Perceptual spaces of verbal attributes used for description of musical sound timbre in Czech language

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Introduction

Searching for perceptual spaces within a given context is carried out through listening tests. When dissimilarity is judged, interpretation of perceptual space dimensions may be difficult. When the VAME (verbal attribute magnitude estimation) test is carried out, the system of verbal descriptions may be insufficient. These situations lead to a systematic search of verbal descriptions and their relations.

The aims of our project are to find a common space of perceptual descriptions of musical sound timbre (with definition of its dimensionality and description of dimensions), and to search for groups of judges and describe them.

Method

In the first stage, expressions used for description of musical sound timbre and their synonymity and anthonymity were collected from 120 musicians [1]. Common and respondent group frequency wordlists and perceptual spaces were constructed from the results obtained. In the second stage of the project, a non-listening pair dissimilarity test was performed on 25 expressions (verbal attributes) most used in the first stage (see Table 1).

The respondent's judgement was based on his internal image of timbre of sounds described by attributes in presented pair. The test consisted of two sessions each with 150 attribute pairs. Several training attribute pairs were evaluated at the start of each session. Pair dissimilarity was evaluated using a scale from 0 (no timbre difference) to 5 (maximum dissimilarity) with the possibility of a half step. The order of attribute pairs in the test was randomised by using the Ross algorithm and shifting the start point of test differently for each respondent.

Czech expression	English equivalent	Czech expression	English equivalent
ostrý	sharp	hrubý	rough
temný	gloomy	tmavý	dark
měkký	soft	teplý	warm
jasný	clear	zářivý	radiant
sametový	velvety	čistý	pure
jemný	delicate	vřelý	hearty
kulatý	round	barevný	colored
tupý	unpointed	zvonivý	ringing
drsný	harsh	chladný	cool
světlý	bright	průzračný	lucid
tvrdý	hard	široký	wide
sladký	sweet	úzký	narrow
plný	full		

Table 1: Verbal attributes used in non-listening pair dissimilarity test.

A retest was carried out after the second session on a selected subset of attributes in order to verify the reliability of judgements. A total 43 respondents took part in the test: 11 string instrument players, 6 wind instrument players, 6 keyboard instrument players, 12 other musicians (drum player, singers, conductors, composers) and 6 sound engineers.

The test results (individual dissimilarity matrices) were processed separately using the latent class approach applied on the weighted Euclidean model (CLASCAL) [2, 3], and the extended CLASCAL model (overview of models is in [4]). This leads to the construction of perceptual spaces (attribute spaces in this experiment) of common dimensions shared among all judges, and the classification of judges into classes, which differ in dimension weights.

Results

Comparison of test and retest results proved that stability of judgements is statistically significant for all respondents.

The CLASCAL procedure resulted in the division of respondents into three classes. It was further found that respondents were divided according to how they used the evaluation scale, e. g. how they differed in the mean values of dissimilarity (Class 1 - low values, Class 2 - middle values, Class 3 - high values), see Figure 1. A group of respondents not included in any of these classes (denoted as Class 4) showed larger variance of dissimilarity values then members of the previous classes. Class 4 was then split into five subclasses by subsequent application of CLASCAL (Figure 2).

All respondents shared a common model with three-dimensional space (see Figure 3). Weights of each of the dimension for respondent classes 1 - 3 are shown in Figure 4.

Space angles between attributes were computed as an instrumental method of attribute space interpretation.

Discussion

Direct interpretation of space dimensions of most appropriate model for all respondents was not sufficiently clear because not enough attributes lay near the space axes. Application of the space angle method was more successful. Three pairs with a space angle between attributes close to 180º were identified in the space. The space angle between directions "*clear, ringing - dark, gloomy*" and "*cool - colored*" is approximately 90º, but the direction "*velvety, round - sharp*" is slightly more skewed from the normal of plane defined by the first two directions. Spaces constructed from expressions collected in the first stage of the project are

different. Their prominent dimensions, "*bright, clear - dark, gloomy*" and "*sharp, hard - soft, delicate*", show that these spaces reflect more the linguistic meaning of the words.

Conclusion

Relations among attribute spaces of individual respondent classes and common attribute space will be studied in the next stage of the project. Different methods of assigning respondent classes will also be applied. The results will function as a basis for selecting appropriate verbal attributes during preparation of listening tests for various sound contexts.

References

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[4] McAdams, S., Winsberg, S., Donnadieu, S., De Soete, G., Krimphoff, J. (1995): Perceptual scaling of synthesized musical timbres: common dimensions, specificities, and latent subject classes. Psychological Research, 58, 177-192.

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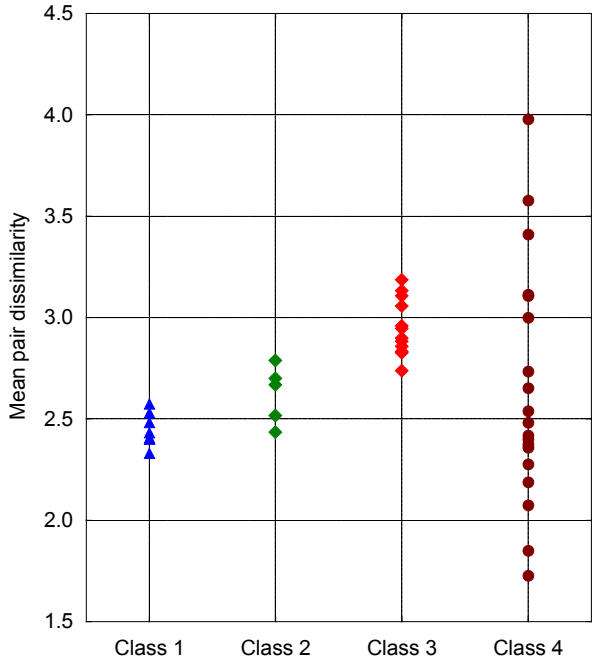

Figure 1: Mean value of a respondent's pair dissimilarity judgements according to respondent class.

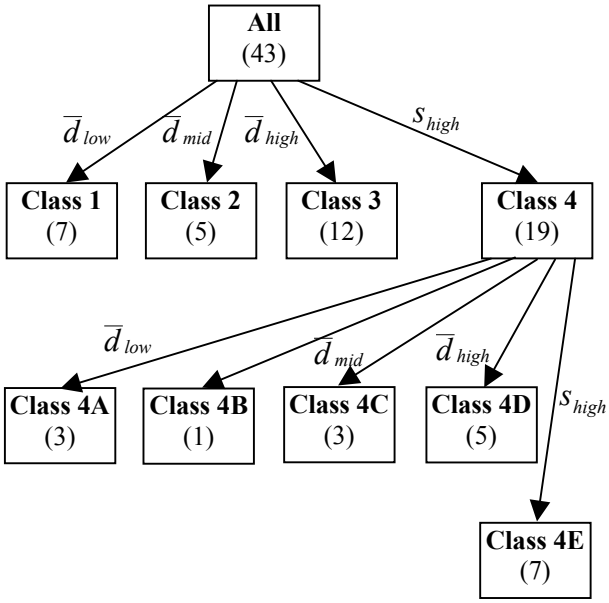

Figure 2: Block diagram of division of respondents into classes. In parenthesis number of class members.
$\bar{d}$ = mean value of dissimilarity
s = standard deviation of dissimilarity

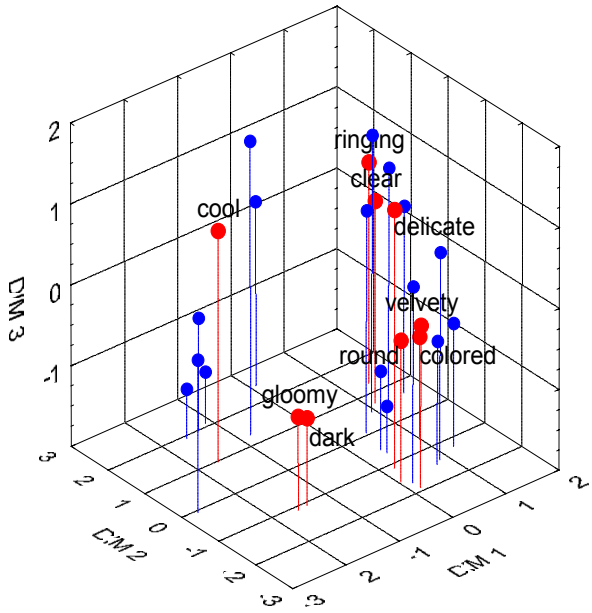

Figure 3: Common three dimensional space of verbal attributes for all respondents.

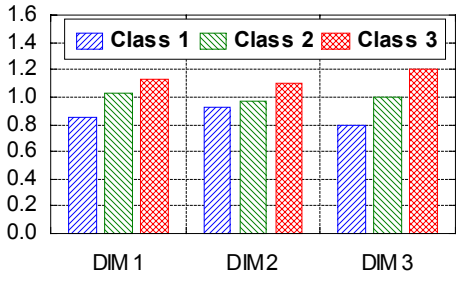

Figure 4: Dimensional weights of classes for common space of attributes.