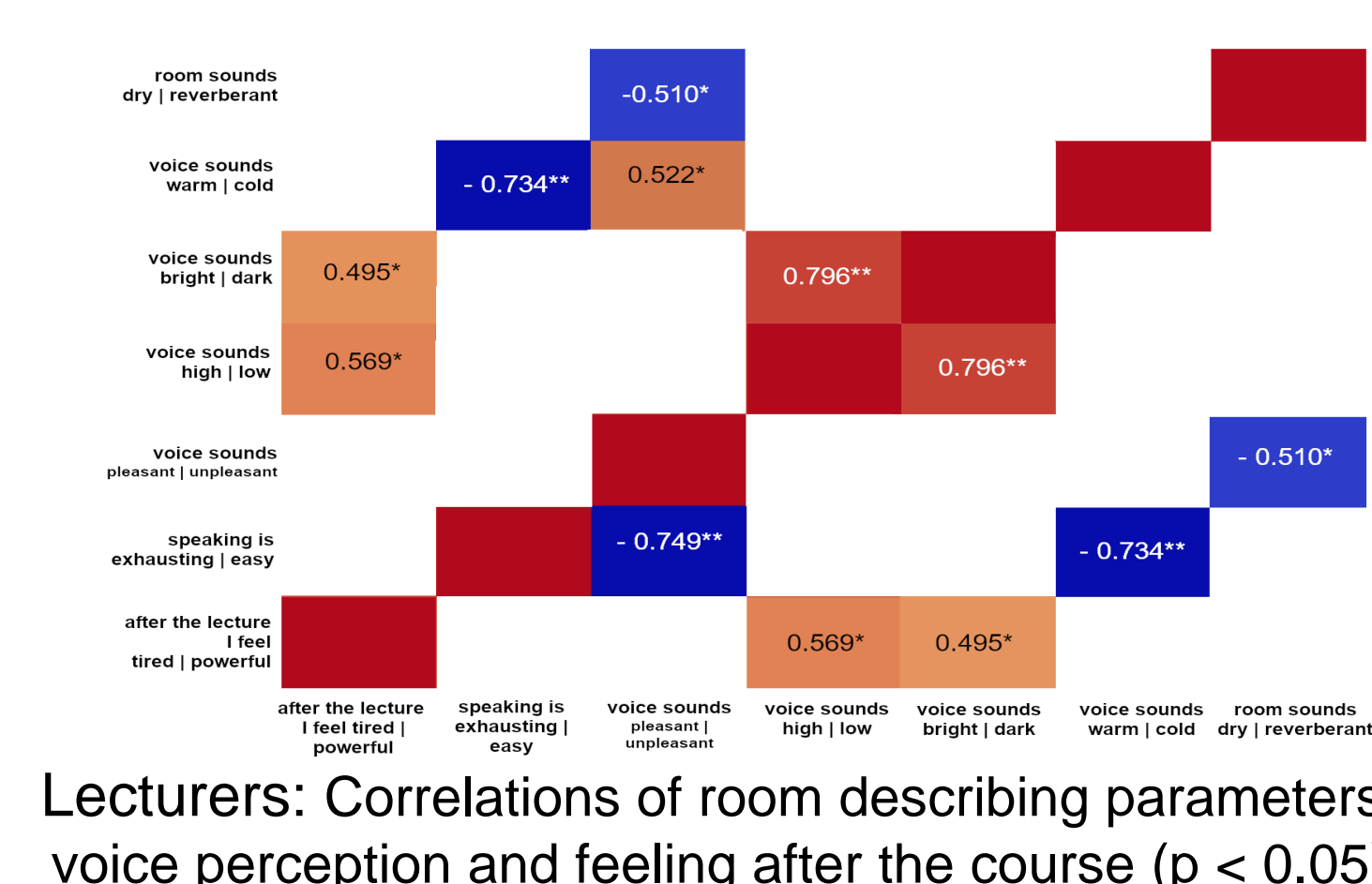
Auditorium 4

Room volume; spec.:	675 m ³ ; 4,7 m ³ /pp
T _{mean} (measured, unoccup.)	0,8 s (125 - 4kHz)
T specification acc. OIB5 (2019)	0,91 s (occup.)
Gtheo	15,7 dB



Lecturers' perception of room atmosphere and the voice of a speaker (item opposites) in **Auditorium 3** and **Auditorium 4**

Lecturers perceive **their voices** as slightly **quieter** in Auditorium 4, which has a different room layout and a measured RT below the guideline's specified value ($t_{booming(9)} = 3.375$; $p = 0.004$).



Lecturers: Correlations of room describing parameters, voice perception and feeling after the course ($p < 0.05$)

Further, **age and experience** influence the perception of voice and how lecturers feel after a course. Additional data is required, but currently, the effort of speaking and feeling tired after class decreases with experience.

References

Alambeigi, P., Burry, J., Zhao, S. & Cheng, E. (2020): "A study of human vocal effort in response to the architectural auditory environment", in: Architectural Science Review 63/3-4, p. 262-274. Bottalico, P., Graetzer, S. & Hunter, E. (2016): "Effect of Reverberation Time on Vocal Fatigue", in: Proceedings of the International Conference on Speech Prodosity, p. 494-497. Rantala, L.M. & Sala, E. (2007): "Effects of Classroom Acoustics on Teachers' Voices", in: Building Acoustics, 22/3-4, p. 243-258. Redman, Y., Glasner, J.D., D'Orazio, D. & Bottalico P. (2023): "Singing in different performance spaces: The Effect of room acoustics on singer's perception", in: J. Acoust. Soc. America 154/4, p.2257-2264. von Georgi, R. & Herr, J. (2020). SEppo - Short Eysenck Personality Profiler with NEO-PI-R Openness. Unpublished ongoing research project. Berlin Institute of Biomusicology and Empirical Research (BIBER), Berlin School of Popular Arts (SoPA). Tsironis, A.; Vlahou, E.; Kontou, P.; Bago, P. & Kopco, N.: "Adaption to Reverberation for Speech Perception: A Systematic Review." In: SAGE 28 (2024), p. 1-17. OIB Richtlinie 5: Schallschutz. Version 2019.

Conclusion and Outlook

- First results of room atmospheres and voices point in the same direction as collected room (acoustics) parameters, e.g. in terms of reverberation and architectural aspects.
- So far, there are no expressive differences in ratings based on personality or sensory process pattern of participants. More data on specific auditoriums are needed for a comparison of a particular room from both the perspective of students and lecturers.