“Male” and “Female” As a Fuzzy Set in Gender Opposition
(Through Intonation Patterns)

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Abstract. The paper considers two polar members of gender opposition, social and linguistic
phenomena, as a fuzzy set revealing fuzzy, overlapping areas while distinguishing between feminine
and masculine properties as regards to male and female intonation patterns in acted speech. As a
social construct, gender is reflected in gender stereotypes—certain signs of group identity that can be
realized through intonation patterns. These patterns possess certain distinctive features forming
male/female category memberships. The research reveals that some prosodic parameters in acted
speech are not gender-specific, thus making up overlapping areas in male/female speech. The claim is
that the fuzzy set approach to the study of gender opposition questions the binary cut of the object
under study and gives rise to the thought that in acted speech prosody this opposition is not clearly cut.

Introduction

The theory of fuzzy sets and fuzzy logic has proved to be fruitful in many scientific fields since it
was developed by Lofti A. Zadeh who defined fuzzy set as a class of objects with a continuum of
grades of membership where the source of imprecision is the absence of sharply defined criteria of
class membership [1]. This theory is widely applied in linguistic studies as natural language concepts
have vague boundaries and fuzzy edges [2], and natural language sentences can be true or false to a
certain extent [3]. In the framework of phonology, the fuzzy set approach also provides research
prospects in connection with such categories as variance and gradience. Given fuzzy sets, the current
research suggests that gender opposition traditionally conceived of as having a clear binary cut
appears as a fuzzy set in which homo loquens may or may not show gender-specific features.

Gender defined as a social sex is constantly in the focus of contemporary scientific studies. Unlike
biological sex which deals with male/female physiological features, gender considers a wide range of
psychological characteristics, social roles, and standards of behavior which are considered proper in
society [4]. Gender is constructed and maintained by social institutions: school, church, army, etc.,
which present gender features and roles as a set of natural standards. As a social construct, gender is
reflected in a social stereotype, being its special case. Gender stereotypes penetrate all aspects of
human life. They define both a set of social roles and psychological features and are considered
veracious although stereotypes do not always contain truthful information. Gender stereotype
influence is very strong and people are often guided by it when they associate, for instance, certain
speech features with male/female speech.

Definition and features of gender stereotype

Any stereotype, including gender ones, exists as mental formation that objectifies itself in semiotic
systems such as languages which both objectify and reproduce stereotypes. The definition of the
“stereotype” given by D. Crystal stresses the point that knowledge of the stereotype is required for
semantic competence in the language [5] which helps people to interact correctly. This understanding
of stereotype is close to Lakoff’s [6] “cluster models”—complex structured systems of knowledge:
language prompts for the construction of mental spaces in ongoing discourse” [7].
Gender stereotype as expressed through linguistic means is characterized by the following features:

- It represents basic semantic knowledge.
- It serves as a cognitive reference point and it sets up norms and expectations against which other units are evaluated and assessed.
- It is predictable, because it is conditioned by speaking situations.
- It is actualized in speech through specific set or arrangement of units.

The relationship between participants of communication process defines their speech strategy and the choice of linguistic means; knowing social and cultural rules for using a language depends on how many social features the speaker and listener share [7,8]. Hymes [9] developed a list of sociolinguistic awareness elements that were involved in particular speaking situations. Pierrehumbert [10] noted that acquisition of phonological categories was gradual, the gradualness of acquisition was correlated with the frequency of the variants and with what groups within the community used them more often [11]. Thus, the speakers’ perception, evaluation and interpretation processes are culture-bound, which influences their manner of pronunciation, word or prosody choice.

Male and female speech is considered to be differentiated by a number of features conditioned by specific physiological conditions. Then, how can male actors perform female roles? Moreover, why do we sometimes describe other people’s speech as “male” or “female” irrespectively of the person’s sex? According to Gussenhoven [12], speech communities employ biological codes, conditioned by human physiology, that represent natural form-function relations. Such exploitation is conventionalized within speech communities. Speakers, using the codes, do not have to create these specific physiological conditions. It is enough to create the effects. These effects are controlled during phonetic implementation. This brings us very close to stereotypes, which exist on the phonological level as particular prosodic elements arranged in the specific order.

Every speaker’s phonological knowledge is organized in clusters of phonological categories—phonetic stereotypes, which, in turn, are represented in the language through intonation patterns. For an intonation pattern (as a representative of a stereotype) to be a phonological unit means to be a point of reference, “default” [13], against which all other prosodic arrangements will be marked as “having a different communicative meaning” [14,15]. Such patterns are characterized by parameters which can be identified through systematic linguistic analysis and interdisciplinary research. Given fuzzy sets, the current research suggests that gender opposition traditionally conceived of as having a clear binary cut appears as a fuzzy set in which homo loquens may or may not show gender-specific features. In order to test this hypothesis we investigate intonation patterns in male and female utterances in acted speech to reveal both distinctive and non-distinctive features. Then the findings based on the analysis of the acoustic data is compared to certain gender stereotypes. We expect to find positive support of the hypothesis with the new approach to the study of gender opposition.

There is a widespread view that we can understand the nature of everyday speech only by direct examination of spontaneous speech. Xu [16] argued that the number of uncontrolled factors in spontaneous speech did not allow for the generalization of the conclusions made on the basis of the analysis of the given situation to other situations with different parameters due to the massive variability of these factors. This view is supported by findings from acted-speech synthesis and recognition and from analyzing acted speech corpora [17,18].

Data and methods

This paper presents preliminary results of the investigation into intonation structure of utterances actualized by the speaker as belonging to characters of different gender.

Speech data. Speech data was taken from the Harry Potter series of audio books performed by S. Fry. The choice of the data was conditioned by the necessity to eliminate all possible situational factors which are present in everyday unrestricted speech. In order to create real-life images in an audio book, actors have to use intonation patterns which are easily identified by the listeners as belonging to a man or a woman.
Participants. Ten male and female characters were chosen and divided into two groups on the criteria of gender, and age within these two groups. In the speech material realized by the speaker utterances of three communicative types (affirmative sentence, Yes/No question, Wh-question) were chosen. In these utterances temporal, dynamic and pitch qualities were measured and analyzed by PRAAT (version 5.3.03 Copyright © 1992-2011 by Paul Boersma and David Weenik). The following parameters were taken into consideration (this approach was successfully used by Rusko et al [17]):

1. Temporal qualities (duration of the utterance, average syllable duration, tempo).
2. Dynamic qualities (average intensity in the utterance, maximum and minimum intensity levels in the utterance, intensity range in the utterance).
3. Pitch qualities (average Fo level in the utterance, minimum and maximum Fo levels in the utterance, Fo variation in the utterance).

The data was organized into groups according to the gender of the characters. Normality test was performed to establish that age factor does not influence the distribution of the parameters in the set. One Way ANOVA test was performed to find statistically significant differences in the acoustic parameters between the groups of male and female characters.

Results and discussion

Table 1. Temporal parameters.

| Parameter                        | Normality test | One Way ANOVA         |
|----------------------------------|----------------|-----------------------|
| Duration of the utterance        |                |                       |
| Male character group             | Passed         | Significant differences |
| Female character group           | Not passed     |                       |
| Average syllable duration        |                |                       |
| Male character group             | Passed         | No significant differences |
| Female character group           | Passed         |                       |
| Tempo (syll. /sec.)              |                |                       |
| Male character group             | Passed         | No significant differences |
| Female character group           | Passed         |                       |

Thus, we can say that the opinion that women speak quicker did not find its confirmation in the analysis of spoken speech. It may be purely perceptual, based on the fact that duration of the utterances actualized by female characters is significantly bigger due to the greater number of syllables.

Table 2. Dynamic parameter.

| Parameter                        | Normality test | One Way ANOVA         |
|----------------------------------|----------------|-----------------------|
| Average intensity in the utterance|                |                       |
| Male character group             | Passed         | No significant differences |
| Female character group           | Passed         |                       |
| Maximum intensity level in the utterance|                |                       |
| Male character group             | Not passed     | Significant differences |
| Female character group           | Passed         |                       |
| Minimum intensity level in the utterance|                |                       |
| Male character group             | Passed         | No significant differences |
| Female character group           | Passed         |                       |
| Intensity range in the utterance |                |                       |
| Male character group             | Passed         | No significant differences |
| Female character group           | Passed         |                       |
The dynamic parameters show that the speech loudness shows the influence of age factor in the male character group in maximum intensity level parameter which causes significant differences between groups. Other dynamic parameters do not show significant differences in prosodic realization.

Table 3. Pitch parameter.

|                           | Normality test | One Way ANOVA     |
|---------------------------|----------------|-------------------|
| Average Fo in the utterance|                |                   |
| Male character group      | Passed         | No significant differences |
| Female character group    | Passed         |                   |
| Maximum Fo level in the utterance |            |                   |
| Male character group      | Passed         | Significant differences |
| Female character group    | Not passed     |                   |
| Minimum Fo level in the utterance |                |                   |
| Male character group      | Not passed     | Significant differences |
| Female character group    | Passed         |                   |
| Fo variation in the utterance |              |                   |
| Male character group      | Passed         | Significant differences |
| Female character group    | Not passed     |                   |

Pitch characteristics behave differently. Average Fo in the utterance does not show any significant differences within and between groups of male and female characters. Maximum Fo data shows significant differences between female characters of different age and minimum Fo data shows significant differences of the same kind in the group of male characters. Fo variation in the utterance reveals significant differences caused by the age factor in the group of female characters. One Way ANOVA test shows that these parameters are actualized by members of two groups differently.

Conclusions

Preliminary results of the survey show that we can distinguish two types of intonation markers that can act as reference points in intonation patterns of acted speech. can be distinguished. Intonation markers of the first type perform the function of male/female speech differentiators. The stereotype states that female voices are higher [7] which is explained by physiological peculiarities [19,20,21]. It has found its expression through statistically significant variation of maximum and minimum levels of Fo in the utterance and through the parameter of maximum intensity level in the utterance perceived as maximum loudness. Intonation markers (duration of the utterance, maximum intensity level in the utterance, maximum Fo in the utterance, minimum Fo in the utterance, Fo variation in the utterance) appear to have statistically significant variations, being gender-specific in their usage. In all probability, what serves as reference points are not only qualitative values, but correlations between maximum, minimum and average Fo levels in the utterance; and maximum, minimum and average intensity levels in the utterance, that being the task for further investigation. Intonation markers of the second type (average syllable duration, tempo, average intensity level in the utterance, minimum intensity level in the utterance, intensity range, average Fo) appear to have statistically insignificant variations, thus being used by representatives of both genders similarly, forming overlapping spheres in the gender opposition. One of stereotypes, which has not been confirmed by the results of the present survey, is a belief that females speak faster than males [22]. Temporal qualities pertaining to the speed of speech, namely average syllable duration and tempo, do not show significant variations in speech of male and female characters. This stereotype may appear to be conditioned by situational circumstances. The variation of average Fo and average intensity levels, minimum intensity level and intensity range in the utterance is statistically insignificant, which is not consistent with the stereotype stating that female speech is believed more emotional and
expressive [23,24] which is expected to be expressed with the help of loudness and voice pitch. These parameters form overlapping prosodic features belonging to both groups. The research has shown that louder and faster speech can no longer be considered characteristic of females rather than males. These parameters reveal a fuzzy area in the gender opposition according to which homo loquens cannot be identified either as a male or a female in acted speech. Thus, the results of the current study in the interface of gender studies, phonology and fuzzy logic theory suggest that gender opposition realized through intonation patterns of acted speech represent fuzzy sets with overlapping areas in which prosodic parameters do not fulfil differentiating functions.

Although further investigation is required to gain a more complete understanding of male/female category memberships and gender opposition both as a clear-cut binary opposition and a fuzzy set, our findings in male and female prosody in acted speech challenge some common beliefs about gender-specific intonation patterns.

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