

# THE HIATUS/DIPHTHONG VARIATION IN ROMANIAN. AN ACOUSTIC ANALYSIS OF THE VOWEL SEQUENCES [au]-[aw] AND [ua]-[wa]

MARIANA PREDA<sup>1</sup>

**Abstract.** The study analyzes two opposite current language facts: syneresis and dieresis. The objective of the study is to examine the variation of the pairs [au]-[aw] and [ua]-[wa], in terms of temporal patterns based on data derived from controlled speech. Our results show that, independent of vocalic pair, the duration of the hiatus is significantly longer than that of the diphthong. In the case of the analyzed sequences, the duration of the hiatus /au/ is longer than the duration of the hiatus /ua/. Furthermore, in the case of the diphthong /aw/ it has a longer duration than the diphthong /wa/.

**Keywords:** syneresis, dieresis, hiatus, diphthong.

## 1. INTRODUCTION

This paper<sup>2</sup> focuses on (a) investigating the way in which native Romanian speakers pronounce different vocalic pairs, (b) examining the acoustic and phonological variation of hiatus and diphthong pairs in standard Romanian, and (c) identifying the current tendencies of hiatus pronunciation. These tendencies are represented by two phonetic accidents, *syneresis* and *dieresis*. We begin by defining the two concepts that underlie our research. Syneresis involves the fusion of two vowels in a diphthong or a single vowel (1 and 2), while dieresis refers to “the separation of two vowels that are normally pronounced as a diphthong in the same syllable” (3 and 4).

(1) /realizezi/	[rɛa.li.zɛzʲ]	‘you realize’ (DSL 2005: 480)
(2) /poljomyelitə/	[po.li.o.mi.e.li.tə]	‘poliomyelitis’ (DTG 2023: 569)
(3) /kalejdoskop/	[ka.le.i.do.skop]	‘kaleidoscope’
(4) /fjasko/	[fi.as.ko]	‘fiasco’

Recent research (Niculescu 2015, 2019, 2020) has led to the expansion of the hiatus definition, distinguishing between *internal hiatus* as VV pairs within the word, and *external hiatus* defined as VV pairs across word boundaries. Our current analysis focuses only on internal hiatus, with future studies further examining vocalic sequences at word boundaries (6).

---

<sup>1</sup> Faculty of Letters, University of Bucharest, predamariana8167@yahoo.com.

<sup>2</sup> This study is part of our MA thesis *Sinereza și diereza în limba română actuală* [Syneresis and dieresis in contemporary Romanian], defended on the 6<sup>th</sup> of July 2023, at the Faculty of Letters, University of Bucharest.

- (5) External hiatus (/ka unu/ ‘as one’)  
 (6) Internal hiatus (/autobuz/ ‘bus’)

An important experimental work that should be mentioned is the one undertaken by Chitoran and Hualde (2007). The authors carry out a comparative study between five Romance languages with different degrees of contrast (French, Spanish, Romanian, European Portuguese and Brazilian), through which they highlight the factors that influence the different degrees of variation across diphthong-hiatus acoustic continuum. From their research, diphthongization in Romanian is done under stress after labials and within words, adding initiality effect and proximity to stress.

Syllabification of *iV* sequences in Romance languages is influenced by historical considerations. Historical diphthongs act as attractors for originally heterosyllabic sequences. French and Spanish have converged heterosyllabic sequences with historical diphthongs. Romanian maintains a clear contrast between heterosyllabic sequences and diphthongs. Portuguese generally judges all sequences to be heterosyllabic.

Stefania Marin’s (2014) study *Romanian diphthongs /ea/ and /oa/: an articulatory comparison with /ja/ - /wa/ and with hiatus sequences* focuses on the analysis of the articulatory properties of the typologically rare diphthongs /ea/ and /oa/, found in a contrastive relationship with the corresponding hiatuses and the diphthongs /ja/ and /wa/.

Starting from previous research, it can be stated that the most important difference between the diphthongs /ɕa/ and /qa/ and the diphthongs /ja/ and /wa/ lies, from an articulatory point of view, in the position of the tongue. The difference between the first diphthongs and the corresponding hiatuses lies in the articulation time of the component vowels. Marin (2014) demonstrates that there is evidence that the transition from one vowel to another occurs earlier for /ɕa/ and /qa/ than for /ja/ and /wa/ or for hiatuses. At the same time, the two types of diphthongs assume different positions of the tongue. In phonological terms, the differences lie in the overlaps between vowels.

Our article is organized in four sections: *Introduction, Methodology, Results and discussions* and *Conclusions and future research*, following the introductory and theoretical remarks.

In the next section, we present the stages carried out in order to conduct the experiment. In the third section we present the results, followed by the conclusions in the last section.

## 2. METHODOLOGY

### 2.1. Experimental set-up

In order to examine the various pronunciations employed by native speakers when producing hiatus and diphthong pairs, a sociolinguistic experiment was performed, eliciting controlled speech.

The words in the corpus were manually extracted from the third edition of the *Orthographic, Orthoepic and Morphological Dictionary* of the Romanian language. We considered two hiatus sequences (ascending hiatus /au/ and descending hiatus /ua/) and two diphthong sequences (descending diphthong /aw/ and ascending diphthong /wa/).

The corpus was recorded in a quiet room within the Phonetic Laboratory of the Institute of Linguistics “Iorgu Jordan – Alexandru Rosetti”. We used a B1 microphone and an external M-Audio Fast Track audio interface.

Regarding the composition of the corpus, we wanted to select words within which the analyzed sequences are in different contexts. Our objective was to take into account all three positions in the word (initial, medial and word-final), but also the stress distribution. The sequences /au/ and /aw/ were identified in initial and medial position. Due to phonotactic constraints (Roceric Alexandrescu 1960), the sequence /ua/ was identified only in word-final position, and the sequence /wa/ in medial and final position.

Our experiment involved reading a list of 20 words (see *Table 1*). The list of words was repeated three times by each participant. In addition to the target words, control words were also added to the list.

At the time of developing the experiment, we considered it useful to make a questionnaire to test if the way the speakers pronounce the analyzed sequences corresponds to what they note in the given questionnaire. In the questionnaire, the participants had to divide into syllables words that they also encountered in the experiment.

/au/	<i>aur</i>	/aur/	‘gold’
/au/	<i>austru</i>	/austru/	‘austere’
/au/	<i>autocar</i>	/autokar/	‘coach’
/au/	<i>fault</i>	/fault/	‘fault’
/au/	<i>faulta</i>	/faulta/	‘to foul’
/au/	<i>mausoleu</i>	/mausolew/	‘mausoleum’
/au/	<i>precaut</i>	/prekaut/	‘cautious’
/aw/	<i>augur</i>	/awgur/	‘augur’
/aw/	<i>august</i>	/awgust/	‘august’
/aw/	<i>glaucom</i>	/glawkom/	‘glaucoma’
/aw/	<i>inaugura</i>	/inawgura/	‘inaugurate’
/aw/	<i>traumă</i>	/trawmə/	‘trauma’
/ua/	<i>anual</i>	/anual/	‘annual’
/ua/	<i>papua</i>	/papua/	‘papua’
/ua/	<i>polua</i>	/polua/	‘pollua’
/ua/	<i>vizualiza</i>	/vizualiza/	‘visualize’
/wa/	<i>cuaternar</i>	/kwaternar/	‘quaternary’
/wa/	<i>guacamole</i>	/gwakamole/	‘guacamole’
/wa/	<i>iguană</i>	/iguanə/	‘iguana’
/wa/	<i>ploua</i>	/plowa/	‘rain’

Table 1. *Corpus*

## 2.2. Participants

There were twelve participants in the experiment (6 female and 6 male), aged between 22 and 46 years old. The average age is 34 years. The experiment consisted of reading a list of words in a carrier sentence *Zic tare* (‘I say loud’). There were 720 tokens in total, distributed as following: 20 words, 3 repetitions, 12 speakers.

### 2.3. Segmentation

In terms of segmentation, we introduced audio recordings into PRAAT, segmenting the phonetic sequences we analyzed. In order to segment the sequences, we looked at the spectrogram and manually aligned it according to the values and trajectory of the first two formants.

## 3. RESULTS AND DISCUSSIONS

A total of 40 tokens were discarded from the analysis due to mispronunciations and metathesis. The remaining 680 were the focus of our analysis. In terms of acoustic measurements, in this study we examined the overall duration of the vocalic sequences, while formant values will be examined in future studies.

As we could see in *Table 1*, the analyzed words contain the pairs /au/ - /ua/ and /aw/ - /wa/. With these sequences we want to see the *Duration pattern of the internal hiatus* (3.1.) and the *Duration patterns of the diphthong pairs* (3.2.) and the duration patterns of the hiatus compared to the diphthong (3.3.).

### 3.1. Duration patterns of internal hiatus

In order to compare the different temporal patterns of the vocalic sequences, we performed ANOVA tests so as to be able to evaluate whether the temporal difference between hiatus and diphthong are statistically relevant. More precisely, the question in this study is whether there is a significant difference between /au/ and /ua/, but also between /aw/ and /wa/.

Next, we will present the data we obtained from the linguistic survey, and we will perform several ANOVA tests to see if these results are statistically relevant.

#### 3.1.1. Hiatus /au/

In our analysis, the /au/ hiatus has a mean duration of 234 ms with a standard deviation of 70 ms. In the table below we can see all the data obtained. Based on the data, we note that two of the analyzed words have a much shorter duration than the average duration of the hiatus /au/. This shows that within the sequence /au/ in tokens such as /autokar/ ‘coach’ (181 ms) and /mausolew/, ‘mausoleum’ (190 ms) there is a tendency to pronounce the hiatus towards the diphthong, by reducing the duration.

	aur	autocar	fault	faulta	mausoleu	precaut	austru
Frequency	36	36	36	36	36	36	35
Mean	314.64	180.94	238.44	205.5	189.56	255.39	252.6
Median	293	182	227.5	194	175	244	249

	aur	autocar	fault	faulta	mausoleu	precaut	austru
Std. Deviation	67.08	37.92	56.51	36.37	47.04	72.33	60.77
Variance	4499.67	1437.83	3192.88	1322.71	2212.37	5231.5	3693.36
Minimum	227	126	163	144	124	176	150
Maximum	486	272	409	288	341	501	379
Range	259	146	246	144	217	325	229
Skew	0.61	0.53	0.93	0.8	1.61	1.41	0.13
Kurtosis	-0.6	-0.23	0.92	-0.11	2.73	2.38	-0.65

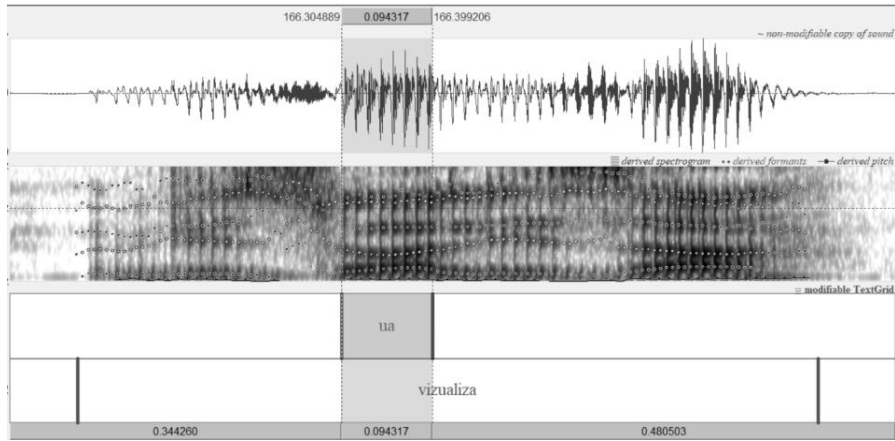
Table 2. Duration (in ms.) of the sequence /au/

### 3.1.2. Hiatus /ua/

In our analysis, the /ua/ hiatus has a mean duration of 205 ms, with a standard deviation of 78 ms. In the following table we can see all the data obtained. Our results show that the shortest average duration of the VV sequence is in the word “vizualiza” (145 ms).

	anual	papua	vizualiza	polua
Frequency	36	36	36	35
Mean	211.39	221.31	145.31	241.66
Median	204.5	206.5	130	252
Std. Deviation	84.76	62.43	45.81	78.77
Variance	7184.3	3897.76	2098.56	6205.23
Minimum	97	134	79	107
Maximum	477	394	245	516
Range	380	260	166	409
Skew	1.16	0.75	0.59	1.22
Kurtosis	1.86	0.15	-0.68	3.16

Table 3. Duration (in ms.) of the sequence /ua/



Spectrogram 1. /vizualiza/ 'visualise', controlled speech, S<sub>1</sub> (I.V., m., 25 years old, policeman)

	duration (ms)
Mean	204.66
Median	192
Std. Deviation	77.76
Variance	6046.75
Minimum	79
Maximum	516
Range	437
Skew	1.02
Kurtosis	1.81

Table 4. Mean duration of /ua/

### 3.1.3. Hiatus /au/ versus hiatus /ua/

As previously noted, one of the questions we are addressing is whether there is a statistically significant difference between the average duration of the /au/ hiatus compared to the /ua/ hiatus. The tests done show that the difference between the ascending hiatus /au/ and the descending hiatus /ua/ is significant ( $t = 3.70$ ,  $df = 270$ ,  $p < 0.001$ ), meaning that the duration of the sequence /au/ (234 ms) is significantly longer than the duration of the sequence /ua/ (205 ms).

The ANOVA t-test reveal that /au/ VV sequences have a significantly higher average duration compared to /ua/ pairs ( $t = 3.70$ ,  $df = 270$ ,  $p < 0.001$ ).

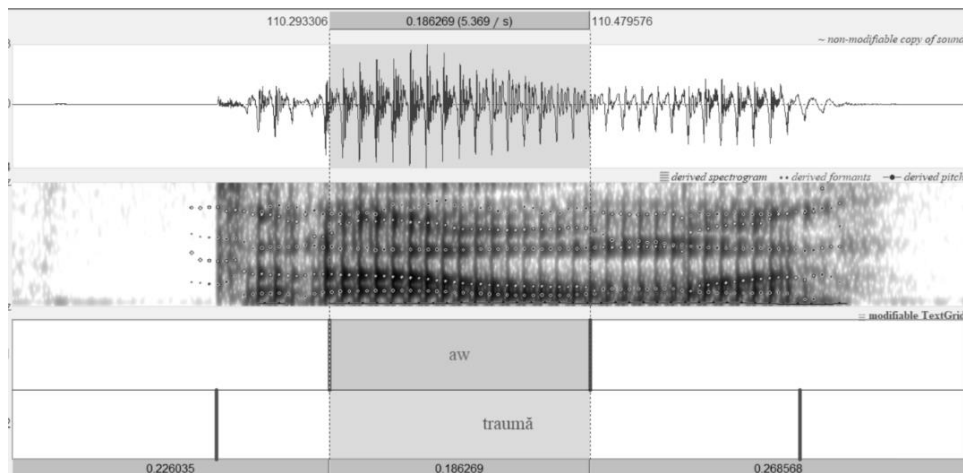
### 3.2. Duration patterns of diphthong pairs

#### 3.2.1. Diphthong /aw/

Our data indicate that the average duration of the [aw] sequence is 189 ms, with a standard deviation of 43 ms. The minimum value for the sequence [aw] recorded in our corpus is 96 ms, while the maximum value recorded for this sequence is 301 ms.

	augur	august	glaucom	traumă	inaugura
Frequency	36	36	36	36	35
Mean	178.97	189.22	196,9	217	164.29
Median	177	190.5	190	209.5	163
Std. Deviation	39.29	43.91	37.28	43.64	29.66
Variance	1543.8	1928.06	1390.02	1904.86	879.8
Minimum	113	103	137	149	96
Maximum	272	267	301	301	262
Range	159	164	164	152	166
Skew	0.3	-0.2	0.89	0.48	0.73
Kurtosis	-0.34	-0.81	0.69	-0.87	2.69

Table 5. Duration of the sequence /aw/



Spectrogram 2. /trauma/ 'trauma' controlled speech, S1 (I.V., m., 25 years old, policeman)

	durata ms
Mean	189.31
Median	185
Std. Deviation	42.53
Variance	1808.54
Minimum	96
Maximum	301
Range	205
Skew	0.47
Kurtosis	-0.03

Table 6. *Mean duration /aw/*

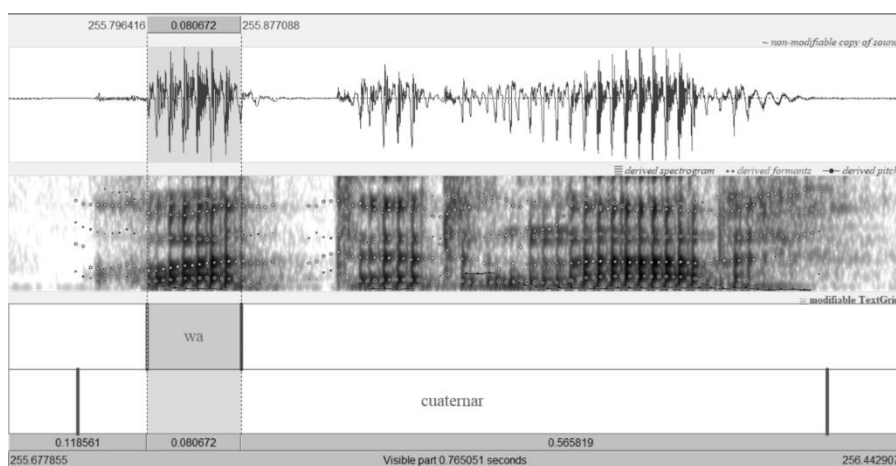
### 3.2.2. *Diphthong /wa/*

Our data indicate that the average duration of the [wa] sequence is 153 ms, with a standard deviation of 58 ms. The minimum value for the sequence [wa] recorded in our corpus is 60 ms, while the maximum value recorded for this sequence is 276 ms. In our data, the falling diphthong /wa/ has a range of 216 ms.

	cuaternar	iguană	guacamole
Frequency	36	36	35
Mean	134.31	196.03	128.31
Median	115	207.5	124
Std. Deviation	60.94	47.05	35.62
Variance	3713.7	2214.14	1269.1
Minimum	60	117	76
Maximum	276	275	255
Range	216	158	179
Skew	1.24	-0.09	1.9
Kurtosis	0.48	-1.42	4.82

Table 7. *Duration (in ms.) of the sequence /wa/*





Spectrogram 3. /kwaternar/ 'quaternary', controlled speech, S<sub>1</sub> (I.V., m., 25 years old, policeman)

	durata ms
Mean	153.11
Median	137
Std. Deviation	57.56
Variance	3313.04
Minimum	60
Maximum	276
Range	216
Skew	0.67
Kurtosis	-0.75

Table 8. Mean duration /wa/

### 3.2.3. Diphthong /aw/ versus /wa/

We investigate whether there is also a significant difference within the descending diphthong /aw/ and the ascending diphthong /wa/ in terms of average duration. After the tests, we obtained the following result:  $t = 5.64$ ,  $df = 175$ ,  $p < 0.001$ , meaning that the t-tests confirmed that the falling /aw/ diphthong has a significantly higher average duration in comparison to the rising /wa/ diphthong ( $t = 5.64$ ,  $df = 175$ ,  $p < 0.001$ )

### 3.3. Duration patterns of hiatus versus diphthong

#### 3.3.1. *Hiatus /au/ versus diphthong /aw/*

As expected, our data indicate that the mean duration of the hiatus [au] is significantly longer than that of the diphthong [aw]. Specifically, the average of duration of [au] is 234 ms, with a standard deviation of 70 ms, while the mean duration of [aw] is 189 ms, with a standard deviation of 43 ms. The minimum value for the sequence [au] recorded in our corpus is

124 ms, and the maximum value recorded is 501 ms. The minimum value for the sequence [aw] recorded in our corpus is 96 ms, while the maximum value recorded for this sequence is 301 ms.

Following the ANOVA tests, we observed that the results are statistically relevant, the ascending hiatus /au/ having a longer duration than the descending diphthong /aw/: ( $t = 8.18$ ,  $df = 419$ ,  $p < 0.001$ ).

#### 3.3.2. *Hiatus /ua/ versus diphthong /wa/*

Our results indicate that the duration of the hiatus [ua] is longer than that of the diphthong [wa]. Specifically, the average duration of [ua] is 205 ms, with a standard deviation of 78 ms, while the mean duration of [wa] is 153 ms, with a standard deviation of 59 ms. The minimum value for the sequence [ua] recorded in our corpus is 79 ms and the maximum value recorded is 516 ms. The minimum value for the sequence [wa] recorded in our corpus is 60 ms, while the maximum value recorded for this sequence is 276 ms.

The tests showed that the duration of the descending hiatus /ua/ is longer than the duration of the ascending diphthong /wa/: ( $t = 8.18$ ,  $df = 419$ ,  $p < 0.001$ ).

## 4. CONCLUSIONS AND FUTURE RESEARCH

Through the data obtained, we showed that during the conducted investigation several phenomena of syneresis and dieresis production were encountered. From the words we analyzed, we noticed that the two phenomena occurred more within the hiatus /au/ and the diphthong /aw/.

Regarding the hiatus /ua/ from /vizualiza/ a shorter duration (145.31 ms) was identified than the overall mean duration of the corresponding hiatus pairs (192 ms), and in the case of the diphthong /wa/ from /igwanə/ the duration is longer (196.03 ms) compared to the overall mean duration of the diphthong pairs (137 ms).

From here, we could note that there is a greater tendency to encounter the phenomenon of syneresis within the ascending hiatus /au/ as opposed to the descending hiatus /ua/. As for the diphthong, the phenomenon occurs more frequently within the descending diphthong /aw/.

In future work we aim to further develop the speech corpus by including speakers from other age groups and socio-economic backgrounds and extending the analysis to a larger number of vocalic sequences to better understand what is happening in other contexts as well.

In addition, we propose to extend the analysis to the Ro-Phon speech corpus (Niculescu 2021) as a way of identifying the temporal patterns of hiatus and diphthong pairs in Romanian connected speech.

## REFERENCES

- Chitoran, I., J.I. Hualde, 2007, "From Hiatus to Diphthong: The evolution of vowel sequences in Romance", *Phonology*, 24, 37–75.
- DSL, 2005, A. Bidu-Vrănceanu, C. Călărașu, L. Ionescu-Ruxăndoiu, M. Mancaș, G. Pană Dindelegan, *Dicționar de științe ale limbii*, ediția a II-a [ed. I: 1997], București, Editura Nemira.
- DTG, 2023, G. Pană Dindelegan, R. Zafiu, A. Dragomirescu, A. Nicolae, A. Boioc Apintei, *Dicționar de termeni gramaticali și concepte lingvistice conexe*, București, Univers Enciclopedic Gold.
- Marin, S., 2014, *Romanian diphthongs /ea/ and /oa/: an articulatory comparison with /ja/ - /wa/ and with hiatus sequences*, *Revista de Filologia Română*, vol. 31, 83–97.
- Marin, S., L. Goldstein, *A gestural model of the temporal organization of vowel clusters in Romanian*.
- Niculescu, O., 2015, "Hiatul – Delimitări teoretice și terminologice", *Studii și cercetări lingvistice*, LXVI, 2, 237–245.
- Niculescu, O., I. Vasilescu, M. Adda-Decker, 2019, "Duration Patterns of Internal and External Hiatus as a Function of Speaking Style", *Revue roumaine de linguistique*, LXIV, 2, 189–197.
- Niculescu, O., 2020, "Rezultate experimentale în analiza acustică a hiatului din limba română contemporană", *Studii și cercetări lingvistice*, LXXI, 1, 35–45.
- Niculescu, O., 2021, "Developing linguistic resources for Romanian written and spoken language", *Proceedings of the 16th International Conference Linguistic Resources and Tools for Natural Language Processing*, Iași, Romania, 21–36.
- Roceric-Alexandrescu, A., 1968, *Fonostatistica limbii române*, București, Editura Academiei.

