



HAL
open science

Perceptual acoustic space of tyre noise

Thibaut Marin-Cudraz, Juan Jesus García, Étienne Parizet

► **To cite this version:**

Thibaut Marin-Cudraz, Juan Jesus García, Étienne Parizet. Perceptual acoustic space of tyre noise. *Internoise 2022*, Aug 2022, Glasgow, United Kingdom. . hal-04009995

HAL Id: hal-04009995

<https://hal.science/hal-04009995v1>

Submitted on 1 Mar 2023

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

PERCEPTUAL ACOUSTIC SPACE OF TYRE NOISE

Thibaut Marin-Cudraz^(a), Juan Jesus García^(b), Étienne Parizet^(a)

a: Laboratoire Vibrations Acoustique, INSA Lyon, France
b: Applus+ IDIADA, Spain

thibaut.marin-cudraz@insa-lyon.fr



INTRODUCTION

Tyre rolling noise is the major contributor to nocturnal traffic noise, provoking **sleep disturbance** that could lead to severe **cardio-vascular diseases**.

One of the objectives of the European **LEON-T project (Low particle Emissions and IOW Noise Tyres)** is to understand and minimize the **impact of tyre rolling noise on sleep**. In this scenario, the **listener** of such noises would be **inside** a bedroom. There are no data on the perception of tyre rolling noises in this scenario but a previous experiment (Hoffmann, 2016) already showed that **tyre noises can be differentiated by perception** in an experiment simulating a **listener outside**, next to the vehicles.

This poster presents the perceptual space of tyre noise based on a free sorting task and the acoustic properties of such noises, as well as the effect of the listening scenario (interior or exterior) on the perceptual space is also presented.

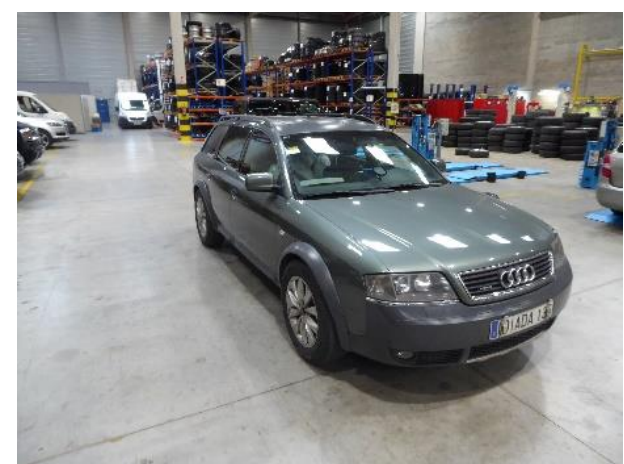


MATERIAL AND METHODS

33 rolling tyre noises recorded at 70 kph



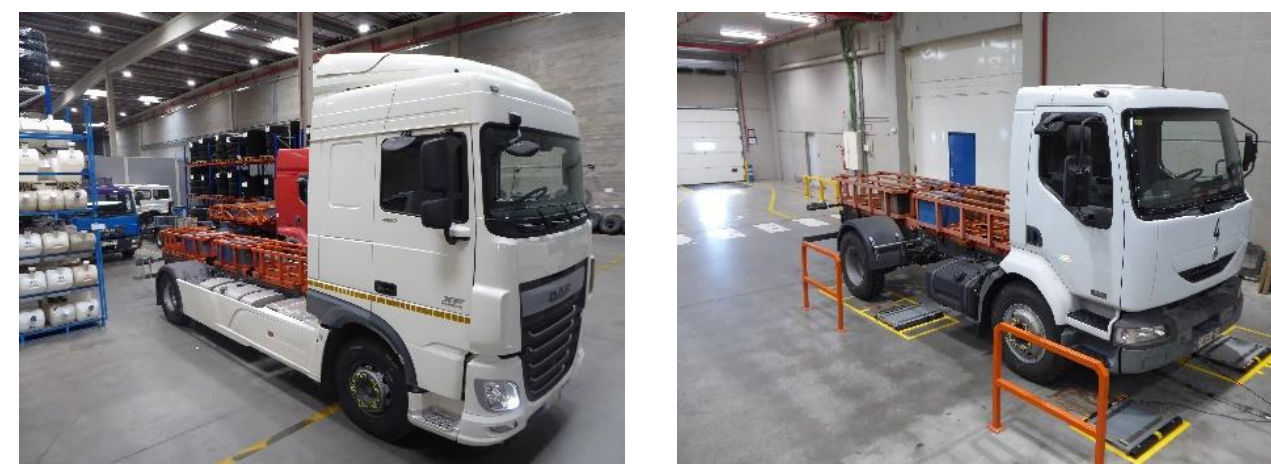
IDIADA Track ISO 10844:2014



C1

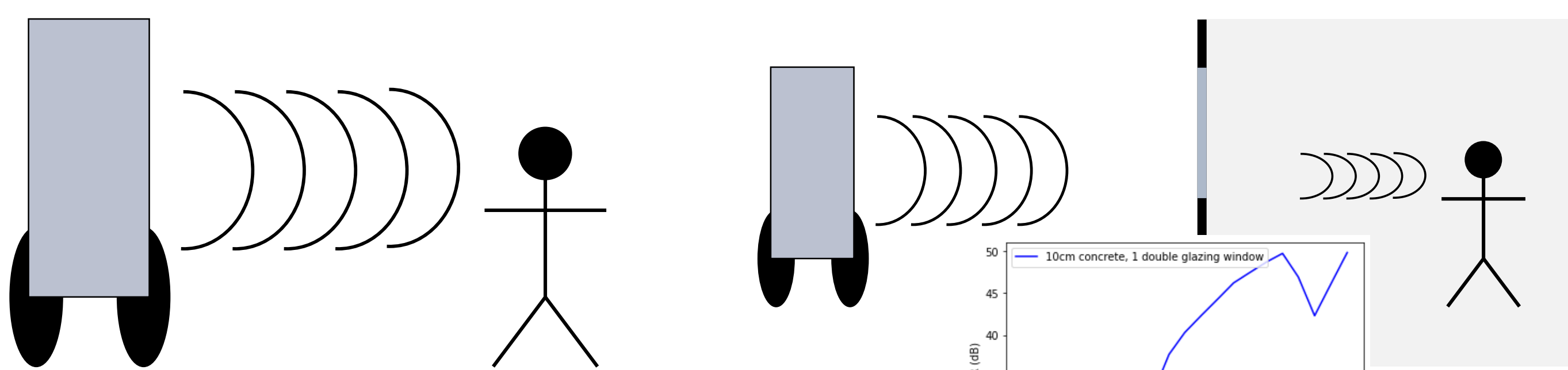


C2



C3

Two listening scenarios: **exterior** and **interior**



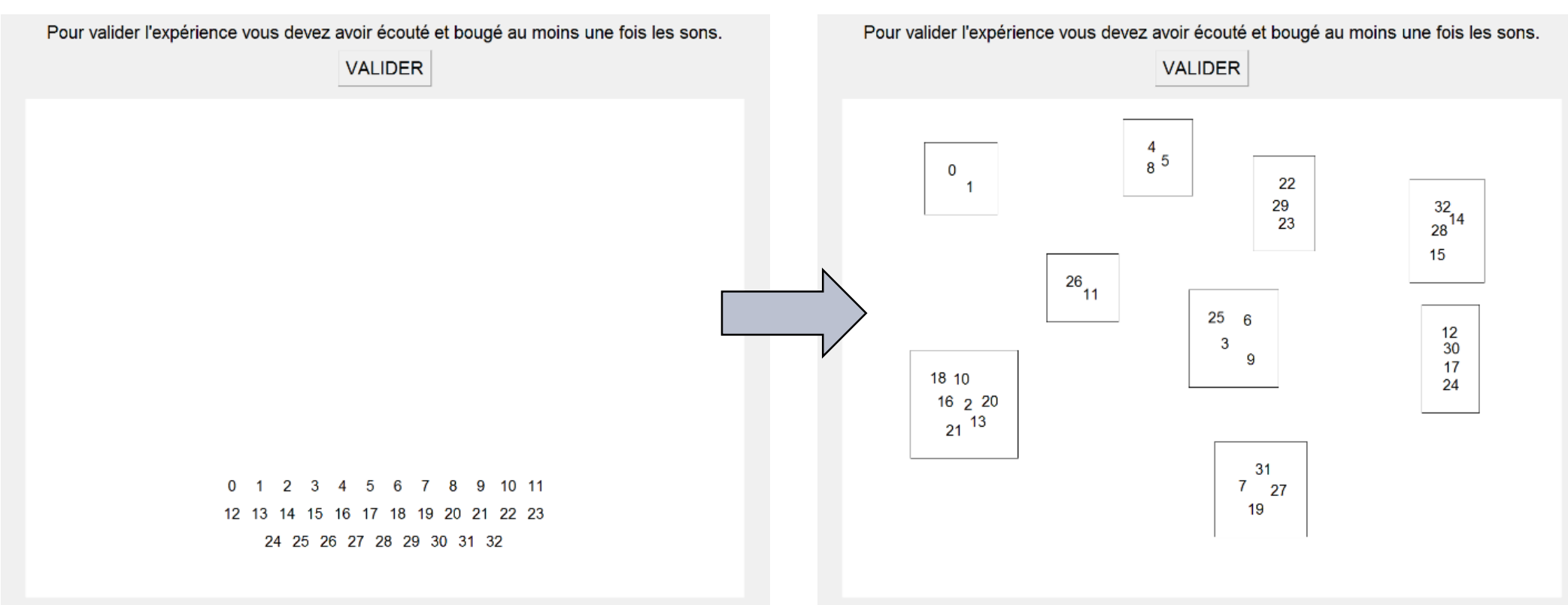
Exterior:
Simulates participants nearby vehicles
Raw recordings

Interior:
Simulates participants in a bedroom
Filtered recordings

Free sorting task



53 participants

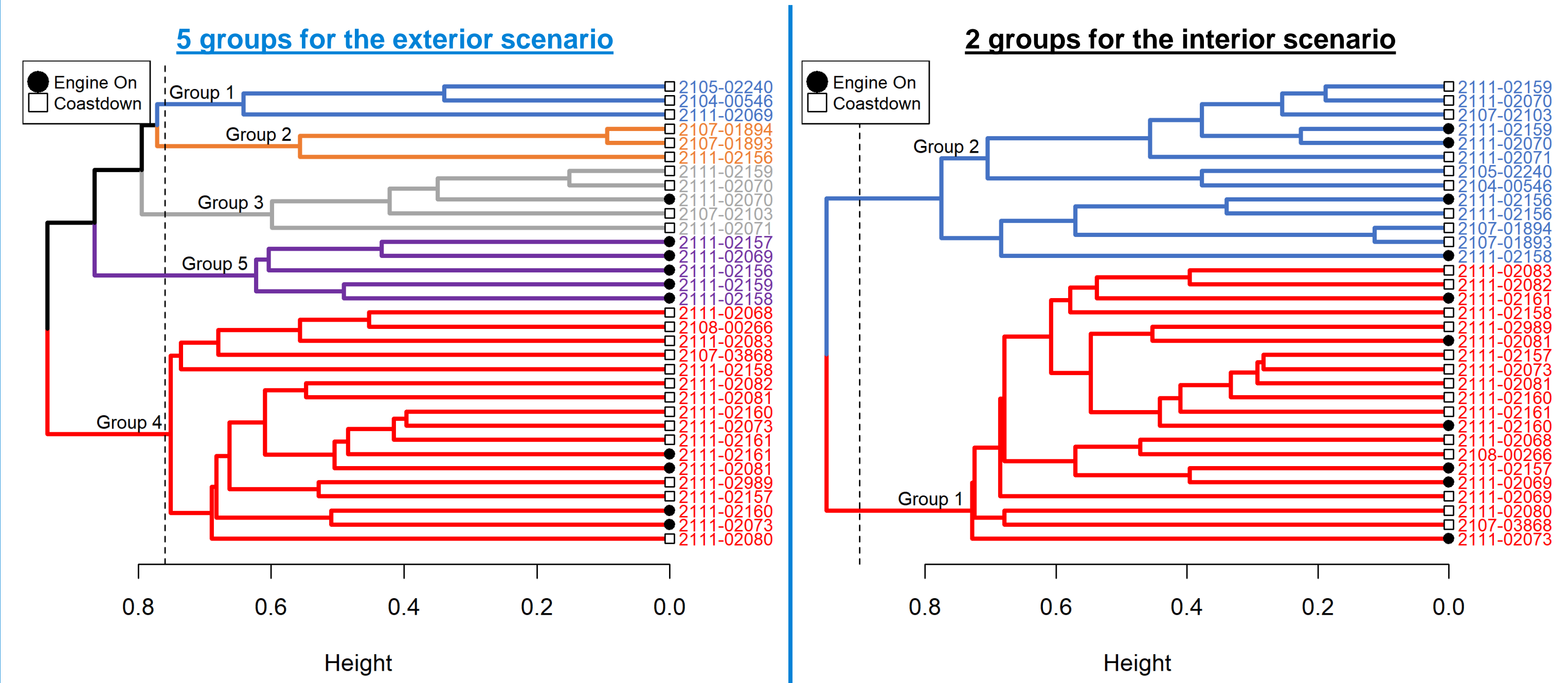


For **Exterior** and **Interior** scenarios separately, each participant had to listen and group the noises according to their similarity



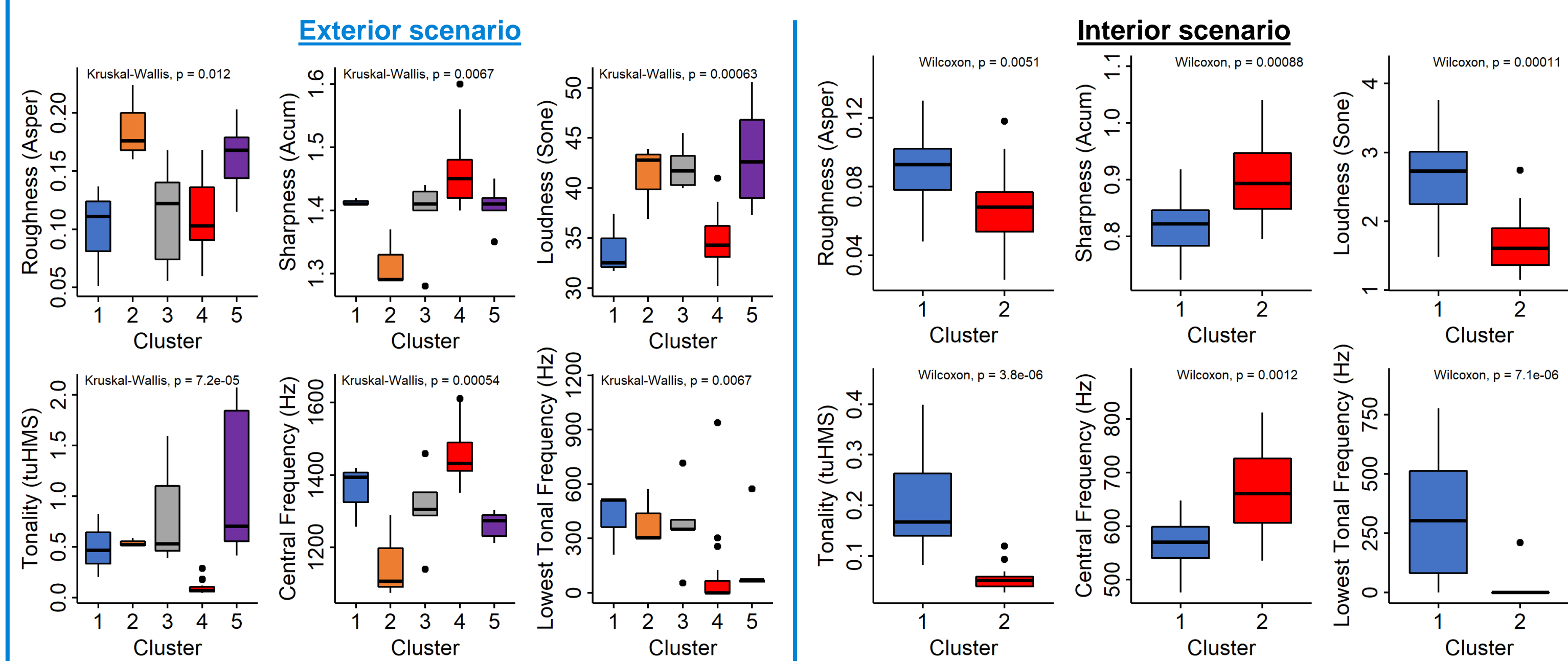
RESULTS

Participants grouped the noises differently in function of the listening scenario



For each scenario separately, the results of all participants were averaged to see if the noises were more often grouped together. Classification trees and hierarchical clustering algorithm performed on those data were used to identified those groups.

The **interior** scenario reduces the diversity of psychoacoustics parameters defining the groups



Several psychoacoustics parameters were measured for each noise in the different scenarios to evaluate the acoustic properties of the identified groups in each listening scenario. **For the exterior scenario, all parameters** highlighted the different acoustic properties of each group. **For the interior scenario**, the notable differences were mainly due to the **tonality and the level**, with a slight effect of the central frequency.



CONCLUSION

The listening scenario greatly influences the perceptual space of tyre rolling noise.

The tonality and level are the main drivers of this perceptual space for the **interior** scenarios. The unpleasantness of these parameters will be studied in future experiments.