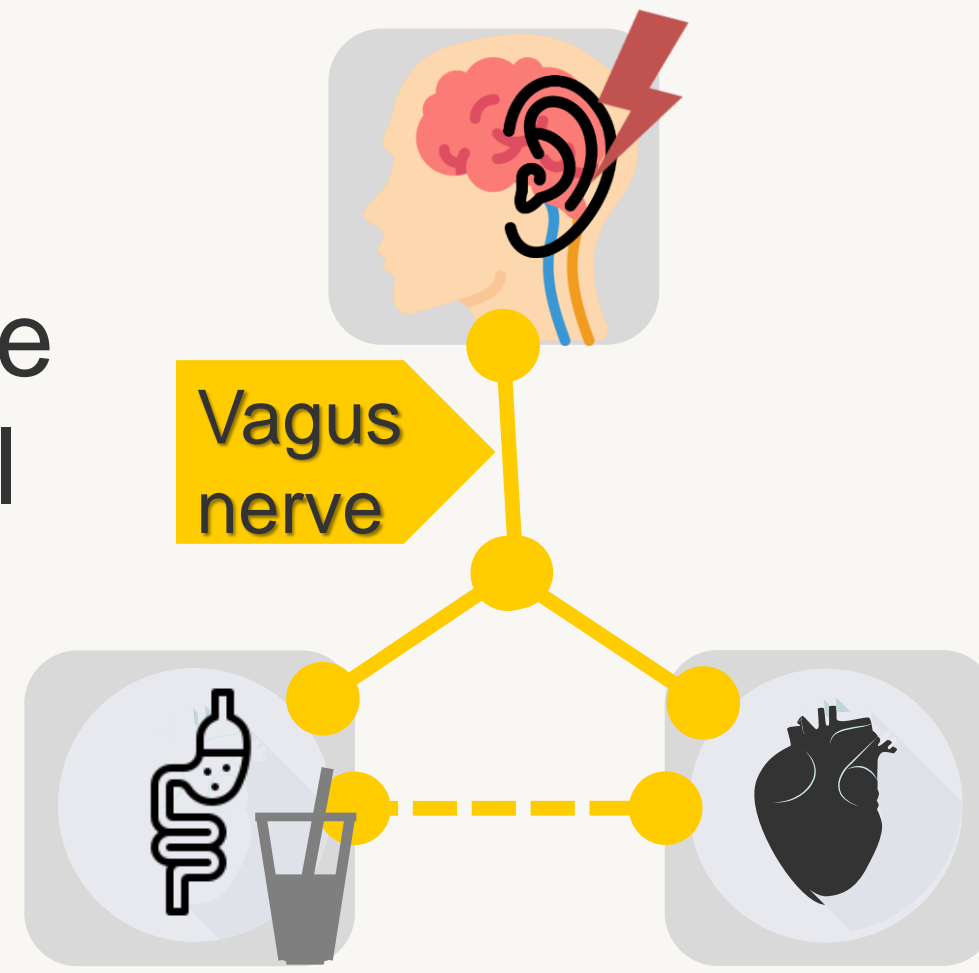


Introduction

Brain-visceral organ communication via the vagus nerve is crucial for homeostasis.



taVNS studies

- yield mixed results on heart rate variability (HRV) ^{1,2} due to varying control conditions and study protocols.
- typically stimulate solely the left auricular branch³ introducing a bias to the literature.

Altinkaya et al. (2023): N = 14

- Decreases HRV in hungry state
- increases HR and decreases HRV
- no cardiac effect after taVNS in the postprandial phase.⁴

Objective: To overcome these limitations and explore the impact of taVNS on HRV before and after a caloric load.

Does taVNS alter the heart's response to a challenge of the autonomic nervous system? Is this dependent on the side of stimulation?

Methods

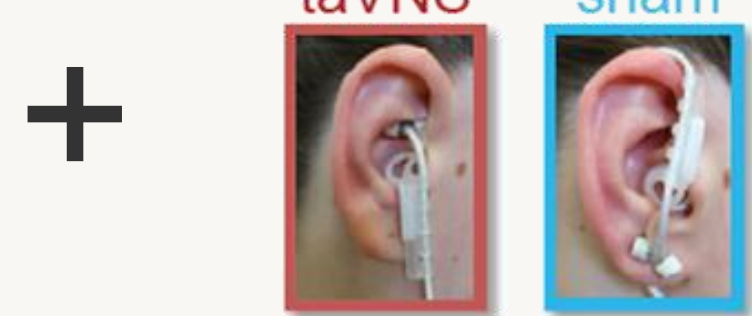
Sample

N = 36 healthy participants
18 female 23.5 ± 3 kg/m² 24 ± 3 years

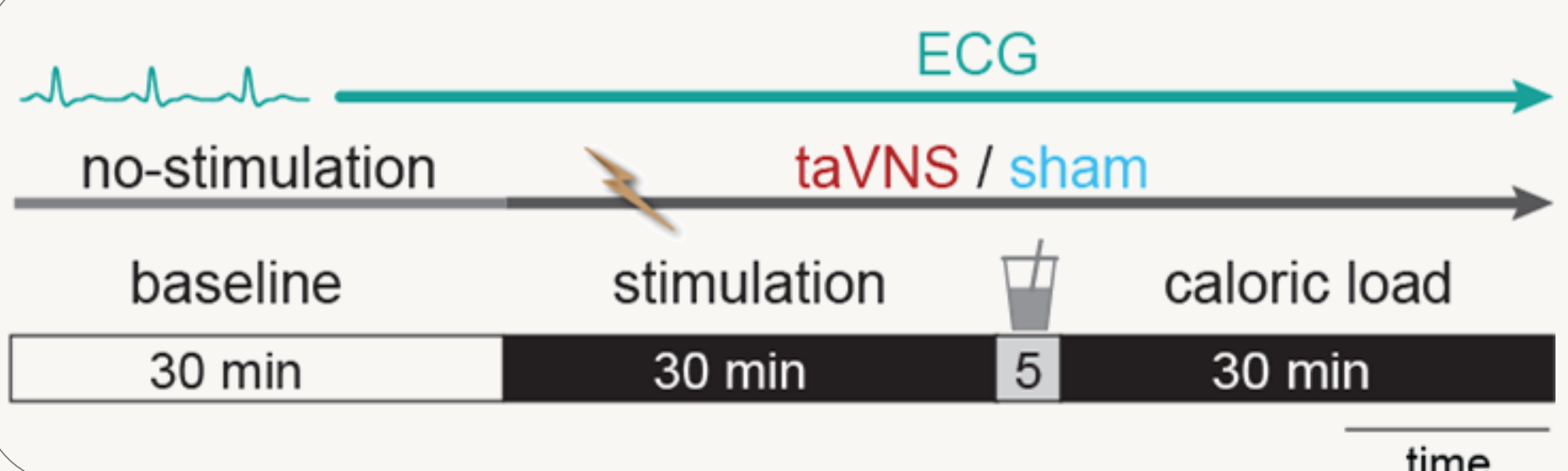
Procedure

- Randomized cross-over design (4 sessions)

right vs. left ear



Timeline of one session

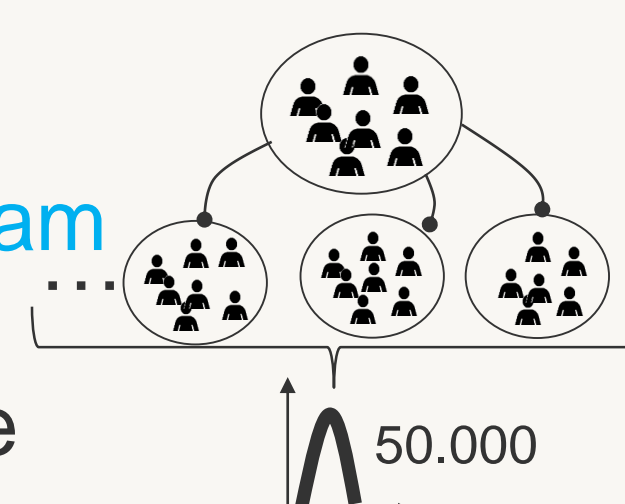


Analysis

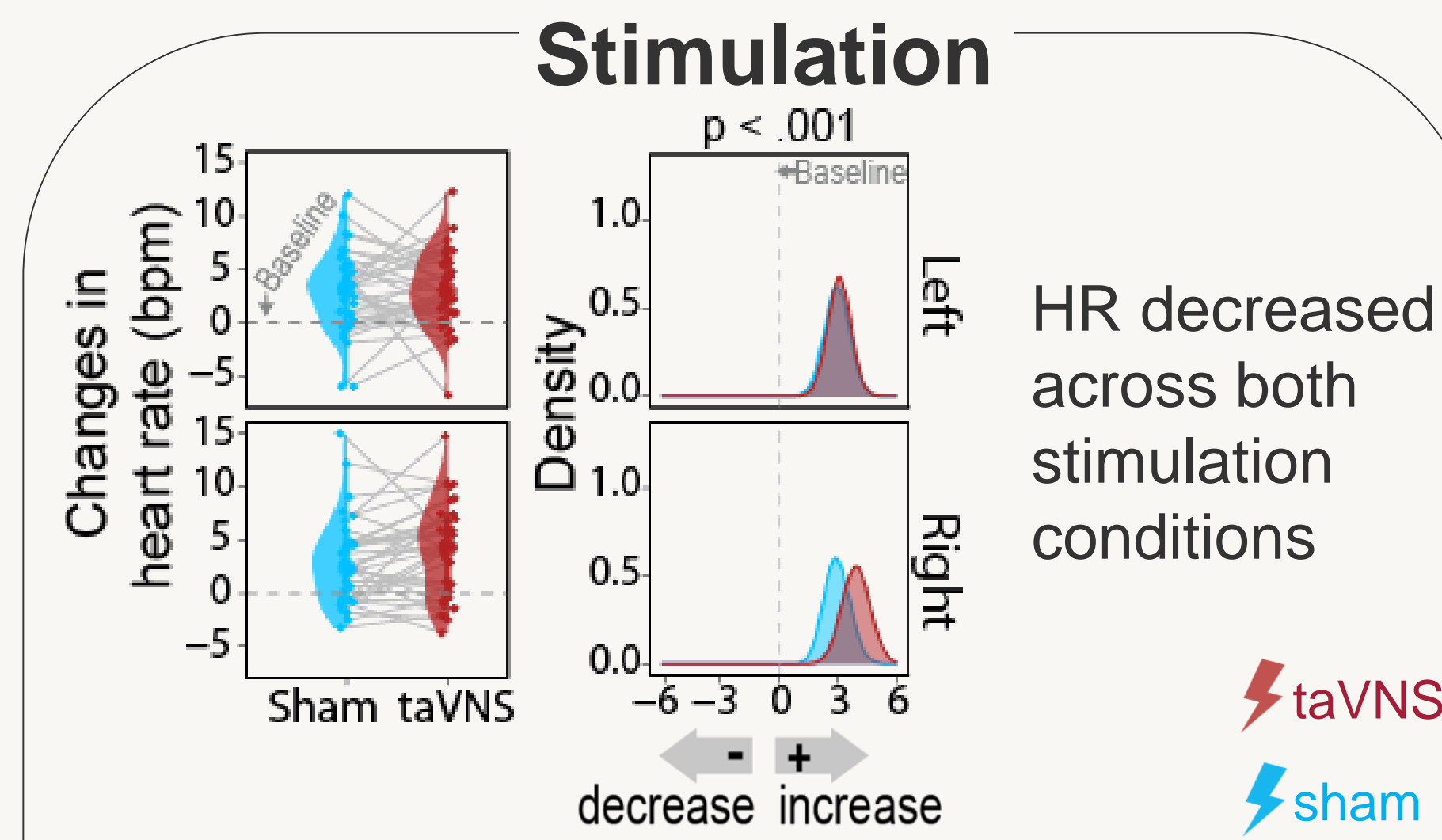
- Compute HR & HRV
 - Time-domain: RMSSD, SDNN
 - Frequency-domain: HF HRV, LF/HF ratio

- Bootstrapping by resampling:

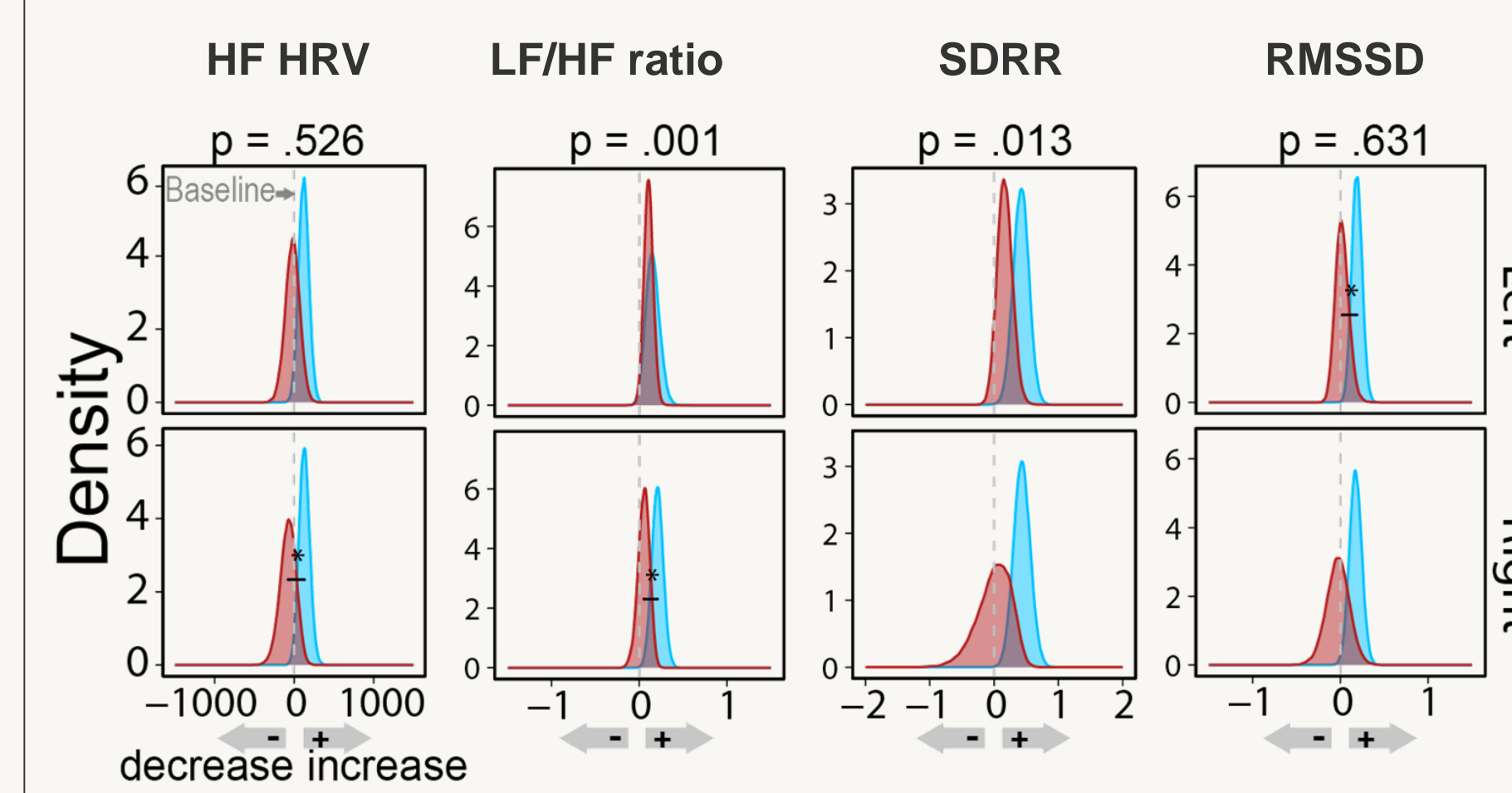
- pairwise difference: taVNS – sham
- resampling repeatedly
- compute mean, 95% CI, p-value



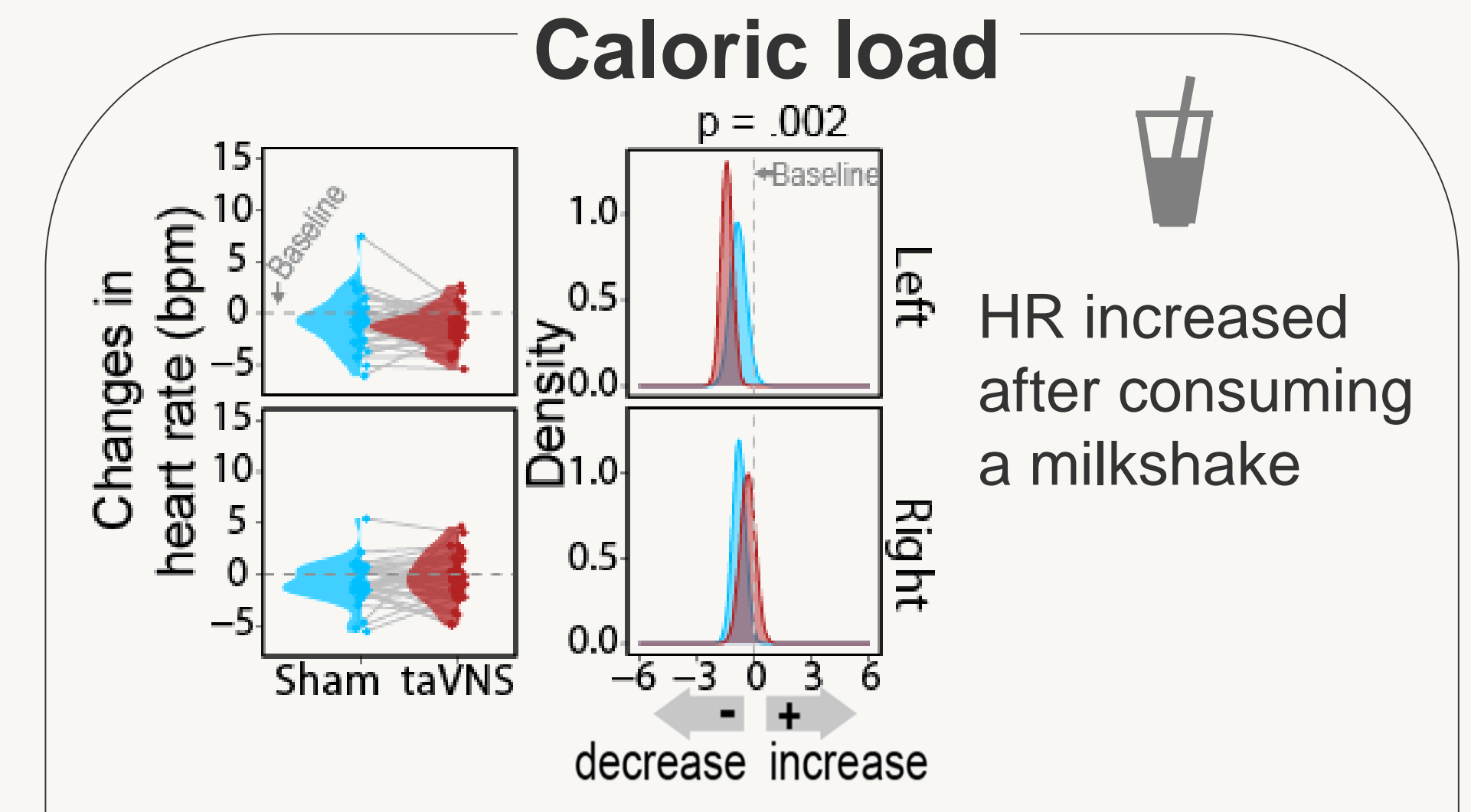
Results



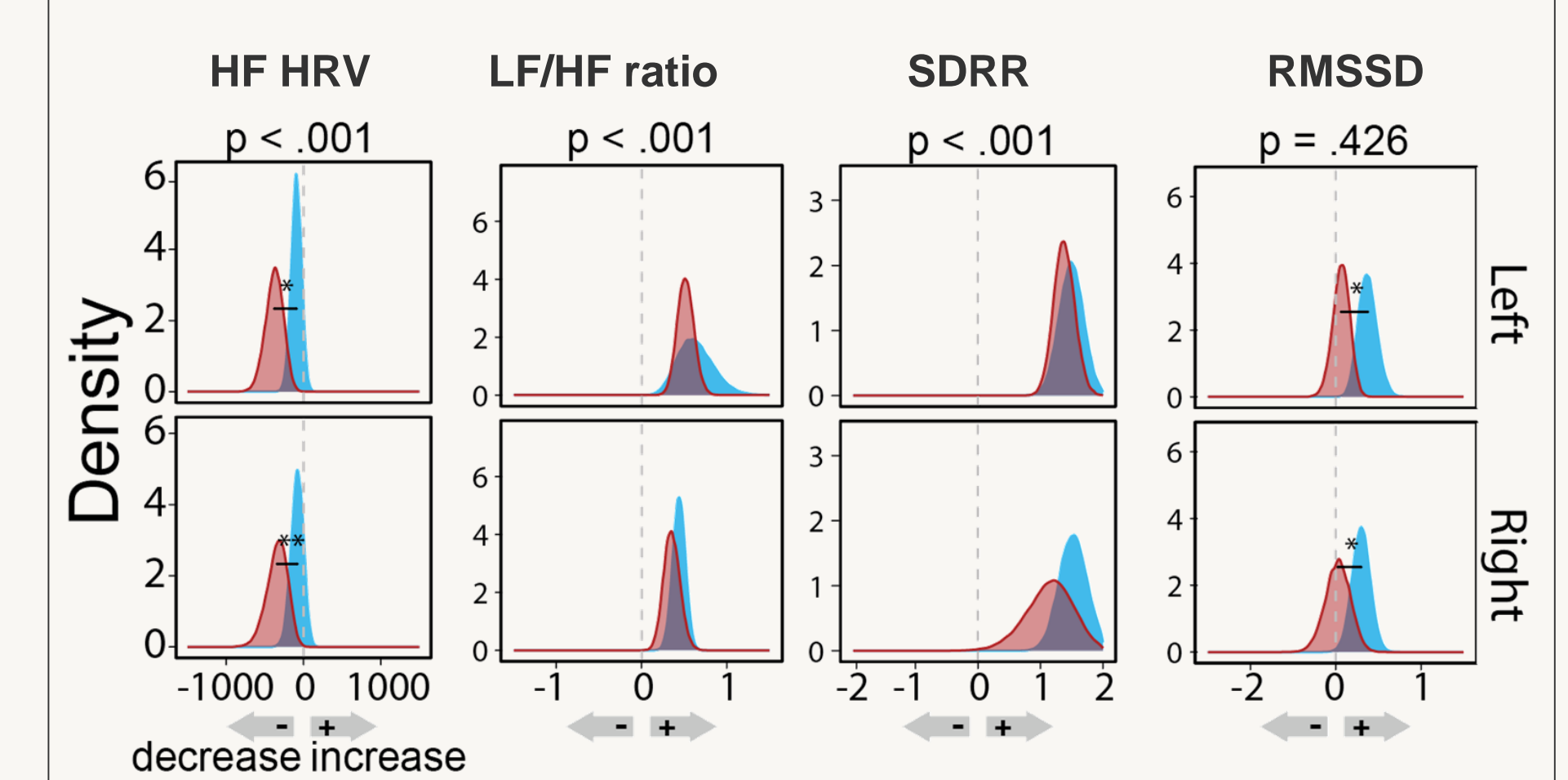
taVNS reduced HRV



HF HRV ($p = .01$), SDRR ($p = .02$) and RMSSD ($p = .03$) across both sides.

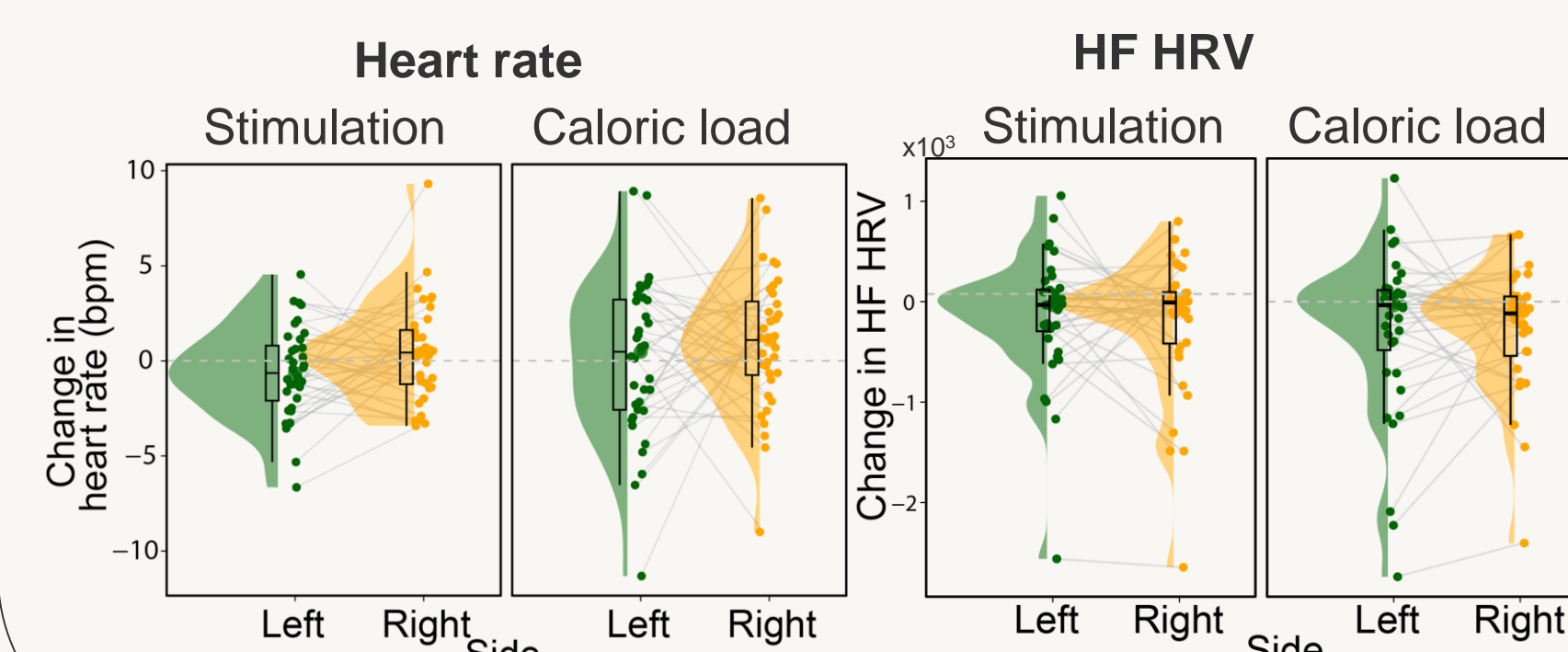


taVNS amplified the decrease in HF HRV after the caloric load

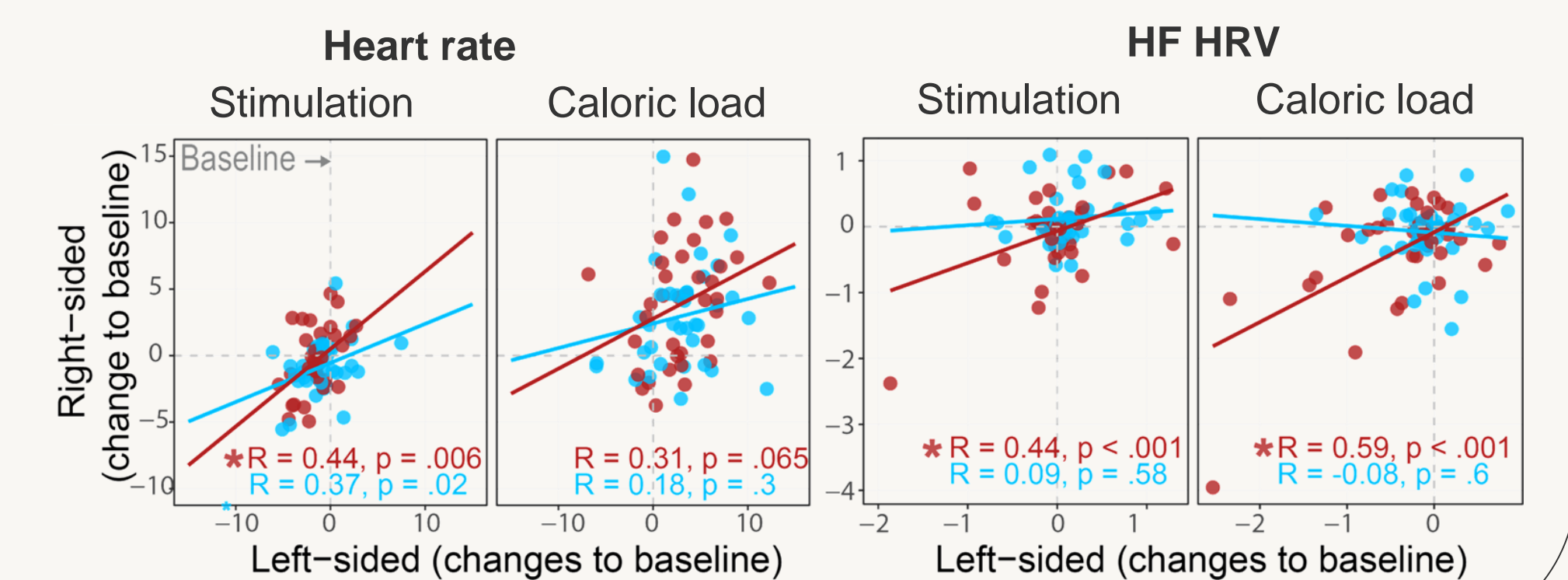


decreased HF HRV and increased LF/HF ratio and SDRR.

No difference between left and right taVNS



The taVNS-induced left-right changes more similar than during sham



Discussion

- The study confirms prior findings⁵ that a caloric load reduces parasympathetic activity, shown by higher HR and lower HF HRV.
- Our study shows taVNS affects HRV like food intake by decreasing HF HRV during digestion.
- taVNS may alter the autonomic nervous system, potentially regulating the heart's response during digestion as part of a homeostatic mechanism.
- Notably, there was no side-specific significant difference in HR or HRV, contrary to the theorized larger risk of right taVNS for cardiac functions.

Conclusion

taVNS is a non-invasive method to investigate the link between the vagal nerve and the heart during metabolic processes. It affects HRV, like food intake, and amplifies the heart's response during digestion, with no noteworthy variation in HR or HRV between left and right taVNS.

References

- Wolf, V., Kühnel, A., Teckentrup, V., Koenig, J., & Kroemer, N. B. (2021). Does transcutaneous auricular vagus nerve stimulation affect vagally mediated heart rate variability? A living and interactive Bayesian meta-analysis. *Psychophysiology*, 58(11). <https://doi.org/10.1111/psyp.13933>
- Forte, G., Faviotti, F., Leemhuis, E., De Martino, M. L., Giannini, A. M., De Gennaro, L., Casagrande, M., & Pazzaglia, M. (2022). Ear your heart: Transcutaneous auricular vagus nerve stimulation on heart rate variability in healthy young participants. *PeerJ*, 10, e14447. <https://doi.org/10.7717/peerj.14447>
- Chen, M., Yu, L., Qiyang, F., Liu, Q., Wang, Z., Wang, S., Zhou, L., Jiang, H., & Zhou, S. (2015). The right side or left side of noninvasive transcutaneous vagus nerve stimulation: Based on conventional wisdom or scientific evidence? *International Journal of Cardiology*, 187, 44–45. <https://doi.org/10.1016/j.ijcard.2015.03.351>
- Altinkaya, Z., Öztürk, L., Büyükgöçük, İ., Yanık, H., Yılmaz, D. D., Yar, B., Değirmenci, E., Dal, U., & Veldhuizen, M. G. (2023). Non-invasive vagus nerve stimulation in a hungry state decreases heart rate variability. *Physiology & Behavior*, 258, 114016. <https://doi.org/10.1016/j.physbeh.2022.114016>
- Ohara, K., Okita, Y., Kouda, K., Mase, T., Miyawaki, C., & Nakamura, H. (2015). Cardiovascular response to short-term fasting in menstrual phases in young women: An observational study. *BMC Women's Health*, 15(1), 67. <https://doi.org/10.1186/s12905-015-0224-z>