Baristas' Ear Candy – Audio Cues for Well-Sounding Brews

Ambros, S.[1] , Reuter, C.[1], Czedik-Eysenberg, I.[1], Yang, J.[1,2] & Kuka, M.[3]

[1] Universität Wien, Musikwissenschaftliches Institut [2] Shanghai Conservatory of Music [3] Robert Bosch GmbH

50. Annual Conference for Acoustics
Hannover, March 18. – 21. 2024

Background

Sounds of products and technical devices are an essential part of their perception and can furthermore regulate the perceived quality in consumers (e.g. Hülsmeier et al. 2014). Regarding refrigerator noises, mainly sounds‘ **loudness** and **roughness** influence perceived noisiness (Sato et al. 2007). In vehicle noises less **roughness** and **sharpness** (in combustion engines; Xu et al. 2018) and greater sounds' **brightness** (in electric engines; Ambros et al. 2023) drive a positive rating. In the case of coffee machines, especially **loudness** and **sharpness** of machine sounds are negatively associated (e.g. Knöferle, 2012).

Aim and Research Question

How do audio features impact a positive sound experience and the value of brewing sounds from coffee machines?

The aim of this study was the evaluation of coffee machine sounds on a visual dimension. Results of this study shall be picked up in a following experiment, where images of coffee machines are going to be paired with sounds in order to evaluate their crossmodal fit.

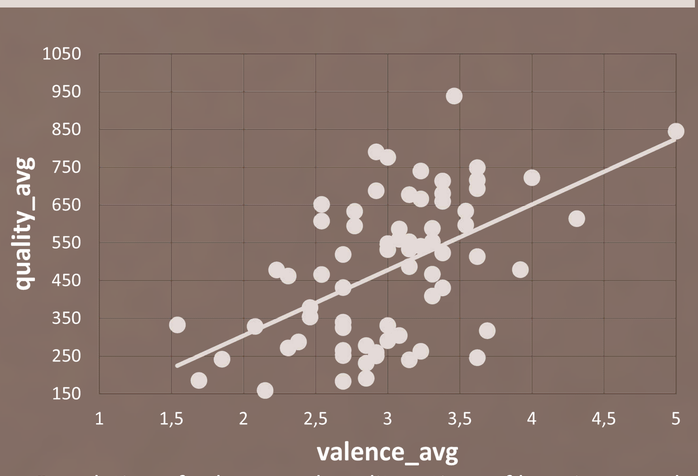
Method

13 brewing sounds were rated in an online listening task from **73 participants** (34♂, 38♀, 1⚧, aged: 19-79, ø 35,4 years) in terms of **valence** (Self Assessment Manikin) and on a scale from 150 - 1500 € regarding **value/quality** of sounds. All dependent variables were implemented graphically.
In the beginning, test subjects adjusted the loudness of their device (-42 LUFS sinus) and gave information on coffee consumption habits, possibly owned coffee machines and estimated their personality traits on a 5-point Likert scale (SEPPO; von Georgi & Herr, 2020; successfully applied in Herr, von Georgi & Starcke 2022).
The brewing sounds were analysed by signal-analysis toolboxes (Matlab) in terms of their audio features and combined with raters’ assessments regarding correlations and group differences.

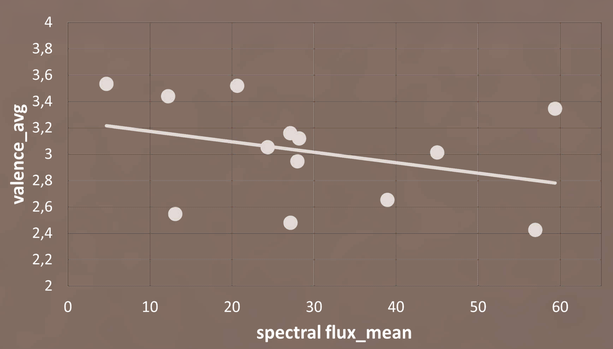
Results

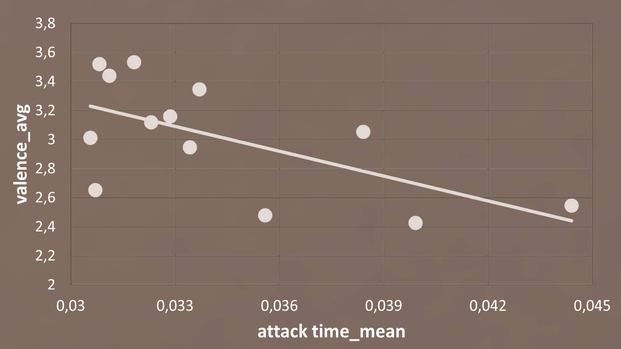
Assessments of valence and quality of sounds are strongly connected.

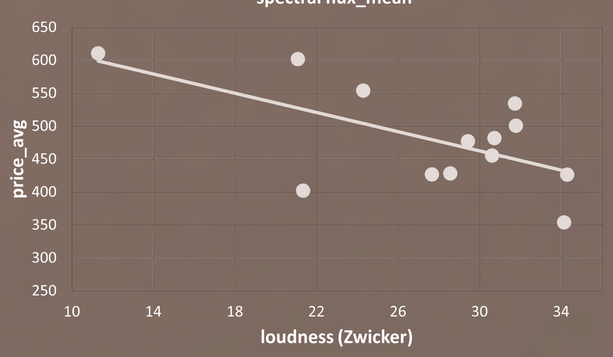
Perceived valence was mainly evaluated by the **strength of the fundamental** (r= 0.555), **attack time** (r= -0.615) and **noise fluctuations** (r= -0.596; p<.05) of tested sounds, whereas assessments of value/price release an additional influence of **spectral flatness** (r= 0.635), **spectral centroid** (r= 0.555) and Zwickers **loudness** (r= -0.612; p<.05).

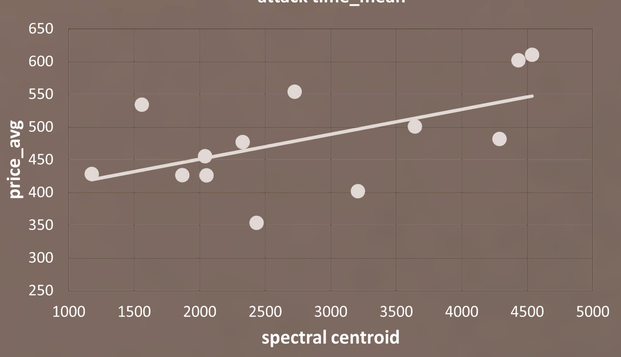


Correlation of valence and quality ratings of brewing sounds.









Correlations of valence and value/price ratings in terms of audio features.

References

Ambros, S.; **Kuka**, M.; **Czedik-Eysenberg**, I.; **von Georgi**, R. & **Reuter**, C. (2023): Fahrzeuggeräusche in Form und Farbe – Entwicklung eines Crossmodalen Ansatzes zur Erfassung Subjektiver Bewertungen von Elektrifizierten Fahrzeugen. Fortschritte der Akustik - DAGA 2023, 49. Deutsche Jahrestagung für Akustik (p. 490–493). Hamburg. **Herr**, J., **von Georgi**, R., & **Starcke**, K. (2022): Massenmagnet oder Publikumskiller? Eine experimentelle online-Studie zum Einfluss von Hintergrundmusik und Persönlichkeit auf die subjektive Bewertung des präsentierenden Unternehmens eines Messestandes. In: C. Zanger (Hrsg.), Events und Wege aus der Krise, p.139–158. Wiesbaden, Springer Gabler. **Knöferle**, K. (2012): Using Customer Insights to Imprive Product Sound Design. Marketing Review St. Gallen 29/2, p. 47–53. **Hülsmeier**, D.; **Schell-Majoor**, L.; **Rennies**, J. & **van de Par**, S. (2014): Perception of sound quality of product sounds. A subjective study using a semantic differenial. Internoise in Melbourne, 16.-19. November 2014. **Sato**, S.; **You**, J. & **Jeon**, J. Y. (2007): Sound quality characteristics of refrigerator noise in real living environments with relation to psychoacoustical and autocorrelation function parameters. ‚JASA 122/314, p. 314–325. **Von Georgi**, R. & **Herr**, J.: 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) (2020). **Xu**, Z.; **Xia**, X.; **Lai**, X. & **He**, Z. (2018): Improvement of interior sound quality for passenger car. Applied Acoustics 130, S. 43–51.

Results

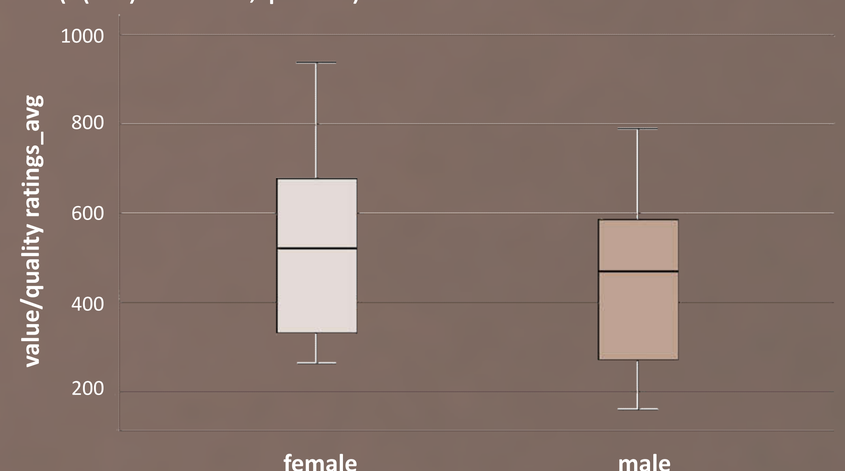
Personality traits of participants were assessed in terms of expressions in the dimensions **extraversion** (Cronbachs α= 0.718), **neuroticism** (α= 0.684), **psychoticism** (α= 0.219) and **openness to new experiences** (α= 0.651).

Valence ratings of the best rated sound example in less (0) and more open-stated (1) participants.

There are no group differences in mean ratings of valence, value and expressions in personality traits.
Only when looking at the overall best rated sound (sound20), participants show significant differences in valence ratings: listeners with openness-scores below the median (0) tend to give better ratings than participants who are more open to new experiences (1) (t(73)= 2,329; p<.05).

Differences in average valence ratings of sounds can be seen by gender of participants. Female raters give brewing sounds on average higher valence ratings than male listeners (t(73)= 2.094; p<.05).

Value/quality ratings (€) of brewing sounds in female (n=38) and male (n=34) participants.



The consumption habits of coffee do not show any differences in valence and value ratings with mean valence ratings of 3,14 / 2,99 points and price ratings of 508,79 € / 474,32 € in non-coffee consumers (n=13) vs. coffee drinkers (n=56). But there is a small effect that with increasing age of raters, the value/price of presented sounds decreases (r= -0.272; p=.02).

Listeners who are self-declared as experienced with audio or music further show significant differences compared to non-experienced participants in both valence (t(73)=-2,154; p=.03) and value ratings (t(73)=-2,006; p=.049). Experienced ears evaluate sounds on average 94 € cheaper than non-experienced listeners.

Interactive graph to valence and value ratings:

Value/quality ratings in self declared audio experienced (n=23) and non-experienced (n=51) participants.

Summary and Discussion

- Ratings indicate **similarities with previous studies** on sound ratings, especially in terms of perceived loudness and fluctuations, which drive a negative evaluation.
- The **brightness** (spectral centroid) of coffee machine sounds correlates with a **positive sound experience**. This is consistent with valence ratings in electric car sounds (Ambros et al. 2023) and will be picked up in the following experiment on the crossmodal fit of products.
- Value/quality, which is based on ratings of the corresponding price of coffee machines reveals more differentiated evaluations and correlations than valence ratings. Maybe this is due to the fact that value of devices is made up on a combination of several characteristics.
- Experienced ears evaluate brewing sounds more often in line with reality. Estimated prices were low, which is consistent with sound examples that were mainly chosen from cheaper coffee machine models.