

# Semantic Differential tests show intercultural differences and similarities in perception of car-sounds

S. Buss <sup>1</sup>, N. Chouard <sup>2</sup>, B. Schulte-Fortkamp <sup>1</sup>

<sup>1</sup> Acoustics/ Physics/ Oldenburg University , <sup>2</sup> HEAD acoustics

## 1 Introduction

In a project concerning the evaluation of car interior sound [1] three methods have been investigated for subject-centered evaluation of different interior car-sounds: Semantic Differential method (SD), Multidimensional Preference Analyses, Associated Imaginations on Sound Perceptions method (AISP) [3]. Here the results of the Semantic Differential tests are presented.

## 2 Development of a Semantic Differential

Especially for the evaluation of interior car sound a Semantic Differential was developed [2]. In a first step a list of 242 adjectives, which were able to describe interior car sounds was composed. The list was completed by finding antonyms to each adjective. The suitability of this adjectives for describing interior car sounds was judged in order to reduce this list to a set of 100 adjectives. On the basis of a factor analysis and a cluster analysis a list of 38 adjective-pairs was selected. A Semantic Differential test resulted in seven factors. By a further reducement to a Semantic Differential of fifteen items the factors comfort, power and sonority have been validated.

## 3 Data analysis

### 3.1 Semantic Differential

Semantic Differential tests were carried out in France, Germany and Italy. The sound database consisted of interior car sounds of nine different cars. These cars are named car A to car I. The following driving situation was chosen: 5<sup>th</sup> g and 130  $\frac{km}{h}$ . These sounds were presented with original loudness and loudness equalized.

#### 3.1.1 Polarity profiles

Intercultural differences in the polarity profiles are shown for two examples: car E (luxury class) and car F (economy class) in the original condition.

The sound of car E is judged pleasant, relaxing, calming, defensive, soft, expensive and luxury in all three countries. In France the sound seems nicer, more calming, smoother and more expensive than in Germany and Italy. Italian subjects judge the sound lower, more powerless, less luxury, expensive and steady. In Germany the sound is judged more powerful and less unsporty.

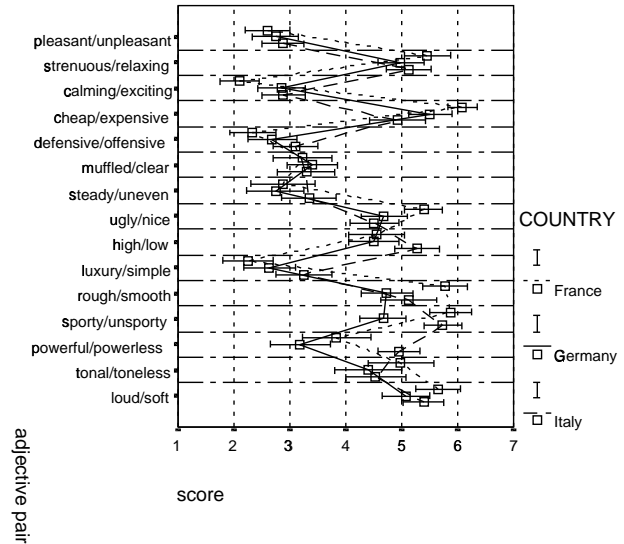


Figure 1: Polarity-profile of car E.

In all three countries the sound of car F seems to be unpleasant, cheap, simple and sporty. Italian subjects judge the sound less unpleasant and powerful than other subjects. In France and Germany the car seems to be cheap and simple and in Italy expensive. German subjects judge the car less sporty than French and Italian subjects.

#### 3.1.2 Factor analysis

**Factor analysis on adjective pairs** A factor analysis on adjective pairs in all three countries leads to three factors with explain variances greater than one. The explained variances are summarized in the following table:

	factor 1	factor 2	factor 3	others
France	6.1	2.5	1.4	5.0
Germany	6.3	2.2	1.6	5.0
Italy	5.1	2.2	2.1	6.0

The first factor in the French data and in the German data are correlated with the same adjective pairs. These adjective pairs are summarized in the factor comfort (see section 2): unpleasant/ pleasant, strenuous/ relaxing, exciting/ calming, cheap/ expensive, ugly/ nice, simple/ luxury, rough/ smooth and loud/ soft. The second and third factor are similar in both countries. The adjective pairs belonging to the second factor belong to sonority: high/ low, muffled/ clear. The third factor is correlated with the adjective pair powerful/ powerless.

The analysis of the Italian data leads to comfort as the first factor. But this time comfort is correlated with the adjective pairs unpleasant/ pleasant, strenuous/ relaxing, exciting/ calming, offensive/ defensive, ugly/ nice, rough/ smooth

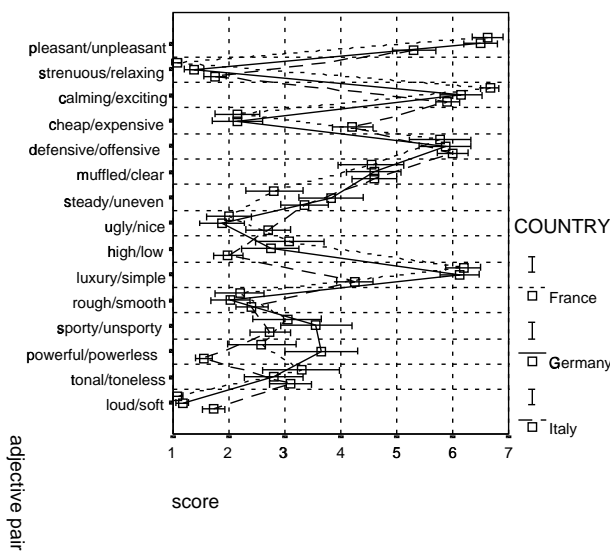


Figure 2: Polarity-profile of car F.

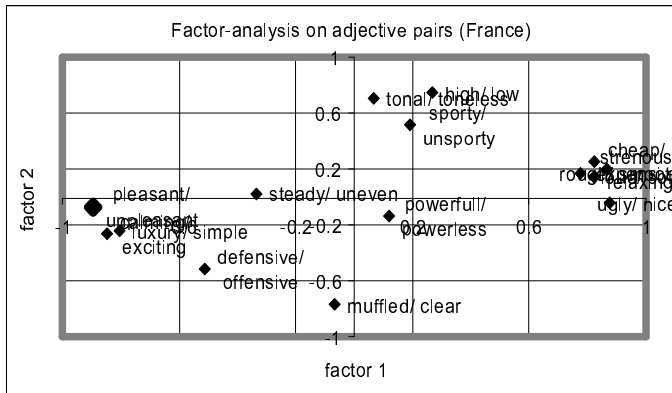


Figure 3: Factor analysis on adjective pairs.

and loud/ soft as well as with offensive/ defensive and powerful/ powerless. The second (expensive/ cheap and luxury/ simple) and third (clear/ muffled) factor in the Italian data differ from the second and third French and German factor.

**Factor analysis on cars** The factor analysis on cars results in two factors in all three countries. The explained variances can be seen in the following table:

	factor 1	factor 2	others
France	2.6	2.3	4.1
Germany	2.7	2.1	4.2
Italy	2.4	2.3	4.3

One factor (the first French factor and the second German and Italian factor) is correlated with the cars A (Sedan class) and B and E (Luxury class). The other factor is represented in all three countries by a different combination of cars, but always the cars G and H (Compact class) belong to this factor.

## 4 Conclusion

Semantic Differential tests led to the essential factors comfort, power and sonority. French and German subjects answered very similar. However the Italian data differed, especially for adjective-pairs like powerful/ powerless, cheap/ expensive and luxury/ simple. Moreover the Italian factors

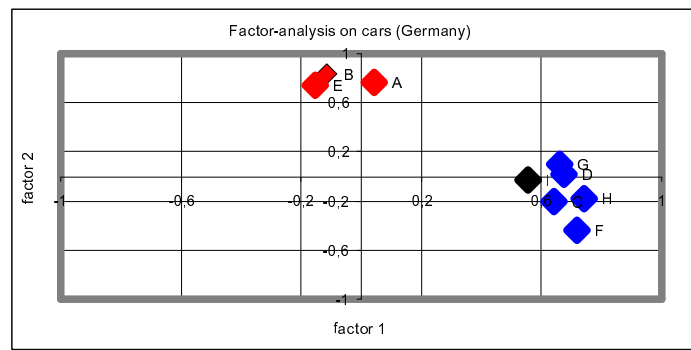


Figure 4: Factor analysis on cars.

differed from the French and German factors. The Italian factor comfort, which included power, consisted of other adjective pairs than the French and German factor comfort. The factor analysis on cars led to the same factors in all three countries.

Further analysis is necessary to deepen the understanding of the subjective evaluation. The comparison of results concerning the multi-method-design will be the next step.

## 5 Acknowledgments

This work was supported by the Brite/EuRam Project BE-96-3727 OBELICS.

## References

- [1] Krebber, W. et al.: Objective evaluation of interior car sound - the OBELICS project, DAGA 2000, Oldenburg, Germany, 2000, in print.
- [2] Chouard, N., Hempel, T.: A Semantic Differential Design Especially Developed for the Evaluation of Interior Car Sound, ASA-EAA-DAGA Joint Meeting, Berlin, Germany, 1999.
- [3] Muckel, P., Ensel, L., Chouard, N., Schulte-Fortkamp, B.: Sound Descriptions as a Matter of Evaluation in Sound Design, Proceedings of the 6th International Congress on Sound and Vibration, Copenhagen, Denmark, 1999.
- [4] Muckel, P., Schulte-Fortkamp, B.: "Passungsarbeit" bei der Beschreibung und Bewertung von Fahrzeuggeräuschen, DAGA 2000, Oldenburg, Germany, 2000, in print.