A Study of the Relationship between Acoustic Features of "bæle" and the Paralinguistic Information

Dr. B. Alinezhad

Assistant Professor, Dept. of Linguistics
Isfahan University
email: batool_alinezhad@yahoo.com

Abstract

Language users benefit from special phonetic tools in order to communicate linguistic information as well as different emotional aspects and paralinguistic information through daily conversation. Having functions in conveying semantic information to listeners, prosodic features form the essential part of linguistic behavour, manipulating them potentially can play an important role in transmitting paralinguistic information.The importance of such a manipulation is so great that the utterance can convey completely opposite meanings.

This paper aims at studying how prosodic and intonational patterns are organized in Persian in order to regulate the non-linguistic information in speech and what relations can be statistically found between different emotions such as agreement, surprise and objection and acoustic features of "bæle" in deferent contexts. Statistical results show that duration is the most effective acoustic correlate followed by pitch and intensity respectively to carry paralinguistic information.

1. Introduction

If interpersonal communication is to be divided into verbal and non-

verbal communication (Laver, 1994: 16) it is the latter i.e. non-verbal communication which encompasses paralinguistic information which is the concern of this paper. Language is a system that unites the vast systems of concepts, emotional states and phones which have inherent prosodic features. Every phonetic unit has its own inherent prosodic properties which are affected as a result of the contiguous phonological context. In this case, these features are considered as linguistic behaviors and are involved in the transition of semantic information. By changing the phonetic characteristics of speech sounds however, language users may add to their speech some non-verbal information such as surprise, objection, complaint, assurance and agreement. These characteristics function as paralinguistic behaviors and have pragmatic functions (Laver, 1994: 14). In other words, prosodic features such as pitch, duration and intensity change their nature due to the influence of context and different types of speech and may contain different meanings. The importance of these prosodic features is that in an utterance, they draw attention even more than syntactic features. Lyons (1995: 21) believes that prosodic features like pitch and duration are imposed on linguistic features as paralinguistic so that communication purposes are arrived at. Lyons (1995 : 61) considers prosodic features as paralinguistic features which contribute to the conveyance of meaning in communication. He assumes these features to be like other paralinguistic features such as body gestures, eye movement and the like. At the same time, among different prosodic features, he takes pitch to be pivotal and introduces the function of these features as a kind of paralinguistic behavior. The purpose of this paper is to find a statistical relationship between phonetic characteristics of sounds and the expression of emotions and opinions through them in Persian language.

2. Review of Literature

Studies on the analysis of speech production and speech perception have been very tacit and peripheral. More attention has been paid to the relation between syntactic categories and prosodic aspects of speech as well. In most of the studies, the utterances were viewed impressionistically and tangibly.

Perhaps the oldest works on both linguistic and non-linguistic information have been done by Ladefoged and Bradbent (1957) and Abrecrombi (1967). They believe that speech sounds consist of not only linguistic information, but also indexical non-linguistic information which relates to the personal features of the speaker such as sound quality, sex, age, accent, and emotional and social factors.

From then on, the studies were progressed through instrumental and phonological methods. The purpose of the former method (instrumental method) is the distinction and measurement of acoustic symbols interfering in the manner of articulation in rhythmic groups such as frequency, intensity and duration of the sounds. They emphasized the relationship between specific syntactic-pragmatic concepts and acoustic symbols. In phonological method, stress and pitch were considered responsible for phonological features, i.e. a highlighted word in the utterance was distinguished by its stress and pitch on a specific syllable. Bolinger (1980), Eslami (1379/2000 & 1384/2005), Eslami and Bijankhan (1381/2002).

Among studies which brought into focus the transformation of paralinguistic information and message transmission which had prosodic variable values, those of Ladd (1996), Mozziconacci (1998), Shirer (1995 & 2005), Chafe (2002), Tickle (1990) and Brazil (1997) are worth mentioning. Ladd (1996) considers fundamental frequency and sound quality as interfering factors in the manifestation of all kinds of emotions and feelings. Mozziconacci (1998) surveyed six senses (anger, sadness, fear, happiness, satisfaction and disappointment) in Dutch language and observed a correlation between pitch curve, pitch amplitude and sound intensity in the beginning and end of the utterances. Scherer (1995) has obtained the same results in Dutch and Hungarian languages. Ladd (1996) regards sound intensity, sound duration and sound quality as interfering. Chafe (2002), with an acoustic phonological view, finds the LH pitch in the beginning and end of the utterances in relation with an abstract formation process and also indicates the fundamental frequency augmentation from the basic line. For the reason, he sees the prosodic articulation as a comparable and gradable phenomenon and believes that the amount of excitement, opposition and

novelty of the message has a sided correlation with phonological keys such as fundamental frequency, sound duration, sound quality and speech rate. Mory and Arnot (1993) examined ways of showing emotion in artificial speech.

However, research in this domain in Persian language is scarcely investigated. Alinezhad (1382/2003) conducted a case study using instrumental method on acoustic features of /bæle/. He found a relation between different beliefs and emotions as paralinguistic information and prosodic keys of duration, pitch level and pitch pattern and amplitude. He measured them in various utterances. Alinezhad and Veisy (1386/2007), with an acoustic phonological view, have scrutinized some short Persian utterances which were displayed with different feelings and came to the similar conclusions. This paper, with an instrumental view, tries to look for the clarification of whether or not there is a statistically significant correlation between different kinds of feeling in /bæle/ and its vowel prosodic features

In this study, three variables of vowel duration, low and high pitch, and the intensity of the sound wave of the vowel /æ/ in the first syllable and the vowel /e/ in the second syllable of "bæle" in eight different contexts are measured so that the relationship between phonological features and the semantics of para-linguistics is identified statistically. It is worth noticing that it is only in spontaneous and natural utterances in which we can witness the transfer of complicated emotions emerging in our everyday life.

3. Method

Confirming some linguists' ideas such as Campel (1996) believing that complicated feelings which emerge in real life are only observable in spontaneous and natural talk. However, we should admit that statistical examination of similar utterances uttered in a natural context is impossible. Therefore, the data for this research has been collected by making such contexts. The data collection procedure of this study is based on Mozziconacci (1998) research. In this article, as in Alinezhad's paper (1382/2003), "bæle" as one of the most frequently used utterances is

examined. However; four of the contexts which seemed to be similar to the previous one were ignored and only eight contexts were investigated. After verifying the contexts, eight 19-24 year old university students (4 boys and 4 girls) uttered the required data. To do this, the intended situation and context was explained to them and they were asked if they were in such a situation, how would they pronounce these data. After repeating the data several times, the most natural ones were put to examination. To collect the most natural data, the utterances were played for some other students and they chose the most natural ones. Besides, the listeners were asked to mention what they think the utterance conveys semantically and pragmatically. Finally, the utterances which almost all of them agreed upon were chosen. Because there were a few samples and many tests and the comparison was done between pairs, Wilcoxon's test was utilized for statistic analysis. As mentioned before, vowel duration, pitch, and intensity of the two vowels are the dependant variables the changes of which are examined with their different meanings. Therefore, the mean of duration, intensity, and pitch of /æ/ and /e/ in different utterances of /bæle/ in eight contexts were the samples and the participants were eight. All the data were recorded on a Laryngograph Microprocessor and converted by the Speech Studio software in the Phonetics laboratory of Isfahan University, at 16000Hz sampling rate, two channel recording, 12dB background noise, dynamic range of 64dB and 16 bits resolution.

4. Data Analysis

It is worth mentioning that sample (1) in which "bæle" has a positive lexical meaning and is paralinguistically neutral is the base against which the comparison is done, and the increase or the decrease of phonetic characteristics of /æ/ in the first syllable and /e/ in the second syllable of /bæle/ in the other seven samples were compared to the neutral case. Furthermore, this statistical comparison was done in binary groups of data. The purpose is to find the correlation between all of the data.

The significance level is set to be less than 0.05 and is shown in the related tables by an asterisk (*), yet the comparison between all the data will

not be the topic discussion. In this paper, we will limit our study comparing all the data with the initial data. In the case of /æ/ and /e/, the null hypothesis and the counter hypothesis are considered with regard to the three variables duration, intensity and pitch followed by descriptive and inferential statistics. Finally, a diagram of the average of the phonetic features of /æ/ and /e/ in all the data will be exhibited.

The eight versions of "bæle" and their paralinguistic features are shown in the table below.

Table 1: Analyzed data and their paralinguistic meanings.

No.	Data	Meanings conveyed
1	Wife: Did you buy meat? Husband: "bæle"	Positive response, paralinguistic meaning: Neutral and normal
2	First: Excuse me, what time is it? Second: "bæle"?	Not noticing the answer and asking a question.
3	Students: Excuse me, I had a question. Professor: "bæle"	Agreed to ask his/ her question
4	Teacher: Did you understand? Student: "bæle"	Fully confirmed.
5	Lady on the phone: "bæle", go ahead. Second: hello, are you Ok?	Waiting for response
6	Sun: Mom, buy this for me. Mom: "bæle"? What did you say?	Question did objection, lack of waiting
7	First: I want to go abroad. Second: "bæle", do you understand what you are saying?	Surprised and lack of waiting
8	First: By the way, did you do that job? Second: of course I did ("bæle")	Confirmed without hesitation

In what follows, the relationship between the phonetic characteristics of duration, intensity and pitch of the vowels in the two syllables of "bæle" and their paralinguistic features will be individually examined.

4.1 Duration and paralinguistic meaning.

A- *Null hypothesis* about the duration of /æ/: The duration of /æ/ is the same in all paralinguistic meanings

Counter hypothesis: There is at least one case in which the duration of /æ/ in paralinguistic meanings are not the same.

The descriptive statistics if the duration of /æ/ in the utterance is provided in the table below.

Table 2: Descriptive statistics, duration of the vowel /æ/

Duration of /æ/	N	Minimum	Maximum	Mean	Std. Deviation
D1	8	.141	.223	.17375	.027499
D2	8	.087	.125	.10788	.015570
D3	8	.110	.236	.16562	.044055
D4	8	.438	.760	.66313	.105102
D5	8	.118	.147	.13275	.011158
D6	8	.082	.148	.11237	.026148
D7	8	.104	.220	.14050	.037271
D8	8	.147	.420	.26563	.086360
Valid N (listwise)	8				

The result of the test in which the relation between the duration of /æ/ and the paralinguistic meaning was analyzed is given in table (3).

Table 3: Statistics of the duration of /æ/:

Number of test	1	2	3	4	5	6	7
2	Z=-2/521 Sig=/012*						
3	Z=-.420 Sig=./67	Z=-2/240 Sig=/025*					
4	Z=-2/521 Sig=/012*	Z=-2/521 Sig=/012*	Z=-2/521 Sig=/012*				
5	Z=-2/380 Sig=/017*	Z=-2/240 Sig=/025*	Z=-1/680 Sig=/093	Z=-2/524 Sig=/012*			
6	Z=-2/521 Sig=/012*	Z=-/700 Sig=/484	Z=-2/103 Sig=/035*	Z=-2/521 Sig=/012*	Z=-1/680 Sig=/093		
7	Z=-2/240 Sig=/025*	Z=-2/316 Sig=/021*	Z=-1/120 Sig=/263	Z=-2/521 Sig=/012*	Z=-/070 Sig=/944	Z=-2/366 Sig=/018*	
8	Z=-2/100 Sig=/036*	Z=-2/521 Sig=/012*	Z=-2/380 Sig=/017*	Z=-2/521 Sig=/012*	Z=-2/521 Sig=/012*	Z=-2/521 Sig=/012*	Z=-2/240 Sig=/025*

As it is observed, seven data have been compared in the second column in paralinguistic meanings with the first data being neutral paralinguiatically. The difference among all the data except the first and the third ones is significant. So, the null hypothesis is rejected and the duration of /æ/ is significant. The analysis has been done two by two between the data. The exciting point is that in most cases, the difference is significant statistically. The cases in which the difference is not significant has been darkened.

B: *Null hypothesis* about the duration of /e/: The duration of /e/ is the same in different paralinguistic meanings.

Counter hypothesis: There is at least one case in which the duration of /e/ in paralinguistic meanings is not the same as others.

The following table shows the descriptive statistics of the duration of /e/:

Table 4: Descriptive statistics of the duration of /e/:

Duration of /e/	N	Minimum	Maximum	Mean	Std. Deviation
D1	8	.071	.170	.10300	.031496
D2	8	.201	.367	.26125	.052320
D3	8	.127	.274	.18863	.048228
D4	8	.126	.264	.20475	.046729
D5	8	.057	.267	.17450	.070486
D6	8	.186	.422	.28062	.085884
D7	8	.255	.587	.40312	.099989
D8	8	.099	.332	.18238	.080486
Valid N (listwise)	8				

The result of the test in which the relation between the duration of /e/ and the paralinguistic meaning was analyzed is given in the following table.

Table 5: Statistics of the duration of /e/:

Number of test	1	2	3	4	5	6	7
2	Z=-2/521 Sig=/012*						
3	Z=-2/521 Sig=/012*	Z=-2/100 Sig=/036*					
4	Z=-2/521 Sig=/012*	Z=-1/540 Sig=/123	Z=-/840 Sig=/401				
5	Z=-2/380 Sig=/017*	Z=-2/100 Sig=/036*	Z=-/560 Sig=/575	Z=-1/400 Sig=/161			
6	Z=-2/521 Sig=/012*	Z=-/980 Sig=/327	Z=-1/540 Sig=/123	Z=-1/820 Sig=/069	Z=-2/100 Sig=/036*		
7	Z=-2/521 Sig=/012*	Z=-2/521 Sig=/012*	Z=-2/380 Sig=/017*	Z=-2/380 Sig=/017*	Z=-2/380 Sig=/017*	Z=-2/521 Sig=/012*	
8	Z=-2/521 Sig=/012*	Z=-2/100 Sig=/036*	Z=-/280 Sig=/779	Z=-/840 Sig=/401	Z=-/560 Sig=/575	Z=-1/680 Sig=/093	Z=-2/521 Sig=/012*

According to the test which was done on the relation between the duration of /e/ and the paralinguistic meaning, the null hypothesis was refuted and there is a significant relation between the duration of this vowel and the paralinguistic meaning. However, this relation is less in the correlation between the data. The average of the duration of /æ/ and /e/ among all of the data is shown in the figure below.
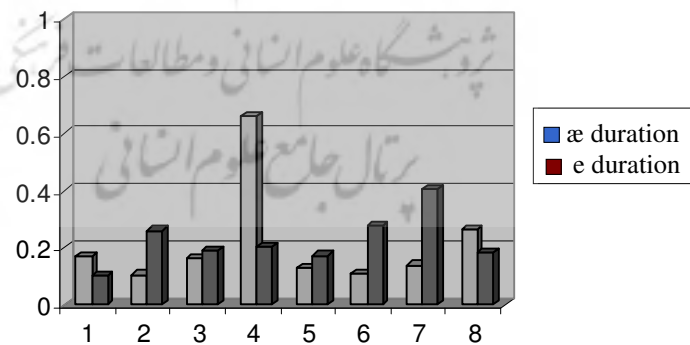

Figure 1: Aaverage of the duration of the two vowels in the eight examined samples

4.2 Intensity and paralinguistic meanings

A- *Null hypothesis* about the intensity of /æ/: The intensity of / æ / is the same in different paralinguistic meanings.

Counter hypothesis: There is at least one case in which the intensity of /æ/ in paralinguistic meanings is not the same as others.

The following table shows the descriptive statistics of the intensity of /æ/ in " bæle ":

Table 6: Descriptive statistics of the intensity of /æ/

Intensity of /æ/	N	Minimum	Maximum	Mean	Std. Deviation
I1	8	69	85	76.00	5.606
I2	8	69	85	76.38	4.955
I3	8	68	78	73.25	3.576
I4	8	68	84	75.75	6.431
I5	8	70	84	76.75	5.800
I6	8	70	81	77.38	3.623
I7	8	69	83	77.13	5.276
I8	8	69	85	77.00	5.581
Valid N (listwise)	8				

The results of the relationship between the intensity of /æ/ and paralinguistic meaning are shown in the table below:

Table 7: Statistical results of the intensity of /æ/

Number of test	1	2	3	4	5	6	7
2	Z=-1/033 Sig=/302						
3	Z=-1/827 Sig=/068	Z=-2/124 Sig=/034*					
4	Z=-/424 Sig=/671	Z=-/351 Sig=/726	Z=-1/364 Sig=/172				
5	Z=-/142 Sig=/887	Z=-/212 Sig=/832	Z=-1/973 Sig=/049*	Z=-1/054 Sig=/292			
6	Z=-/984 Sig=/325	Z=-1/279 Sig=/201	Z=-2/527 Sig=/012*	Z=-/983 Sig=/326	Z=-/344 Sig=/731		
7	Z=-/702 Sig=/438	Z=-/422 Sig=/673	Z=-2/379 Sig=/017*	Z=-/771 Sig=/441	Z=-/254 Sig=/799	Z=-/318 Sig=/75	
8	Z=-/861 Sig=/389	Z=-/738 Sig=/461	Z=-2/536 Sig=/011*	Z=-/914 Sig=/361	Z=-/141 Sig=/888	Z=-/256 Sig=/79	Z=-/255 Sig=/799

As can be seen, there is no difference between the initial data and the rest of the data; therefore, the null hypothesis is confirmed. The intensity of

/æ/ does not interfere with the transition of meaning. Moreover, the dual study of the data revealed that in many cases there was no significant difference statistically.

B. *Null hypothesis* about the intensity of /e/: The intensity of /e/ is equal in all paralinguistic meanings.

Counter hypothesis: There is at least one case in which the intensity of /e/ is not the same in paralinguistic meaning.

The descriptive statistics for the intensity of /e/ is provided in the table given below.

Table 8: Descriptive statistics related to the intensity of /e/

Intensity of /e/	N	Minimum	Maximum	Mean	Std. Deviation
I1	8	65	79	69.25	5.285
I2	8	69	82	73.25	4.132
I3	8	65	76	69.50	4.106
I4	8	69	83	73.88	5.489
I5	8	67	79	73.50	4.309
I6	8	63	78	73.00	5.155
I7	8	68	80	74.25	4.559
I8	8	65	76	70.25	3.615
Valid N (listwise)	8				

The result of the test on the relation between the intensity of /e/ and paralinguistic meanings is shown in table (9).

Table 9: Statistical result of the intensity of /e/:

Number of test	1	2	3	4	5	6	7
2	Z=-2/395 Sig=/017*						
3	Z=-0/213 Sig=/831	Z=-2/379 Sig=/017*					
4	Z=-1/609 Sig=/108	Z=-0/271 Sig=0/78	Z=-1/897 Sig=/058				
5	Z=-2/254 Sig=/024*	Z=-0/339 Sig=/734	Z=-2/536 Sig=/011*	Z=-0/211 Sig=/83			
6	Z=-1/612 Sig=/107	Z=/000 Sig=1/00	Z=-1/832 Sig=/067	Z=-0/736 Sig=/462	Z=-0/170 Sig=/865		

Number of test	1	2	3	4	5	6	7
7	Z=-2/527 Sig=/012*	Z=-1/065 Sig=/287	Z=-2/533 Sig=/011*	Z=-0/170 Sig=/86	Z=-1/200 Sig=/230	Z=-1/063 Sig=/288	
8	Z=-0/680 Sig=/497	Z=-2/375 Sig=/018 *	Z=-0/791 Sig=/429	Z=-1/572 Sig=/116	Z=-2/254 Sig=/024 *	Z=-1/378 Sig=/168	Z=-2/371 Sig=/018 *

As it is observed, the intensity of /e/ in the second, fifth and seventh data is significant in contrast to the first one. So, our null hypothesis is refuted. In addition, the dual analysis of the data shows that the difference is not statistically significant in most conditions.

The graph for the average of the acoustic features of /æ/ and /e/ is shown below:
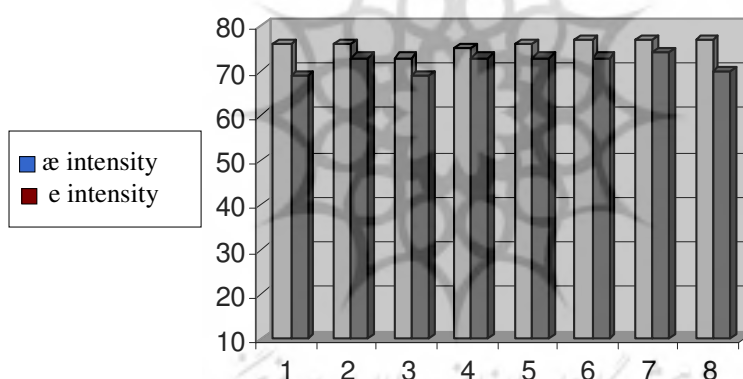
Figure 2: Average of the prosodic features of the vowels

4.3 Pitch and paralinguistic meanings

A. *Null hypothesis* about the pitch of /æ/: The pitch of /æ/ is similar in paralinguistic meanings.

Counter hypothesis: There is at least one case in which the pitch of /æ/ in paralinguistic meanings is not the same.

The following table shows the descriptive statistics of the pitch of /æ/ in "bæle":

Table 10: Descriptive statistics of the pitch of /æ/:

Pitch of /æ/	N	Minimum	Maximum	Mean	Std. Deviation
P1	8	108	232	166.38	47.692
P2	8	95	227	171.00	51.105
P3	8	88	233	164.88	53.220
P4	8	110	227	171.13	42.512
P5	8	102	220	169.50	48.291
P6	8	97	247	174.88	51.435
P7	8	135	227	184.75	33.661
P8	8	132	326	212.50	74.938
Valid N (listwise)	8				

The result of the test which was done to get the relation between the pitch of /æ/ and paralinguistic meanings is shown in table (11).

Table 11: Statistical result of the pitch of /æ/:

Number of test	1	2	3	4	5	6	7
2	Z=-1/051 Sig=0/293						
3	Z=-0/280 Sig=/779	Z=-1/053 Sig=/292					
4	Z=-0/560 Sig=/575	Z=-0/169 Sig=/866	Z=-0/701 Sig=/483				
5	Z=-0/983 Sig=/326	Z=-0/702 Sig=/483	Z=-1/260 Sig=/208	Z=-0/210 Sig=/83			
6	Z=-2/033 Sig=/042*	Z=-0/912 Sig=/362	Z=-1/680 Sig=/093	Z=-0/280 Sig=/77	Z=-1/192 Sig=/233		
7	Z=-1/404 Sig=/160	Z=-0/911 Sig=/362	Z=-1/260 Sig=/208	Z=-1/400 Sig=/161	Z=-1/192 Sig=/233	Z=-/338 Sig=/73	
8	Z=-2/521 Sig=/012*	Z=-2/521 Sig=/012*	Z=-2/521 Sig=/012*	Z=-2/521 Sig=/012*	Z=-2/524 Sig=/012*	Z=-2/366 Sig=/73	Z=-1/260 Sig=/208

As it is shown, there is a significant difference between the pitch of data (6) and (8) and the first one. Hence; the null hypothesis is refuted and the pitch of /æ/ is meaningful. Furthermore, the two by two analysis reveals that in most of the cases the difference is not statistically significant.

B- *Null hypothesis* about the pitch of /e/: The pitch of /e/ is the same in

different paralinguistic meanings.

Counter hypothesis: there is at least one case in which the pitch of /e/ in paralinguistic meanings is not the same as others.

Descriptive statistics for the pitch of /e/ given in the following table.

Table 12: Discriptive statistics of the pitch of /e/:

Pitch of /e/	N	Minimum	Maximum	Mean	Std. Deviation
P1	8	85	258	153.63	59.332
P2	8	111	279	212.63	63.049
P3	8	103	248	177.25	55.672
P4	8	110	247	177.75	52.706
P5	8	114	261	190.63	61.064
P6	8	120	337	231.00	66.294
P7	8	156	276	214.25	45.890
P8	8	83	231	170.63	48.187
Valid N (listwise)	8				

Based on the result of the test, the following table shows the relationship between the pitch of /e/ and paralinguistic information.

Table 13: Statistical results of the pitch of /e/:

Number of test	1	2	3	4	5	6	7
2	Z=-2/521 Sig=/012*						
3	Z=-1/992 Sig=/046*	Z=-2/521 Sig=/012*					
4	Z=-1/542 Sig=/123	Z=-2/380 Sig=/017*	Z=-0/140 Sig=/888				
5	Z=-1/893 Sig=/058	Z=-2/100 Sig=/036*	Z=-1/120 Sig=/263	Z=-1/402 Sig=/161			
6	Z=-2/380 Sig=/017*	Z=-1/260 Sig=/208	Z=-2/521 Sig=/012*	Z=-2/313 Sig=/021*	Z=-2/103 Sig=/035*		
7	Z=-2/521 Sig=/012*	Z=-0/491 Sig=/623	Z=-1/680 Sig=/093	Z=-1/540 Sig=/123	Z=-1/260 Sig=/208	Z=-0/421 Sig=/674	
8	Z=-0/840 Sig=/401	Z=-2/380 Sig=/017*	Z=-0/280 Sig=/779	Z=-0/491 Sig=/624	Z=-1/521 Sig=/128	Z=-2/521 Sig=/012*	Z=-1/820 Sig=/069

As observed, the difference between the four data and the initial data is meaningful. Thus, the null hypothesis is refuted. In addition, the dual analysis of all the data demonstrates that in most cases there is no meaningful difference. The graph for the average of the pitch of the vowels is shown here.
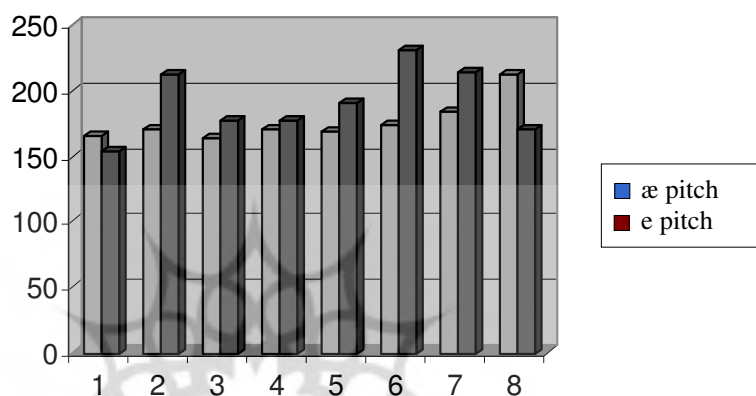

Figure 3: Average of the pitch of the two vowels

5. Analysis of Each Individual Set of Data:

In the previous section, the change of the phonetic characteristics of duration, intensity and pitch in the vowels of "bæle" and their paralinguistic meanings was analyzed. In this part, collected statistical information about duration, intensity and pitch will be individually extracted and a sample spectrum will be presented.

Data one: It was said that we consider data one which has positive meanings as neutral paralinguistically and then based on that we evaluate the rest of the data. The average of acoustic features of /æ/ and /e/ are shown below:

Table 14: The average of acoustic features of the vowels in data one:

	Vowel /æ/	Vowel /e/
Duration (1/1000 second)	0/173	0/103
Intensity (Decibel)	76	73
Pitch (Hertz)	166	153
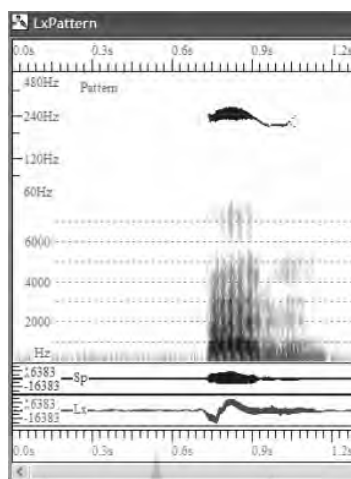
Figure 4: Sample of data one - a 22 year old girl.

Data two: "bæle" is used with the paralinguistic meaning of "not understanding and asking". The investigation reveals that: A) there is significant relation between the duration of /æ/ and the paralinguistic meaning. B) There is no significant relation between the intensity of /æ/ and the paralinguistic meaning, but there is a significant difference between the intensity of /e/ and paralinguistic meaning. C) There is no significant relation between the pitch of /æ/ and the paralinguistic meanings. However, considering /e/, there is a meaningful relation between its pitch and the paralinguistic meanings.

Table 15: The average of acoustic features of the vowels in data two:

|	Vowel /æ/	Vowel /e/
Duration (1/1000 second)	0/107	0/261
Intensity (Decibel)	76	72
Pitch (Hertz)	171	212
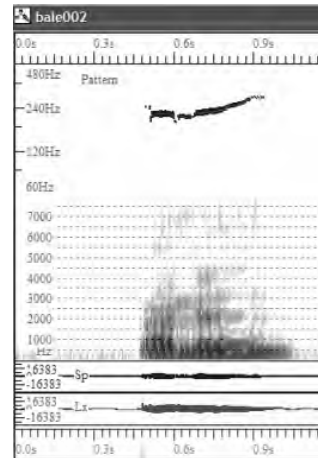
Figure 5: Sample of data two - a 24 year old girl.

Data three: "bæle" is used with the paralinguistic meaning of "agreement and continuation of speech". The investigations show that: A) there is no significant relation between the duration of /æ/ and the paralinguistic meaning. However; there is such a relation between the duration of /e/ and the paralinguistic meaning. B) There is no significant relation between the intensity of /æ/ or /e/ and the paralinguistic meaning. C) There is no significant relation between the pitch of /æ/ and the paralinguistic meanings, but considering /e/ there is a meaningful relation between its pitch and the paralinguistic meanings.

Table 16: Average of the prosodic features of the vowels in data three

	Vowel /æ/	Vowel /e/
Duration (1/1000 second)	0/165	0/188
Intensity (Decibel)	72	69
Pitch (Hertz)	164	177
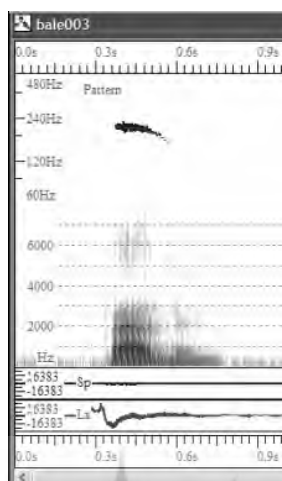
Figure 6: Sample of data three - a 24 year old girl

Data four: "bæle" is used with the paralinguistic meaning of "complete agreement":

Statistical analysis reveals that a. There is a meaningful relationship between the duration of /æ/ and the paralinguistic meaning, b. There is not such a relationship between the intensity of /æ/ and /e/ and their paralinguistic meanings, c. Neither is there a relationship between the pitch of /æ/ and /e/ and paralinguistic meaning.

Table 17: Average of the phonetic characteristics of the vowels in data 4

	Vowel /æ/	Vowel /e/
Duration (1/1000 second)	0/663	0/204
Intensity (Decibel)	75	73
Pitch (Hertz)	171	177
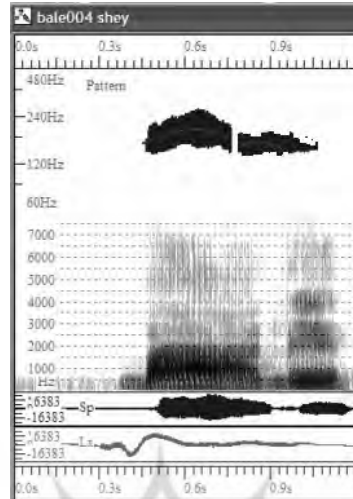
Figure 7: Sample spectrum of data 4- 24 year old girl:

Data 5: here, "bæle" has been used so as to mean 'waiting for reply". Statistical analysis uncovers that a. there is a meaningful relationship between the duration of /æ/ and the paralinguistic meaning, b. There is no such a relationship between the intensity of/æ/ and /e/ and their paralinguistic meanings, c. Neither is there a relationship between the pitch of /æ/ and /e/ and paralinguistic meaning.

Table 18: Average of the phonetic characteristics of the vowels in data 5.

	Vowel /æ/	Vowel /e/
Duration (1/1000 second)	0/132	0/174
Intensity (Decibel)	76	73
Pitch (Hertz)	169	190
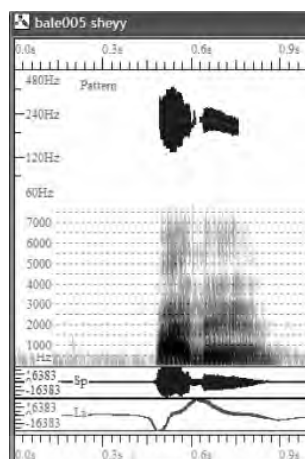
Figure 8: An example of data five - a 22 year old girl

Data six: here, "bæle" has been used to mean 'asking along with objection". Statistical analysis uncovers that a. There is a meaningful relationship between the duration of /æ/ and /e/ and the paralinguistic meaning. b. There is no such a relationship between the intensity of /æ/ paralinguistic meaning. c. There is a significant relation between the pitch of /æ/ and /e/ and their paralinguistic meanings.

Table 19: Average of acoustic features of the vowels in data six:

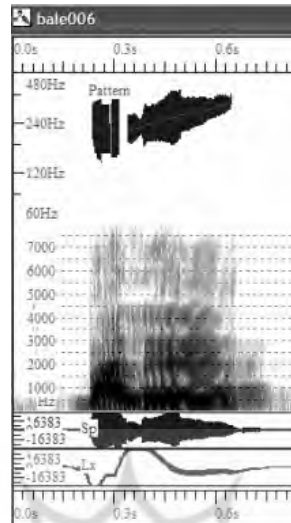|	Vowel /æ/	Vowel /e/
Duration (1/1000 second)	0/112	0/280
Intensity (Decibel)	77	73
Pitch (Hertz)	174	231

Figure 9: Sample of data six - a 22 year old girl

Data seven: "bæle" is used with the paralinguistic meaning of "surprise and unexpectedness". Data analysis displays that:

a. There is a meaningful relation between the duration of /æ/ and /e/ and their paralinguistic meanings. b. There is not any significant relation between the intensity of /æ/ and its paralinguistic meaning, whereas there is a significant difference between the intensity of /e/ and the paralinguistic meaning.

c. There is not a meaningful relation between the pitch of /æ/ and the paralinguistic meanings, whereas there is a significant difference between the pitch of /e/ and the paralinguistic meaning.

Table 20: Average of the prosodic characteristics of the vowels in data seven

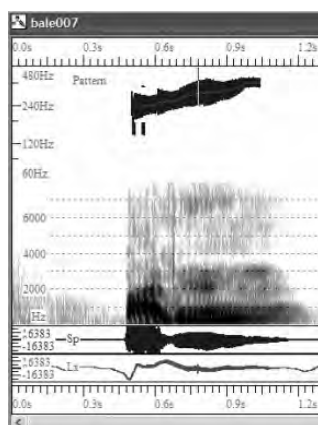|	Vowel /æ/	Vowel /e/
Duration (1/1000 second)	0/140	0/403
Intensity (Decibel)	77	74
Pitch (Hertz)	184	214

Figure 10: Sample of data seven – a 22 year old girl

Data eight: "bæle" is used with the paralinguistic meaning of "doubtless agreement". The results revealed that: a. There exists a significant relation between the duration of /æ/ or /e/ and the paralinguistic meaning. b. There is no significant relation between the intensity of /æ/ or /e/ and the paralinguistic meaning. c. There is a significant relation between the pitch of /æ/ and the paralinguistic meaning, but not with the pitch of /e/.

Table 21: Average of prosodic characteristics of the vowels in data eight

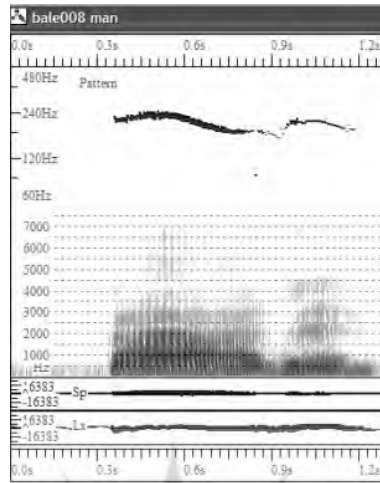|	Vowel /æ/	Vowel /e/
Duration (1/1000 second)	0/265	0/182
Intensity (Decibel)	77	70
Pitch (Hertz)	212	170

Figure 11: Sample of data eight – a 22 year old girl

6. Discussion and Conclusion

The study specified that in the transition of paralinguistic meaning, duration is more important than the other two characteristics and that the phonetic characteristics of /e/ in the second syllable have more effect than /æ/ in the first syllable so that the duration of /e/ in all cases (100%) and that of /æ/ in 85% of the cases was statistically meaningful in the transition of meaning with respect to the neutral case or the lexical form. The null hypothesis was only confirmed in the case of the intensity of /æ/ . In no other cases was this factor responsible; yet, the intensity of /e/ in 42%, the pitch of /æ/ in 28% and the pitch of /e/ in 57% of the cases were effective in transferring paralinguistic meaning. It can thus be concluded that on the whole the phonetic characteristics of the vowel in the second syllable is more responsible than the first syllable and that among the phonetic features, duration and pitch respectively and to a lesser extent intensity is effective in transferring paralinguistic information.

The study also revealed that the scope of the meanings of "bæle" is from absolute agreement to complete objection which is arrived at by a change in the duration, pitch and intensity of its vowels. It is obvious that such studies in greater scopes and with more participants, with larger set of data and other phonetic characteristics like the examination of the extent of

pitch and vowel factors, can be a further step towards the discovery of the nature of paralinguistic information in Persian language.

Reference

Abercrombie, D. (1967). *Elements of general phonetics*. Chicago: University of Chicago Press.

Alinezhad, B. (1384/2005) Bæræsi-ye rabete-ye beyn-e vizhegihay-e ærrozi-ye zæbaan-e farsi væ næghshhyay-e mænzoorshenakhti. (Investigating the relationship between the prosodic features in Persian and their pragmatic functions), *43-44/2*, Fall and Winter, 199-226.

Alinezhad, B. and Veisy, A. (1386/2007). Bæræsi-ye rabete-ye beyn-e vizhegihay-e avashenakhti væ bæyan-e ævatef dær farsi: motaleh-ye mowredi. (Investigating the relationship between the applied acoustic features and the expression of emotions in Persian: A case study), *The 7th Linguistics Conference*, Iran, 143-165.

Bollinger, D. (1980). *Intonation and its uses, melody in grammar and discourse.* Stanford: Stanford University Press.

Brazil, D. (1997). *Communicative value of intonation in English.* Cambridge: Cambridge University Press.

Campbell, W. N. (1996). Synthesizing spontaneous speech, computing prosody, *Springer-Verlag*, 165-186.

Chafe, W. (2002). Prosody and emotion in a sample of real speech. In Fries, P., Cummings, M., Lockwood, D. and Sprueill, W. (Eds.), *Relations and functions within and around language*, London: Continuum, 277-315.

Eslami, M. (1384/2005). *Vaj shenasi: Tæhleel-e nezam-e ahæng-e zæban-e farsi*. (Phonology: The analysis of intonation system in Persian), Tehran: SAMT.

Eslami, M. (1379/2000). Shenakht-e nævaye goftar-e zæbane farsi væ karbord-e an dær bazsazi-e rayanehi goftar. (Recognition of the intaonation of speech in Persian and its application in the computational retreival.) Ph.D. Dissertation, Department of Linguistics, Tehran: Tehran University.

Eslami, M. and Bijan-Khan, M (1381/2002). Nezam-e ahæng-e zæban-e farsi. (Intonation system in Persian), *Journal of Linguistics, 17/2*, 36-61.

Ladd, D. R. (1996). *Intonational phonology*. Cambridge: Cambridge University Press.

Ladfoged, P. and Broadbent, D.E. (1957). Information conveyed by vowels. *Journal of the Acoustical Society of America.* (29), 98-104.

Laver, J. (1994). *Principles of phonetics*. Cambridge: Cambridge University Press.

Lyons, J. (1995). *Linguistic semantics: An introduction*. London: Cambridge University Press.

Mozziconacci, J. J. L. (1998). Speech variability and emotion: Production and perception. *Ph.D. Thesis*. Eindhoven: Technical University.

Murray, I. R. and Arnott, J. L. (1993). Toward the simulation of emotion in synthetic speech: A review of the literature on human vocal emotion. *Journal of the Acoustical Society of America,* (2), 1097-1108.

Scherer, K. R. (1995). Expression of emotion in voice and music. *Journal of Voice, 9,* 235-48.

Scherer, K. R. (2000). Emotional expression: A royal road for the study of behavior control. In *Control of human behavior, mental processes, and awareness,* Grob, A. and Perrig, W. (Eds.), Hillsdale, NJ: Erlbaum, 227-244.

Tickle, A. (1990). Cross-language vocalisation of emotion. methodological issues., *Proceedings of ICPHS 99.* San Francisco, USA, 305-308.