

*Valiyeva G.*

Sumgait State University

## CHARACTERISTICS OF WORD STRESS IN AZERBAIJAN LANGUAGE: EXPERIMENTAL ANALYSIS

*The article reflects the outcomes of a phonetic experiment conducted to determine the acoustic correlate of word stress in the Azerbaijani language based on a small database (62 words). Our acoustic experiment was performed using the speech signal acoustic analysis program Praat (version 5.3.39). Our observations lead to the conclusion that the acoustic parameters that determine word stress should be studied separately and in interaction, taking into account their influence on each other. Clarifying these parameters or parameter combinations are leading in a specific language is one of the important issues. Issues such as the dominance of different acoustic parameters for different languages, their leading, the fact that these parameters have different weights in determining word stress, the fact that stress in some languages cannot be explained by the role of a specific parameter (for example, in the Czech language), the prosody system of each language, language structure and it shows that experimental and statistical researches are necessary in determining both universal and individual characteristics, besides updating the analysis taking into account the typological structure of the language. According to the results of our experiment, the quantity – continuity and intensity of more accented vowels appear as the parameters standing in the dominant position for word stress in the Azerbaijani language. The frequency of the main tone is not the main parameter of stress, but it can be considered as an additional sign of word stress. According to the results of our observation, the existence of the law of vowel harmony does not exclude the presence of accent in the Azerbaijani language. Synharmony and word stress coexist and complement each other.*

**Key words:** *word stress, acoustic analysis, synharmonism, experimental phonetics, stressed syllable.*

Researches delivered in the field of linguistics in modern times are characterized by issues such as the general features of the language structure, the internal regularities of the language, as well as conducting useful researches for the development of applied aspects and speech technologies. Interest in the study of speech activity requires increased attention to specific areas such as segmental and prosodic organization of speech.

Prosodic elements or prosodic features in linguistics mean a set of sound devices that make up the sequence of segment units (phonemes) and serve to transform them into meaningful language units – words, syntagms. The use of internal features such as pitch frequency, intensity, and pitch duration as prosodic features of speech is one of the oldest features of human speech. Intonation-semantic signs of speech, articulation, expression of the communicative type of speech, use of a set of prosodic features for conveying individual emotional meanings can be considered a universal feature for all languages.

One of the most important forms of prosodic features that operate autonomously in language is word stress. Signs, which usually play a prosodic role

and convey important linguistic information, are also actively involved in the transfer of extralinguistic information. As in the case of prosody in general, the formation of parameters in which word stress is expressed is manifested in a number of issues, as well as in word stress, depending on some physiological characteristics. Concurrent factors affecting emphasis should each be kept in focus. Issues such as acoustic parameters of word stress such as intensity, sound continuity, frequency of the main tone, spectral characteristics, their correct determination, and the weight of leading parameters are still in the spotlight today. Research should be conducted on all the parameters that determine the accent, and the typological structure of the language and developmental regularities should be in focus to draw conclusions.

A. Akhundov [1, p. 276–277], who wrote that the main material signs of word stress in the Azerbaijani language are quantitatively long vowel, that the main tone in an accented vowel is higher than other vowels, and that an accented vowel is stronger in terms of intensity [1, p. 276–277], additionally notes that “Azerbaijan the accent in the language ... is

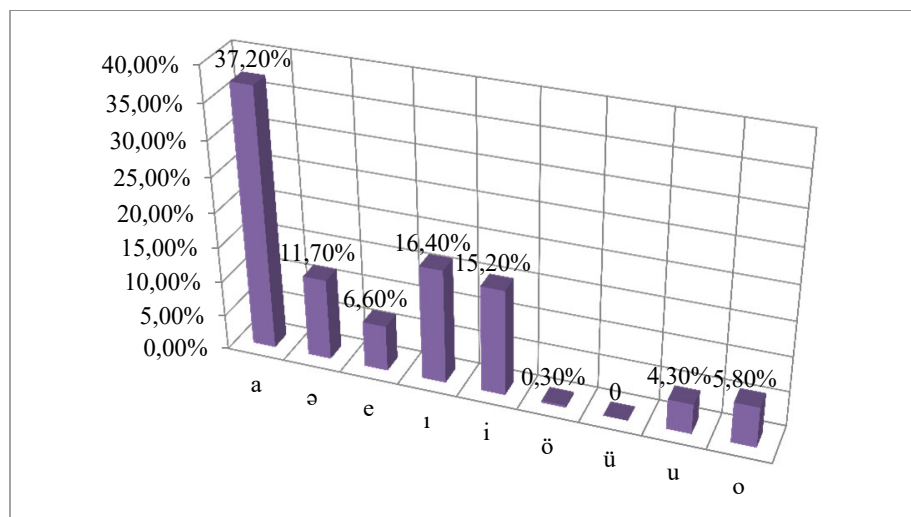
a force accent based on the tension of the muscles involved in pronunciation, and the essence of the accent is not whether the vowel is pronounced long or not. It is about the relatively long pronunciation of vowels of the same gender in the accented syllable” [1, p. 276]. Taking into consideration that word stress in various languages is accompanied by different physical-acoustic parameters, L. Zinder mentions the possibility that the lengthening of the vowel in the stressed syllable may play a secondary role in relation to stress: “... in English, German, a short vowel with a stress is somewhat longer than an unstressed short vowel is distinguished by its presence” [2, p. 297].

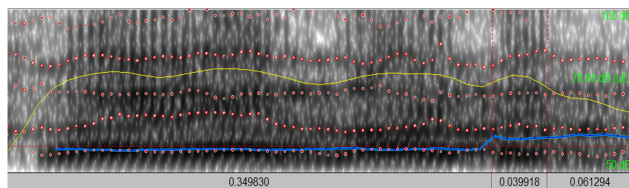
Generally, many problems arise during research on speech prosody, as well as word stress. These are primarily due to the fact that word stress is a fact of voice – live speech, and in this case, various options are more likely to appear. The researcher of prosodic features of speech has to solve such issues as distinguishing linguistic and extralinguistic, segment and supersegment, universal and specific signs. On the other hand, the internal nature of word stress, its physical characteristics, its manifestation in each language with its own characteristics, the fact that it has different nuances depending on the fact of gender, and other such facts make it urgent to study it by comprehensively describing and interpreting it experimentally.

3000 words taken from the “Orthographic dictionary of the Azerbaijani language” were analyzed in order to conduct a statistical study in order to determine the place of word stress in the Azerbaijani language, the position of the accented syllable, functionality, and the possibility of accentuation of various vowels. According to the results of the linguistic statistical study, vowels differ from each other in terms of the possibilities of working in stressed syllables. Some

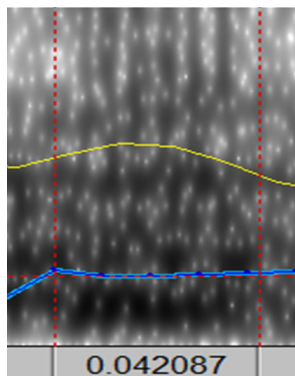
vowels exceed others in terms of the frequency of processing in the stressed syllable.

The accentological typology of the language acts as a special component of the general phonological typology of languages. Word stress has a different functional load in the sound and grammatical structure of the word in different languages. In modern times, the specific features, internal nature, and acoustic quality of word stress in any language are carried out through programs of acoustic analysis of the speech signal. The acoustic experiment we performed on the basis of a small database (62 words) was performed using the speech signal acoustic analysis program Praat (version 5.3.39). Based on experience, the program allowed to pay attention to the qualitative (F1, F2 – formant indicators) and quantitative (time – t) characteristics of vowels, to identify stressed and unstressed syllables in the word in order to monitor changes in the quality of the vowel sound using oscillograms and spectrograms. Amplitude (tone), loudness, length (continuity), etc., are used to determine the stressed syllable. All components are taken into account as quality indicators of vowel sound. Theoretically, the accented syllable is characterized by more muscle tension and therefore leads to a higher pitch, more sustained length and preservation of all the qualities of the vowel sound. However, research has shown that not all of these components are accompanied by the vowel in the stressed syllable. According to the results of studies devoted to the characteristic features of word stress related to different languages, languages are different in terms of vowel accent perception through the predominance of these acoustic features, and this feature has a typological character. The results of our experiment on Azerbaijani language materials confirm these ideas.





Consider our observation on the word “rocks” cut from the speech fragment.

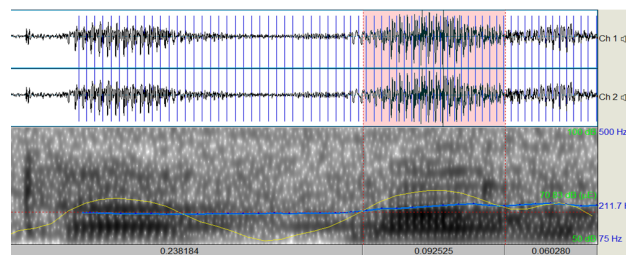


A certain part of extraneous sounds are also added, and when we reach the vowel “i” in this “secdiyimiz” piece, the increase in intensity and the frequency of the main tone and the decrease in intensity when moving to another sound are clearly visible.

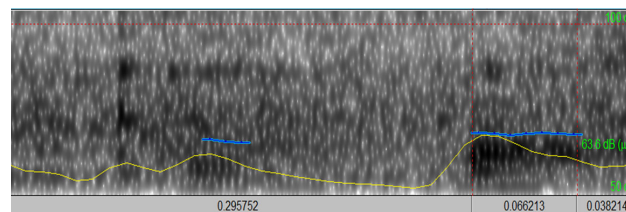
It is known that word stress is not expressed by only one acoustic feature. The frequency, intensity, and duration of the main tone act as correlates of the accented syllable. A stressed syllable differs from other syllables in that it is pronounced more forcefully, which means more physiological effort. During the articulation process, it is observed that the segments in the accented syllable are more continuous, as the more tense pronunciation configuration is observed and the extreme articulatory movements require more time. In this regard, vowel continuity is considered one of the most reliable parameters for determining word stress. According to the results of many studies, the fact that the accented syllable is more stable than the unaccented one for different languages has been confirmed [5, p. 767]. Studies show that in many languages, continuity and intensity are perceived parameters at the same level, and continuity and amplitude can be considered the most reliable of these parameters in determining stress [6, p. 68].

However, it should be taken into account that in addition to high intensity, this intensity appears due to high amplitude in the accented syllable pronounced under a special accent [7, p. 73]. Since the intensity as an acoustic sign implies the addition of special energy in the pronunciation, physiologically the strength related to breathiness, it is more appropriate to look at the intensity together with other physical

parameters, not in isolation, in determining the accent. In fact, intensity does not exclude the accompanying continuity as a sign [8, p. 540; 9, p. 452]. Intensity, which is considered the leading correlate of word stress for some languages, does not act as a stable parameter because it tends to change, but it can act as a factor that causes a syllable to sound stronger despite small differences. The vowel “a” in the accented syllable (maq) in the word “find” is 92 m/s. has durability. And “a” in the unstressed syllable (tap) is 56 m/s. contane.



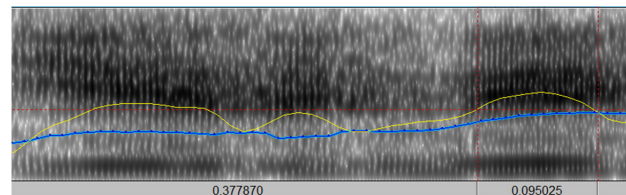
In the spectrogram of the word “to find” in another speech example, we witness a similar picture.



There is no special quality change in formant indicators: F1 – 940 Hz, F2 – 1244 Hz, F3 – 2431 Hz, F4 – 3380 Hz.

In addition to the continuity of vowels in stressed and unstressed syllables, a certain difference in intensity indicators (yellow line) attracts attention: the intensity of the vowel in the stressed syllable is 65 dB, in the unstressed syllable it is 59 dB.

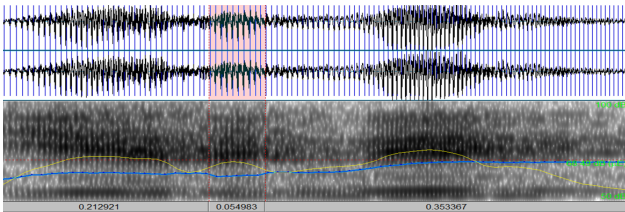
Taking into consideration the mentioned indicators, we decided to repeat the experiment on three-syllable words. Below is the spectrogram of the word “place”.



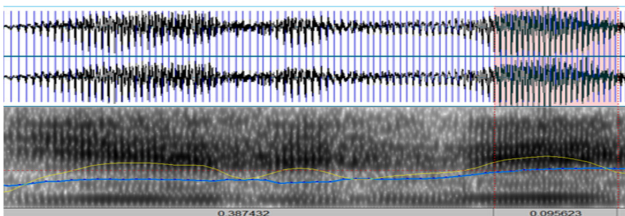
As can be seen, the intensity curve (yellow line) rises during the pronunciation of all three vowels, but since the stressed syllable is the last syllable, the intensity of the vowel in this syllable is higher than the others. Let’s take a look at the table to visualize this:

Yerini	Frequency of the main melody (Hz)	Intensity (db)
Yer(i)ni	183 Hz	68 db
Yerin(i)	234 Hz	74 db

Unstressed |i| in the second syllable in the word “Yerini” vowel duration is 54 m.s.



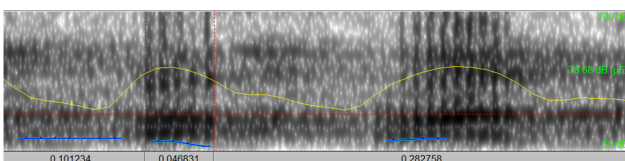
Third – |i| in the stressed syllable the duration of the vowel is 95 m.s.



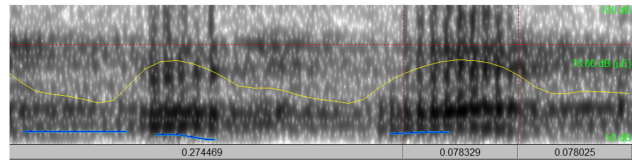
The analysis of the physical characteristics of vowels in stressed and unstressed syllables shows that the parameters that determine stress for the Azerbaijani language are mainly intensity and duration of the vowel. One issue of interest is the quality of the vowel in the stressed syllable. Accented vowels have a full quality, while unaccented vowels usually attract attention because they tend to be pronounced short [5, p. 12]. This fact also confirms that the continuity of the vowel of the accented syllable is greater than the others.

One of the main characteristics of a spectrally “genis” stressed syllable is that it is not affected by coarticulation itself, while it strongly affects adjacent syllables. Thus, the accented syllable retains its “autonomy” while affecting the next syllable and changing the quality of the sounds in it.

In the first syllable of the word “baxmaq”, the unstressed syllable |a| vowel duration is 46 m.s.



Second – stressed syllable |a| and the duration of the vowel is equal to 78 m.s.



In the second (unstressed) syllable in the word “bitenden” is |ə| the duration of the vowel is 86 m.s., in the third (stressed) syllable |ə| the duration of the vowel is 111 m.s.

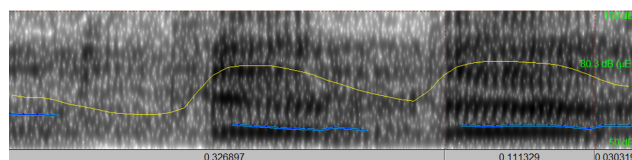
As can be seen in the spectrogram, there is not a big difference in the indicators of FMM. It is interesting that the results of some experiments confirm with facts that the frequency of the main tone, which is usually presented as a strong sign for determining the accent in scientific literature, actually acts as a weak tool [10, p. 1041]. our conclusion is that, unlike some languages, the frequency of the main tone in the Azerbaijani language cannot be evaluated as a marker that determines the stress, so even though there is a slight difference in the FMM of vowels in stressed and unstressed syllables, no special change is noticeable.

In another word, let’s look at the physical indicators of the same vowel in stressed and unstressed syllables:

Baxmaq	Frequency of the main melody (Hz)	Intensity (db)
B(a)xmaq	97 Hz	76 db
Baxm(a)q	111 Hz	82 db

As can be seen from the analysis of physical parameters, the frequency of the main tone of the vowel “a” in the accented and unaccented syllable in the word “look” differs very slightly. A. Akhundov, who wrote that the second of the main material signs of word stress in the Azerbaijani language is that the tone of the vowel in the accented syllable is higher than the tone of the vowels in the unstressed syllables, notes that “... tone is used in different ways as a phonetic term. When we say the tone of stressed syllables, we mean the physical quality of the sound determined by the frequency of the rhythmic vibrations of the stressed vocal cords” [1, p. 277].

Sh.Abdullayev notes that “in two-syllable words with an accented second syllable, the main tone of the accented vowel within the same word is higher than the main tone of the unaccented vowel.” Here, the basic tone of an accented vowel is 160–225, and the basic tone of an unaccented vowel is 100–180 hertz” [3, p. 8].



[ə] in the second and third syllables in the word “bitenden” acoustic indicators of vowels are as follows:

Bitəndən	Frequency (Hz)	Intensity (db)
Bit(ə)ndən	140 Hz	79 db
Bitənd(ə)n	147 Hz	81 db

As can be seen from the examples, although there are differences in FMM and the indicator of intensity, the main indicator of stress for the Azerbaijani language can be considered the continuity of the vowel. Depending on the typological characteristics, the phonetic system of different languages has different development trends, and the differences are also manifested due to the superiority of the physical parameters in which the word stress is expressed. The study of these features is important in terms of creating a correct idea about the structure and development features of the language in general.

The results of our experiment lead to the conclusion that the acoustic parameters that determine word stress should be studied separately and in interaction, taking into account their influence on each other. Clarifying which of these parameters or which parameter combinations are leading in a specific language is one of the important issues. According to the results of the study, while taking into account that continuity is the most reliable parameter in the determination of stress in the Azerbaijani language, we should note that studies with different results

in this regard show the importance of approaching this issue with special sensitivity. Thus, if English, Polish and French languages the frequency of the main tone acts as the leading acoustic correlate in determining the accent [11; 12; 13], in Swedish, Italian and Estonian languages continuity plays a major role as the main correlate [14]. Issues such as the dominance of different acoustic parameters for different languages, their leading, the fact that these parameters have different weights in determining word stress, the fact that stress in some languages cannot be explained by the role of a specific parameter (for example, in the Czech language), the prosody system of each language, language structure and it shows that experimental and statistical researches are necessary in determining both universal and individual characteristics, besides updating the classification taking into account the typological structure of the language. According to the results of our experiment, the quantity – continuity and intensity of more accented vowels appear as the parameters standing in the dominant position for word stress in the Azerbaijani language. The frequency of the main tone is not the main parameter of stress, but it can be considered as an additional sign of word stress.

According to the results of our observation, the functioning of the law of vowel harmony does not exclude the presence of accent in the Azerbaijani language. Synharmony and word stress coexist and complement each other.

#### Bibliography:

1. Akhundov A. Phonetics of the Azerbaijani language, B., Maarif, 1984.
2. Zinder LR. General phonetics. L., 1960.
3. Abdullayev Sh. The nature of word stress in the Azerbaijani language. Scientific works of ASU (language and literature). 1964, No. 5.
4. Martine A. Mechanisms of phonetic changes: Problems of diachronic phonology. M.: КОМКНИГА, 2006.
5. Fry, D. B., “Duration and Intensity as physical correlates of linguistic stress”, J. Acoust. Soc. Am., 27:765–768, 1955.
6. Sereno, J.A. & Jongman, A. (1995). Acoustic correlates of grammatical class. *Language and Speech*, 38(1), 57–76.
7. Sluijter, A. M. C., and Heuven, V. J. van “Effects of focus distribution, pitch accent and lexical stress on the temporal organization of syllables in Dutch,” *Phonetica* 52, 1995. 71–89.
8. Dobrovolsky, Michael. 1999. The phonetics of Chuvash stress: Implications for Phonology. Proceedings of the 15th International Congress of Phonetic Sciences, Barcelona, Spain, 539–542.
9. Lieberman, Ph. 1960. Some acoustic correlates of word stress in American English. *Journal of the Acoustical Society of America* 32, 451–454.
10. Kochanski G., E. Grabe, J. Coleman, and B. Rosner, “Loudness predicts prominence: Fundamental frequency lends little,” *The Journal of the Acoustical Society of America*, vol. 118, no. 2, pp. 1038–1054, 2005
11. Bolinger D. L. “Theory of Pitch Accent in English”, *Word*, vol. 14, pp. 109–149, 1958.
12. Jassem W. J, Morton J, Steffen-Batog M. “The perception of stress in synthetic speech like stimuli by Polish listeners”, *Speech Analysis and Synthesis*, vol. 1, pp. 289–308, 1968.
13. Rigault, A. “Supra segmentals”, In *Lehiste, I*, the M.I.T Press, Cambridge, 1970, pp. 125, 1962.

14. Westin K, Buddenhagen R. G, Obrecht D. H. "An experimental analysis of relative importance of pitch quantity and intensity as cues to phonemic distinctions in southern Swedish", *Language and Speech*, vol. 9, pp. 114–126, 1966.

### **Валієва Г. ХАРАКТЕРИСТИКИ СЛОВОДАРЕНЬ В АЗЕРБАЙДЖАНСЬКІЙ МОВІ: ЕКСПЕРИМЕНТАЛЬНИЙ АНАЛІЗ**

*У статті відображено результати фонетичного експерименту, проведеного для визначення акустичного кореляту словесного наголосу в азербайджанській мові на основі невеликої бази даних (62 слова). Наш акустичний експеримент був виконаний за допомогою програми акустичного аналізу мовного сигналу Praat (версія 5.3.39). Наші спостереження дозволяють зробити висновок про те, що акустичні параметри, що визначають словесний наголос, слід вивчати окремо та у взаємодії, враховуючи їхній вплив один на одного. Уточнення цих параметрів чи поєднань параметрів, які ведуть у конкретній мові, одна із важливих питань. Такі питання, як домінування різних акустичних параметрів для різних мов, їхнє провідне положення, те, що ці параметри мають різну вагу при визначенні словесного наголосу, те, що наголос у деяких мовах не можна пояснити роллю конкретного параметра (наприклад, у чеській мові), систему просодії кожної мови, мовну структуру і показує, що необхідні експериментальні та статистичні дослідження щодо як універсальних, і індивідуальних характеристик, крім актуалізації аналізу з урахуванням типологічної структури мови. За результатами нашого експерименту кількість – безперервність та інтенсивність більш ударних голосних виступають параметрами, що стоять у домінуючому положенні для словесного наголосу в азербайджанській мові. Частота основного тону не є основним параметром наголосу, але може розглядатися як додаткова ознака словесного наголосу. За результатами нашого спостереження наявність закону гармонії голосних не виключає наявності наголосу в азербайджанській мові. Сінгармонія та словесний наголос співіснують та доповнюють один одного.*

**Ключові слова:** словонаголос, акустичний аналіз, сінгармонізм, експериментальна фонетика, ударний склад.