

# Development of an adaptive test of musical scene analysis ability

Robin Hake<sup>1</sup>, Michel Bürgel<sup>1</sup>, Daniel Müllensiefen<sup>2,3</sup> & Kai Siedenburg<sup>1</sup>

<sup>1</sup> Dept. of Medical Physics and Acoustics, University of Oldenburg

<sup>2</sup> Dept. of Psychology, Goldsmiths, University of London

<sup>3</sup> Hanover Music Lab, Hochschule für Musik, Theater und Medien, Hannover

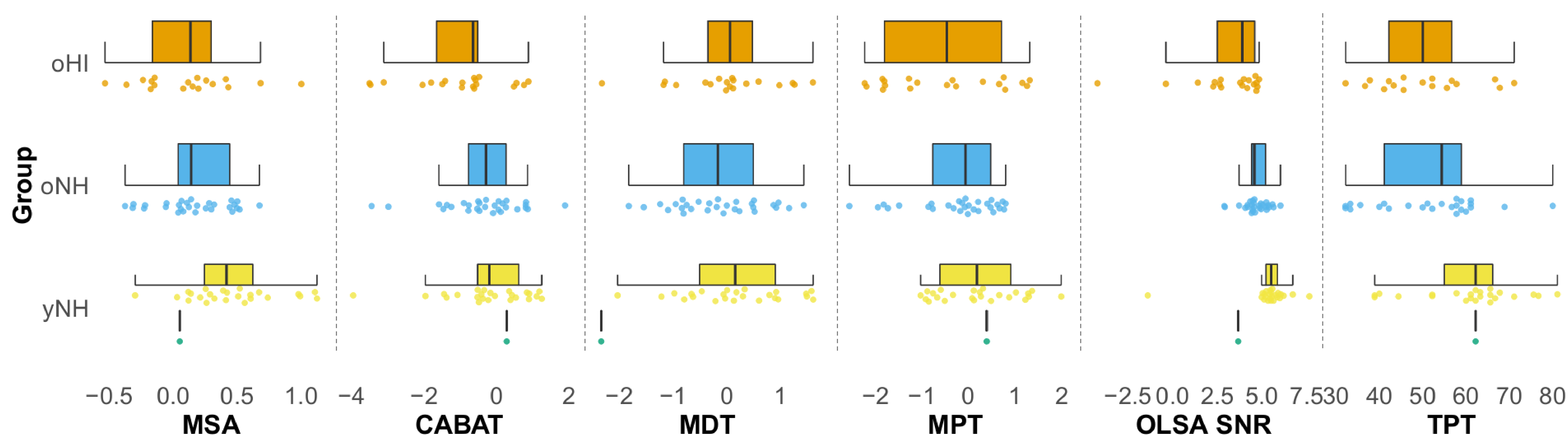
Carl von Ossietzky  
Universität  
Oldenburg

## INTRODUCTION

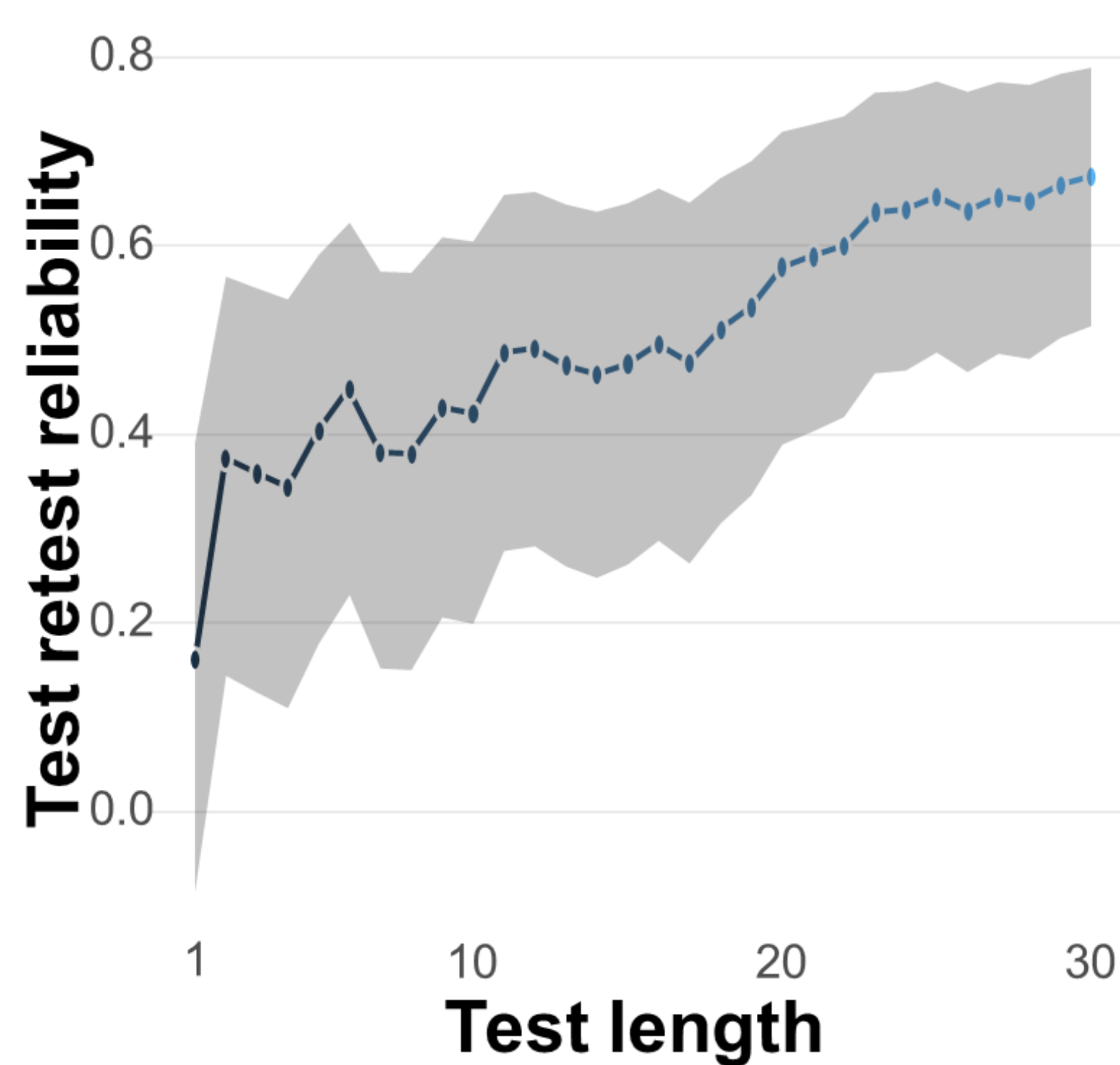
- A critical aspect of music perception is the ability of the auditory system to organize the acoustic world into coherent events and streams – a process known as **auditory scene analysis (ASA)**.
- No standardized test to precisely **quantify listeners' ASA ability in realistic musical scenarios** has been published yet.
- The objective was thus the development of an adaptive and ecologically valid **Musical Scene Analysis (MSA) test**, which is suitable for measuring musical ASA abilities of individuals with a wide range of abilities.

## VALIDATION RESULTS

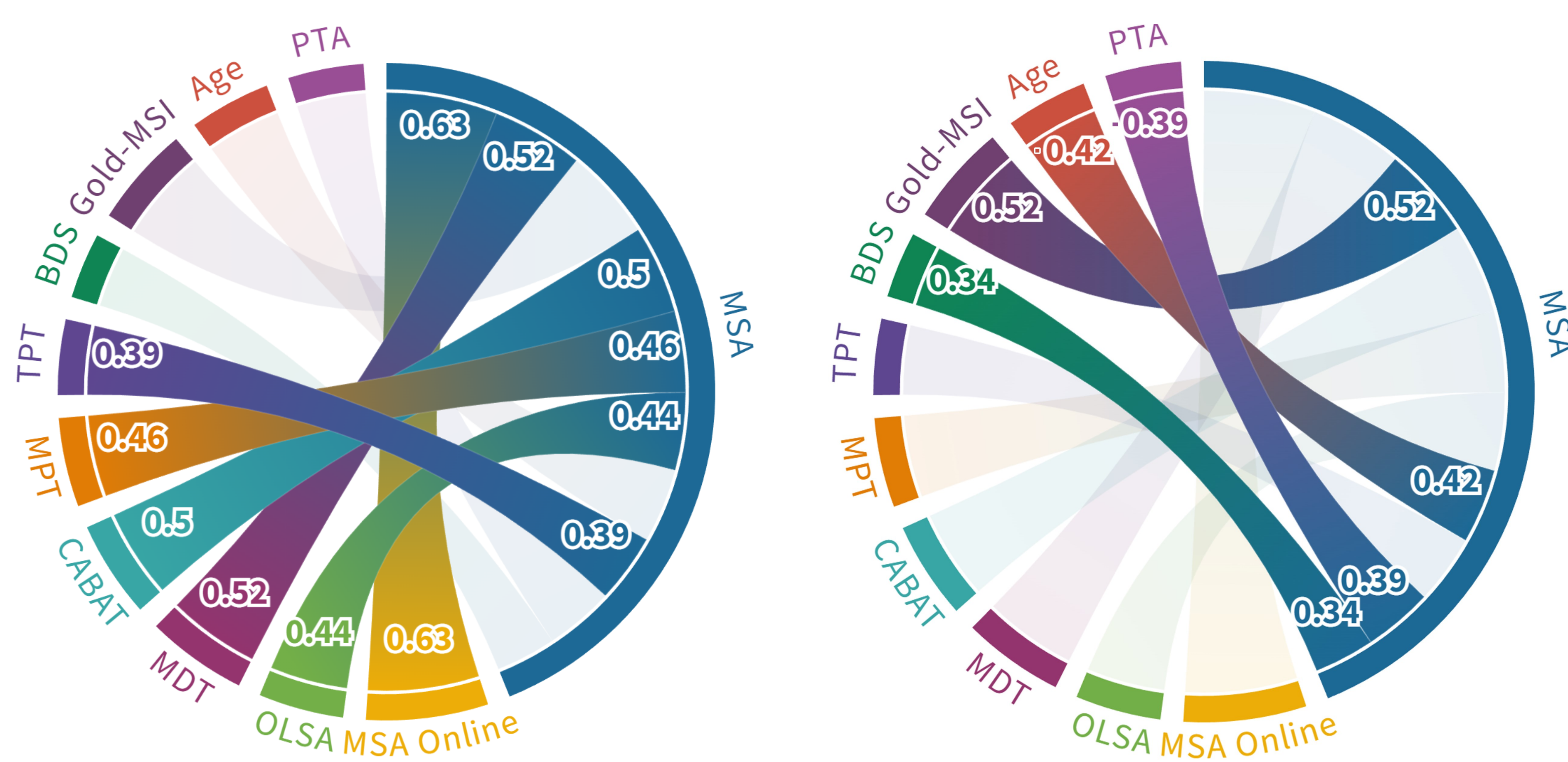
- 29 older normal-hearing (oNH), 19 older hearing-impaired (oHI), 25 younger normal-hearing (yNH), and one younger HI subjects were recruited for an **in-lab validation experiment**. An adaptive MSA with 30 items was developed based on 160 excerpts (each 2 sec) from 98 different songs (extracted from „MedleyDB“; see Bittner et al., 2014; 2016).



**Fig. 1** Group performance of older NH, older HI, younger NH, and younger HI (green dot below yNH) subjects on musical scene analysis (MSA), beat perception (CABAT), melody discrimination (MDT), mistuning perception (MPT), speech-in-noise (OLSA), timbre perception (TPT) abilities. Threshold for grouping older = being above 49 in age; for hearing impaired = average PTA from 0.125 to 8 kHz is above 20 dB.



**Fig. 2** Test-retest-reliability of the MSA as a function of test length (ICC = 0.63,  $p < 0.001$ ).



**Fig. 3** The correlation of the MSA to psychoacoustic and musical tests (left) and to potential influencing factors to explain individual differences (right), i.e. working memory (BDS), musical sophistication (Gold-MSI), age, and degree of hearing impairment (PTA). All correlations are significant at the 0.01 level.

## Conclusion

- Results from the online calibration experiment ( $N = 657$ ) indicates, that (1) the choice of the target instrument, (2) the number of instruments in the mix, and (3) the level-ratio between target are all suitable to differentiate between listeners' ASA abilities.
- The validation experiment under in-lab conditions suggest moderate to high test-retest reliability for the MSA. In addition, the MSA show moderate correlations with related psychoacoustic and musical tests.
- Based on a Bayesian IRT model, an adaptive version of the MSA test was developed, which is now freely available within the software environment R (see QR-Code or [github.com/rhake14/MSA](https://github.com/rhake14/MSA))



Funded by the  
Freigeist  
Fellowship of  
the Volkswagen  
Foundation

### Literature

- Bittner, R., Salamon, J., Tierney, M., Mauch, M., Cannam, C., & Bello, J. P. (2014). MedleyDB: A Multitrack Dataset for Annotation-Intensive MIR Research. In 15th International Society for Music Information Retrieval Conference, Taipei, Taiwan.
- Bittner, R., Wilkins, J., Yip, H., & Bello, J. (2016). MedleyDB 2.0: New Data and a System for Sustainable Data Collection. International Conference on Music Information Retrieval (ISMIR-16), New York, NY, USA.

### Contact

Robin Hake (robin.hake@uni-oldenburg.de)  
Michel Bürgel (michel.buergel@uni-oldenburg.de)  
Daniel Müllensiefen (d.muellensiefen@gold.ac.uk)  
Kai Siedenburg (kai.siedenburg@uni-oldenburg.de)  
Internet: <https://uol.de/en/music-perception>

LEISTEIER