Estimating Word Phonosemantics

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Abstract

The paper describes a method of word phonosemantics estimation. We treat phonosemantics as a subconscious emotional perception of word sounding independent on the word meaning. The method is based on the data about emotional perception of sounds obtained from a number of respondents. A program estimates word's emotional characteristics using the data about sounds. The program output was compared with human's judgment. The results of the experiments showed that in most cases computer description of a word based on phonosemantic calculations is similar with our own impressions of the word's sounding. On the other hand the word meaning dominates in emotional perception of the word and phonosemantic part comes out for the words with unknown meaning.

1. Introduction

Webster's defines the term phonosemantics as "the study of the meaning and symbolism of vocal sounds." It is based on the assumption that every sound and every letter may be pleasant or unpleasant, round or sharp, hot or cold. For example, English word "break" is perceived as something sharp, Romanian words "ou" (egg) is something round, "licurici" (firefly) is something small, pleasant and fast even for non-Romanian speakers.

Humboldt [1] said that "sound was not a directly imitative sign but a sign which indicated a quality which the sign and the object have in common; to designate object, language selected sounds which partly independently and partly in comparison with others produce an impression which to the ear is similar to that which the object makes upon the mind".

In the paper we interpret phonosemantics as a subconscious emotional perception of word sounding independent on the word meaning. On the other hand the word meaning dominates in emotional perception of the word and phonosemantic part comes out for the words with unknown meaning. The question is how to teach the computer to estimate the phonosemantic part of human's emotional impression of a word or a text? To determine emotional perception we start with individual sounds. We asked the respondents to describe emotional characteristics of each sound and then we used an algorithm to sum up these characteristics to obtain the overall emotional perception of a word.

2. Method description

Letter sounding influence how we feel about word sounding. Thus we can create a sound dictionary, appreciate every sound emotionally and obtain so called 'phonosemantic aureole' of the word as the sum of 'emotional marks' of sounds the word consists of. 'Phonosemantic aureole' of a word represents a man's emotional impression of a word. It can be described using various features.

We used 20 pairs of features suggested in [3] which describe sounds such as 'strong – weak', 'beautiful – ugly', 'light – heavy', etc. Some of them have very close meaning, e.g., 'good - bad' and 'kind – evil'. We decided to use all pairs of features in order to check the answers. If a respondent selects similar features (as 'rude' and 'brute')

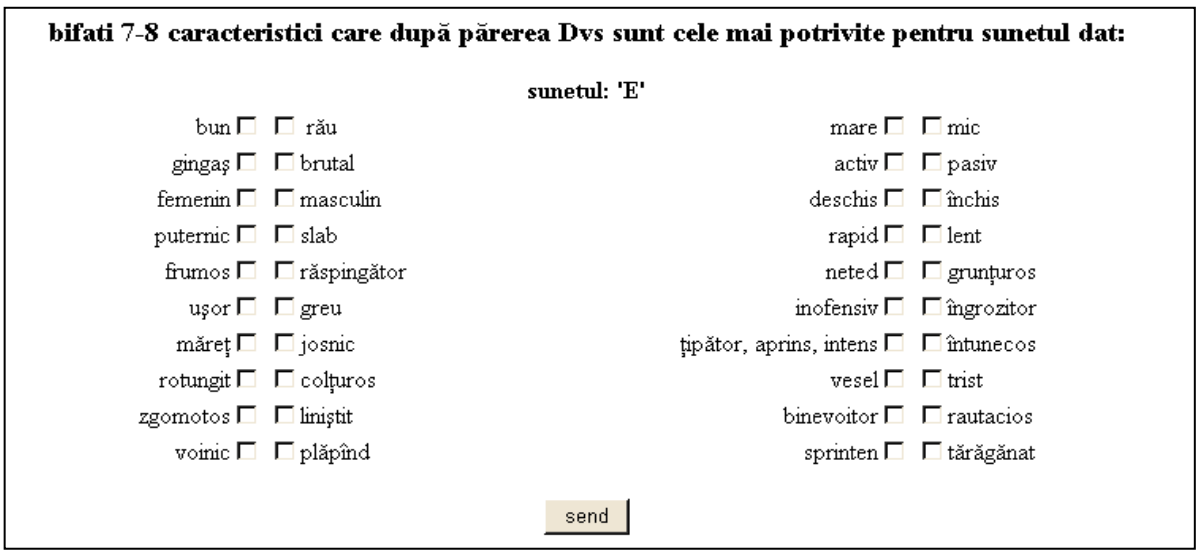

Figure 1: Web-interface for the questionnaire

for a sound he/she is really certain about his/her feeling the sound.

We asked the respondents to give their marks to Romanian sounds according to the features. We used web interface with HTML forms and checkbox type input for the questionnaire (figure 1). Each respondent was asked to check about 7-8 most appropriate features for the sound. We used a Perl script to process the responses. For each sound two arrays for 'positive' and 'negative' features were stored in memory. Selected 'positive' feature gets mark 10 and selected 'negative' feature gets -10. If the feature is not selected it gets 0.

2.1. Sound dictionary of Romanian

This part of the paper describes a sound dictionary used in the experiments. [2] provides the following information about sounds in Romanian:

Vowels - segmental subcategory, accent carrier, which shape the syllable nucleus. The vowels system of the Romanian language includes 7 units: a, ă, î, e, i, o, u.

Consonants - phonological (phonematics) category which constitutes the syllable satellites. They produce syllable delimitation and thus segmentation of the sonorous flux. The Romanian language consonants system includes 20 consonants: p, b, t, d, k, g, ts [ts], tS [tsh], dZ [dj], f, v, s, z, S [sh], Z [j], h, l, m, n, r. (to show particular Romanian sounds we use transcription symbols)1.

As result a list of 27 sounds for Romanian was created. 50 respondents appreciated this list using 20 pairs of features described above. Obtained data all together reflect subconscious impression of these people about the sounds of Romanian language and their content.

2.2. Algorithm description

Having sound characteristics we can calculate characteristics of the word summing up all features for all its sounds. However, informative significance of sounds in a word is different. The rarer sounds contain more information. There are some aspects that influence sound's informative weight, from which sound's stress and position in the word are the most influential. Here we introduce some notions used in the algorithm:

n_i^j is phonosemantic estimation of sound i by the respondent j for one feature pair (it can be 10, 0 or -10); m is number of respondents; f_i - mean value of respondent's sound phonosemantic estimation for one pair of features:

$$f_i = \frac{\sum_{j=1,m} n_i^j}{m},$$

k_i is the coefficient for informative weight of each sound in a word:

$$k_i = \frac{1}{P_i}$$

i is sound's position in the word ($i=1,n$); P_i is overall sound frequency in speech.

F is the overall assessment of phonosemantic perception of the word for one pair of features:

$$F = \frac{\sum_{i=1,n} f_i k_i}{\sum_{i=1,n} k_i}$$

Main Algorithm

Input:

Input separate word

IV. Counting:

- the word is split up into letters;
- for each letter:
  - transfer letter → sound i;
  - for each feature:
    - sound mark $k_i \cdot f_i$ is calculated;
- for each feature:
  - for each letter i:

calculate and display F.

3. Experiment results and discussion

3.1. Analysis of respondent's valuation of sounds

50 respondents participated in the experiment and depicted each sound using interface described above. Besides, they described their impression about the features. They considered that some of characteristics are not relevant for sound description and could be removed. We analyzed statistics of features used by all the participants. The features were organized in pairs of antonyms so the frequencies of pairs are compared. The result of the comparison presented in figure 2 is rather unexpected. Almost all features were used rather often. Although there are some features used more frequently, the difference between frequencies is small. Only one feature was not used at all: the one that we could not name with one word and used three synonyms for it. Apparently respondents were confused by this set of words and avoided using it.

Figure 3 shows frequency of each feature. The most frequent (masculine, big, heavy, strong, dark) are more appropriate for consonants and there are more consonants than vowels in the alphabet; that is why these features were used more frequent.

The next step is the calculation of differences between each feature in pair in order to detect respondent's confidence in certain characteristics for certain sound. The diagram in figure 4 shows the sum of differences between number of positive and negative feature selection for each sound. It is seen that the respondents were more certain in the most frequently used features.

[1] http://www.phon.ucl.ac.uk/home/sampa/rom-uni.htm

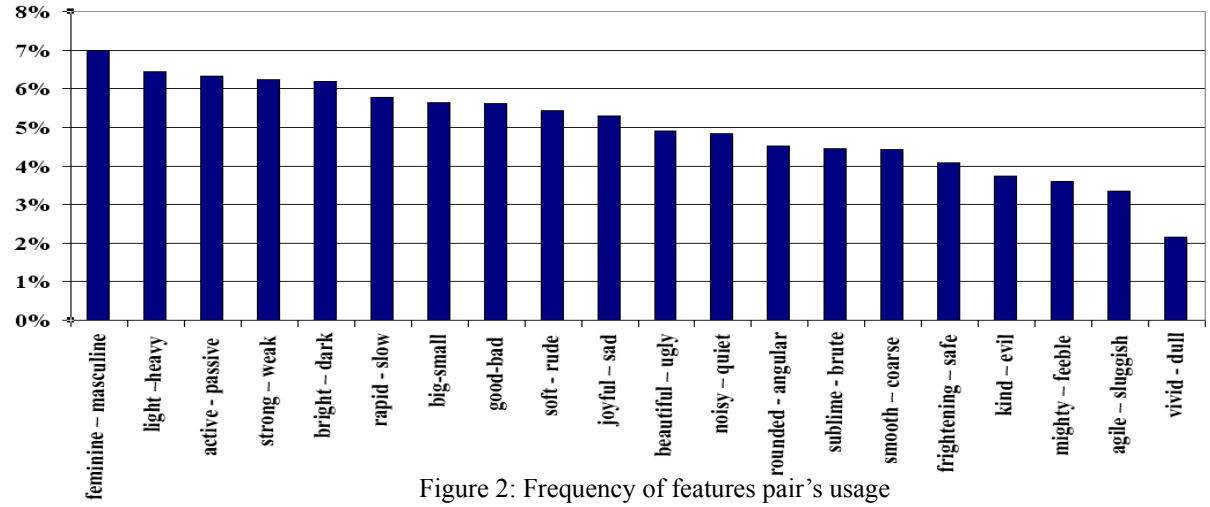

Figure 2: Frequency of features pair's usage

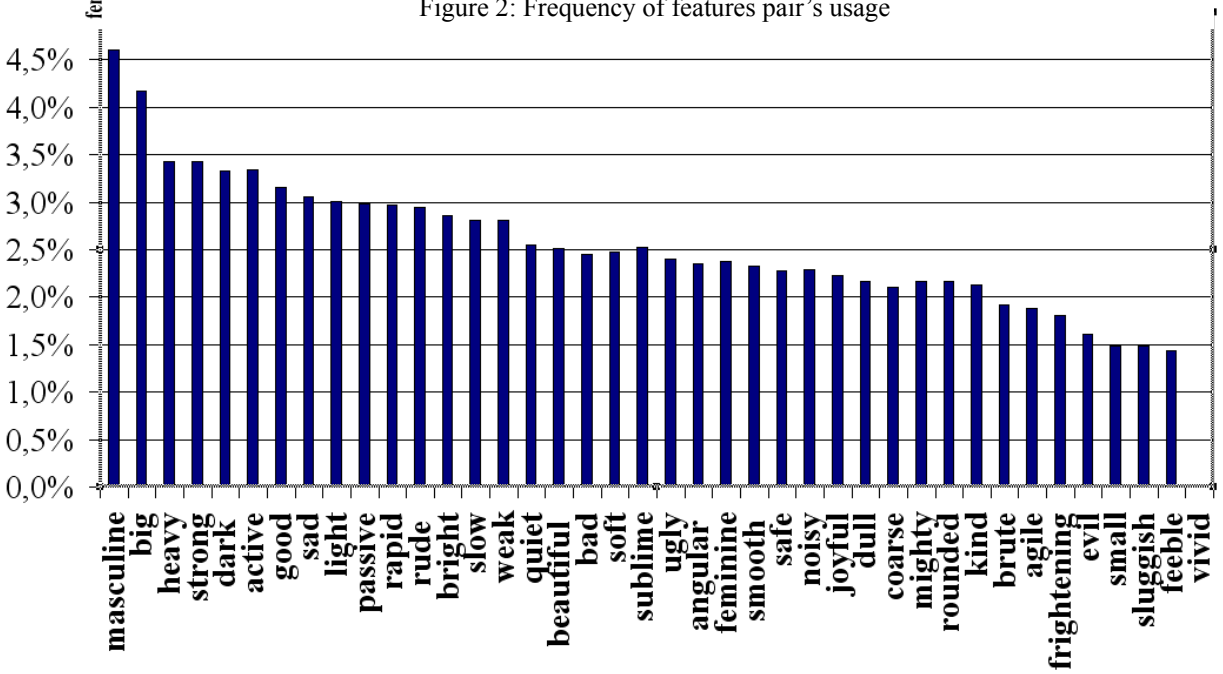

Figure 3: Frequency of individual feature's usage

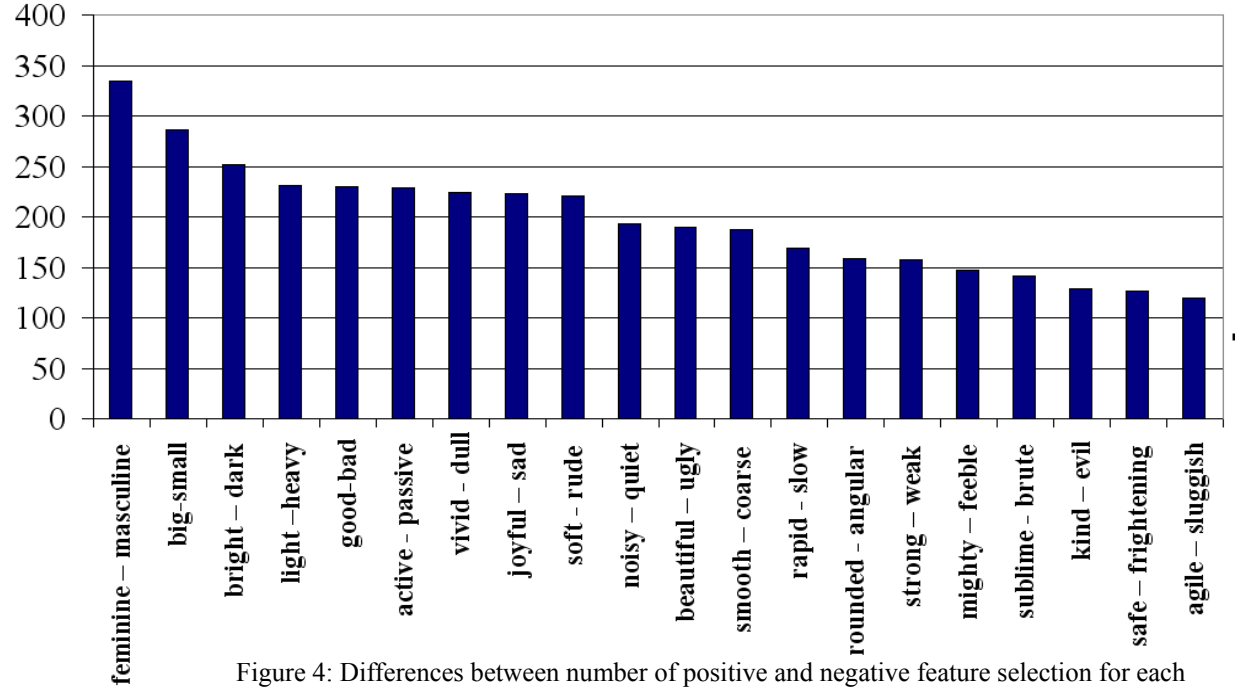

Figure 4: Differences between number of positive and negative feature selection for each sound summarized for each pair of features

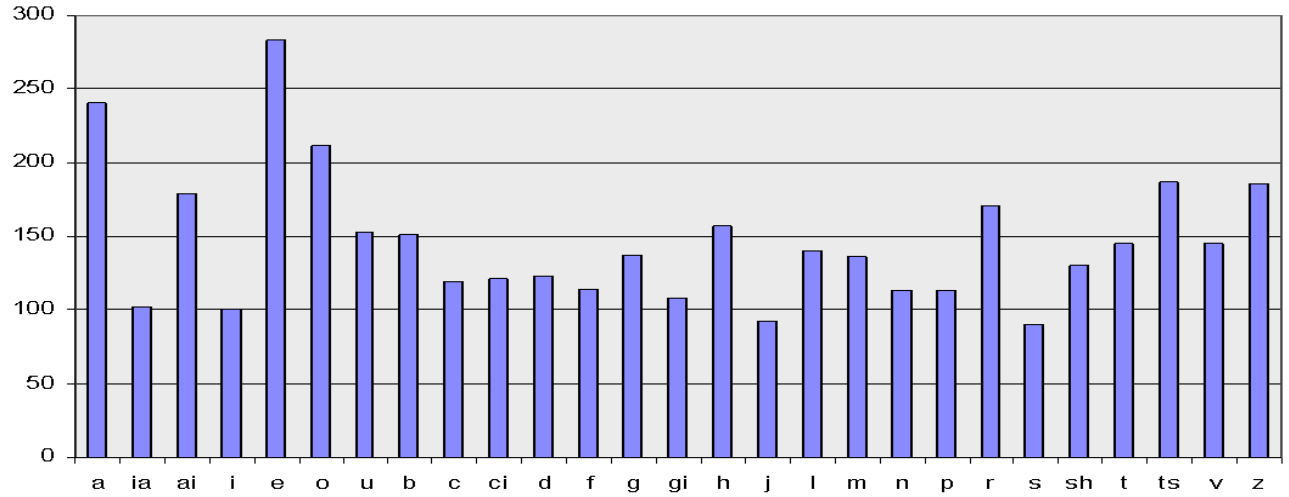

Figure 5: Differences between number of positive and negative feature selection summarized for each sound

The same verification was made for each sound. The diagram for sounds is presented in figure 5.
In the figure 5 we can see that the respondents were more certain about vowels.
Next we compared some similar feature pairs to be sure that the respondents were honest and confident in appreciating the sounds. We compared the following pairs of characteristics: “good - bad” and “kind - evil”; “rapid - slow” and “agile - sluggish”; “strong - weak” and “mighty - feeble”; “rounded - angular” and “smooth - coarse”. In the figure 6 the diagram for the pairs “strong-weak” and “mighty-feeble” is presented. It is seen that for the most sounds there is an agreement between the pairs appreciation. The difference in polarity appears only for 6 sounds of 27. For all other compared pairs the number of mismatches is about 5-7 from 27 appreciated sounds. It means that most of the respondents had the same feeling about the sounds.

In the figures 7 and 8 semantic evaluation for two sounds “a” and “z” is presented. Columns above the axe X show the intensity of the first feature of the pair, while columns below show the intensity of the second one. For example, the sound “z” is perceived as very “noisy”, “angular” and “coarse”.

3.2. Evaluation for words

The last step in our work was the evaluation of the method described in 2.2. To this end respondents appreciated the whole words using the same set of characteristics. We selected 20 words: 10 Romanian and 10 non-Romanian, so that respondents could evaluate a word by its sounding not by its meaning. The same words were also processed by the program according to the algorithm described in 2.2. Figures 9 and 10 present comparison of the evaluation results obtained from humans and the program.

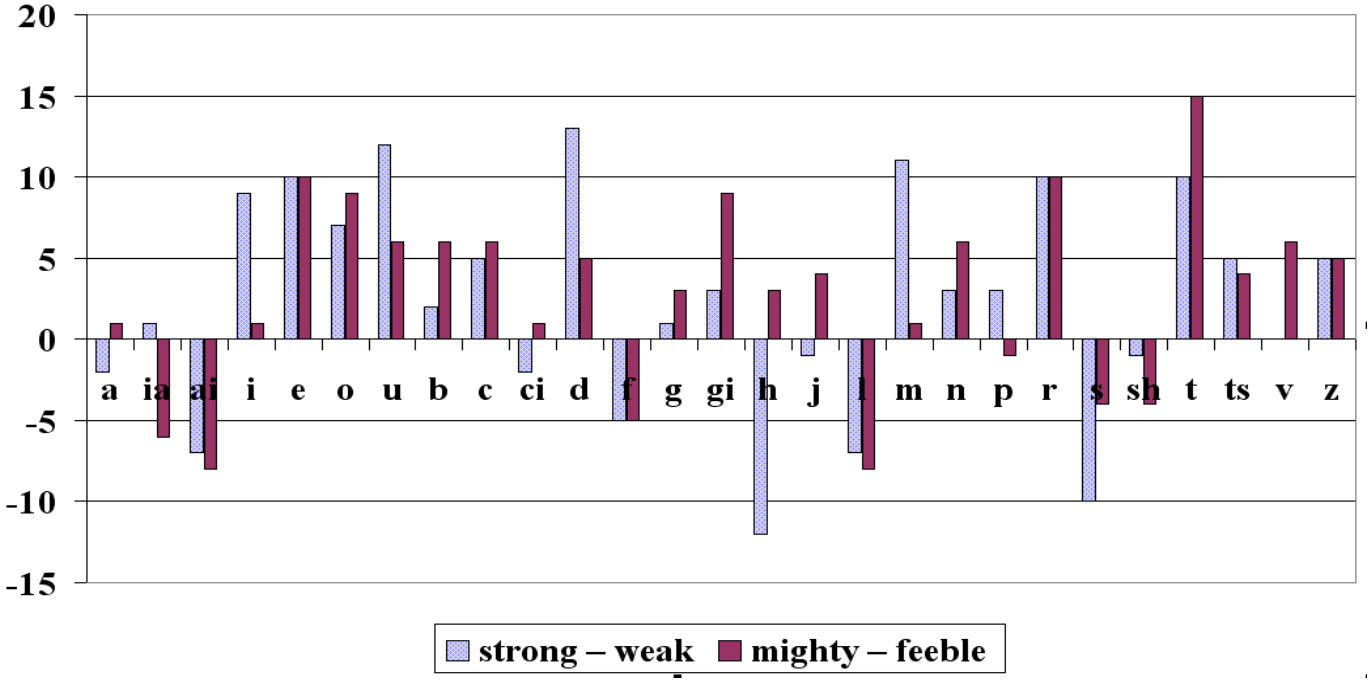

Figure 6: Comparison of two pairs of features valuation for each sound

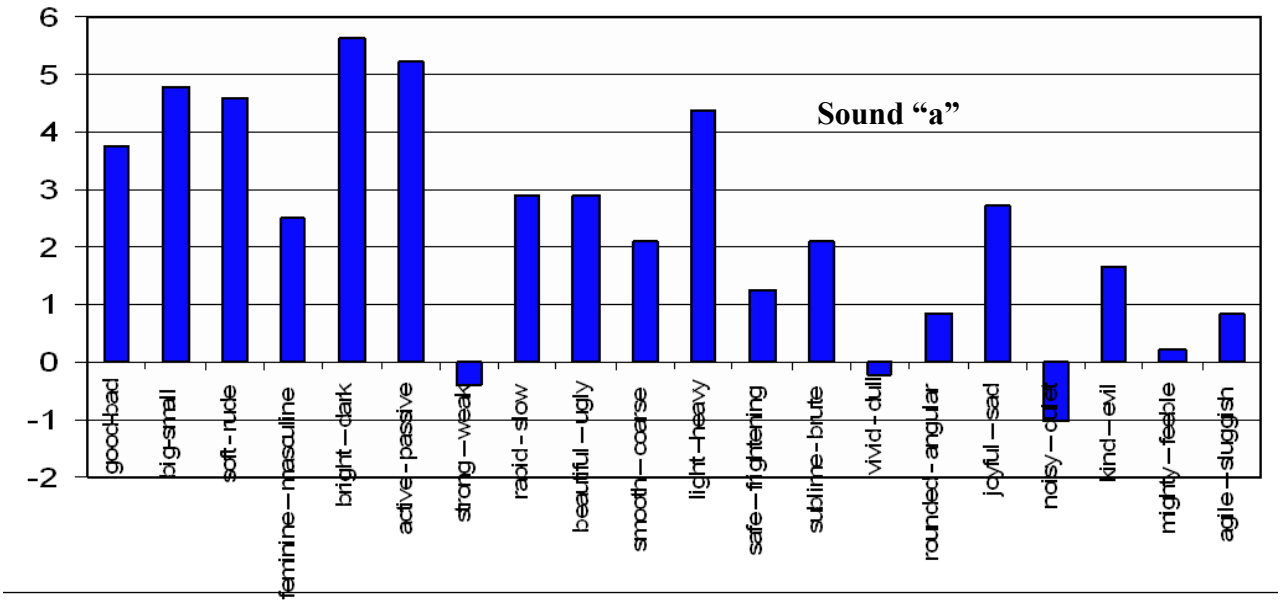

Figure 7: Phonosemantic evaluation of the sound “a”

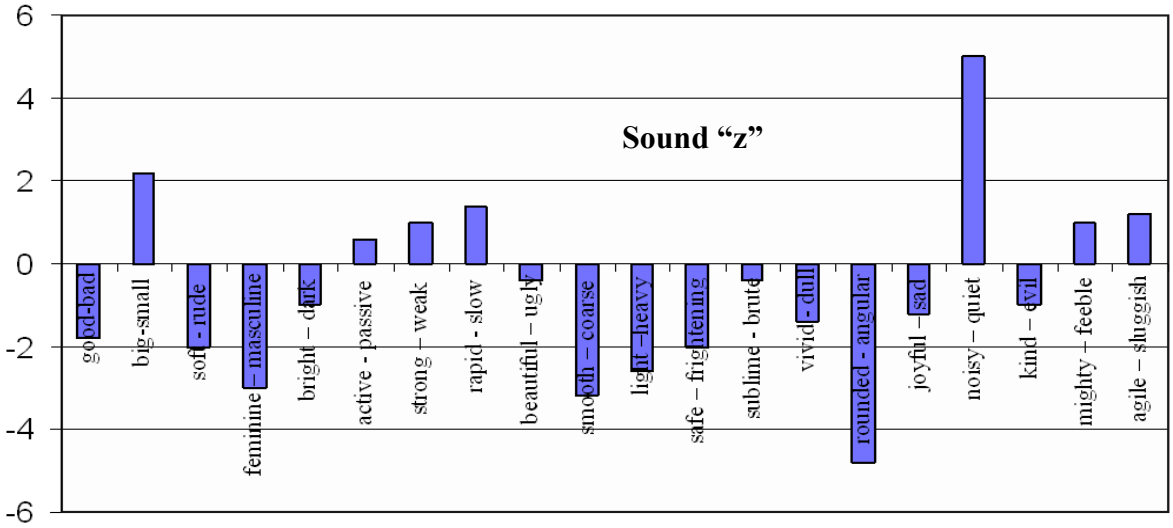

Figure 8: Phonosemantic evaluation of the sound “z”

Figures 9 and 10 present comparison of the evaluation The diagram in the figure 9 is for the word that had no any sense for the Romanian respondents, so they appreciated only its sounding. It is seen that the appreciations by humans and program match for the most features. The diagram in the figure 10 shows the appreciation of a Romanian word “moarte” (death); the differences are considerable. In this case the respondents were misled by the word’s meaning and appreciated it as “bad”, “sad” and “ugly”.

For the Romanian words respondents took into consideration the word meaning and their appreciation did not match with the one made by the program. On the other hand non-Romanian words were appreciated similarly both by respondents and the program. It proves that the program appreciates the word sounding close to the way people do.

4. Conclusion

The paper describes a method of word phonosemantics estimation. The method is based on the data about emotional perception of sounds obtained from a number of respondents.

The results of the experiment showed that in most cases computer description of a word based on phonosemantic calculations is similar with our own impressions of the word’s sounding. This allows us to think about further perspectives in the domain of phonosemantics. It could be possible for example to get computer’s assistance in selecting a name for a firm, product or music band, just introducing some key features you think could describe the word you’ve been looking for and the computer will give you a list of appropriate words. However it should be stressed that the word meaning dominates in emotional

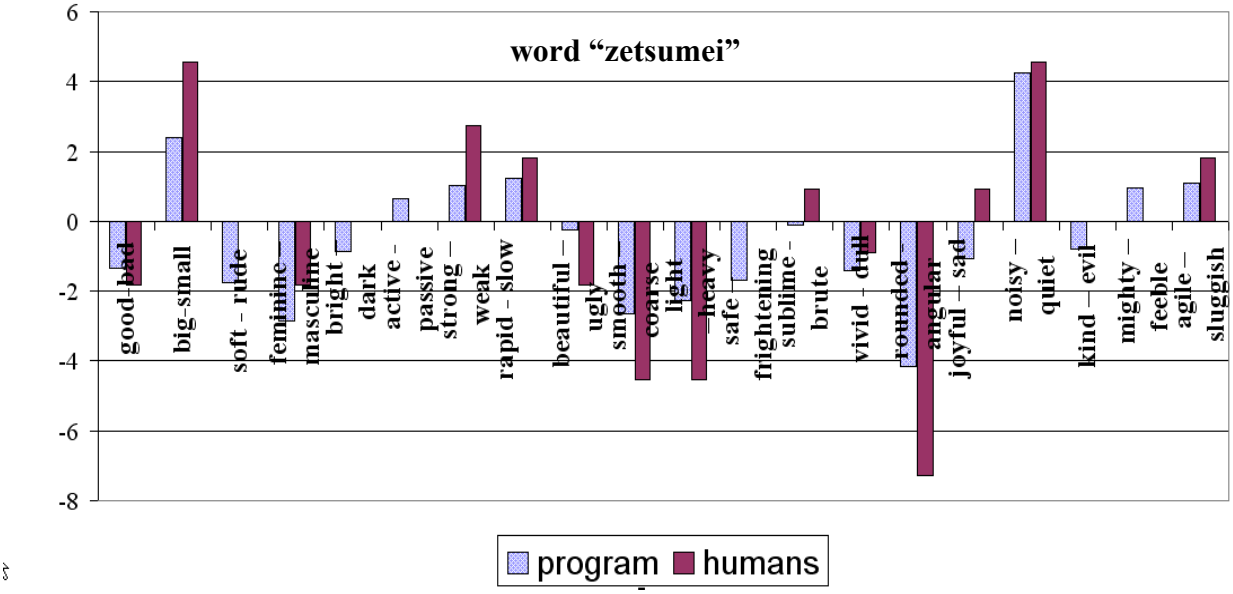

Figure 9: Phonosemantic evaluation of the non-Romanian word “zetsumei”

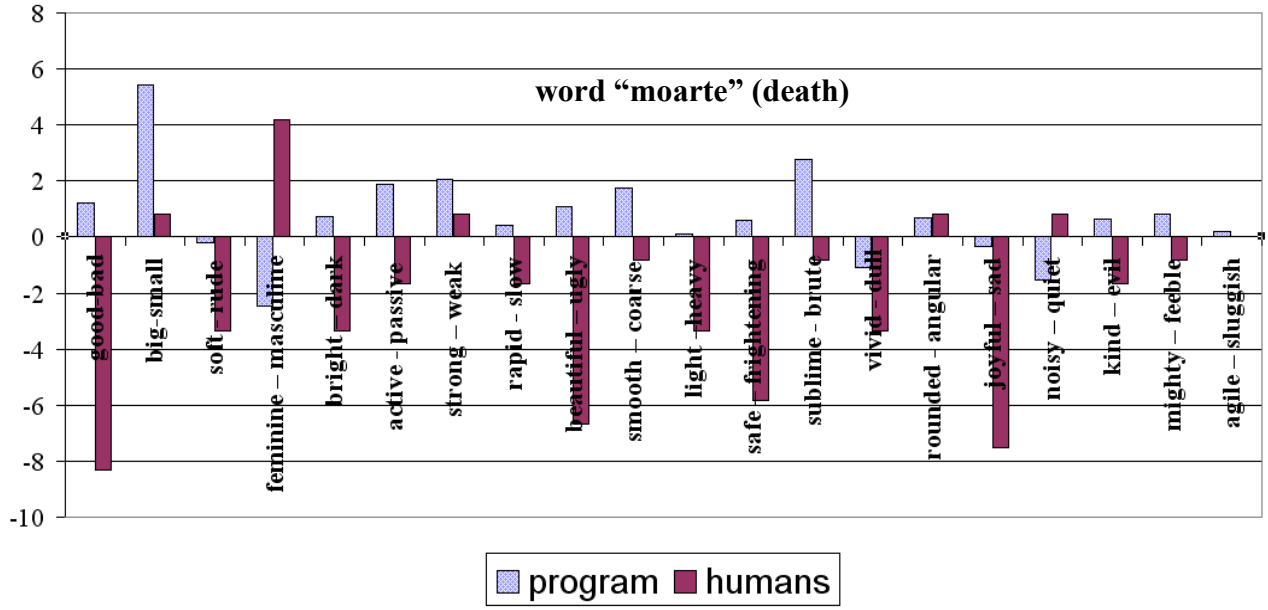

Figure 10: Phonosemantic evaluation of the Romanian word “moarte” (death)

perception of the word and phonosemantic part comes out for the words with unknown meaning.

There are some ways for improving the algorithm. Firstly, we found that vowels are of great importance in the word perception while they have small influence in the process of calculation because of the frequency coefficient. Some coefficients for them can improve the calculation results. Another kind of possible coefficients for each sound can be found on the base of respondent’s confidence in their characterizing presented in figure 5. Besides, it is possible to merge marks for similar pairs of features to get more legible characterization for the word.

5. References

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