COMPARATIVE FREQUENCY ANALYSIS OF [aı] DIPHTHONGIZATION IN ENGLISH AND BORROWED WORDS WHICH HAVE ARABIC ORIGIN IN TURKISH; A CASE STUDY

İngilizce'deki ve Türkçe'ye Geçmiş Alıntı Sözcüklerdeki [aı] Karma Ünlüleşmesi Üzerine Karşılaştırmalı Frekans Analizi; Bir Durum Çalışması

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ÖZ

Bu durum çalışmasının amacı, Arapça'dan dilimize geçmiş, diğer bir değişle Türkçe'leşmiş alıntı sözcüklerde [aı] karma ünlüleşmesinin var olup olamayacağı, İngilizcede [aı] karma ünlüleşmesi barındıran sözcüklerle bilgisayar destekli karşılaştırmalı frekans analizi yöntemiyle tartışmaktır. Çalışmada içinde [aı] karma ünlüsü barındıran yedi Türkçe ve yedi İngilizce sözcük grubu bilgisayara 44.100 Hertz frekansında ve 16 bit çözünürlükle sağlıklı ve herhangi bir konuşma bozukluğu olmayan sekiz Türk ve sekiz İngiliz yerel erişkin konuşmacı ile kaydedilmiş ve hedef ses üzerinde CSL (Computerized Speech Lab) programı kullanılarak formant analizi yapılmıştır. Söz konusu yedi sözcük ile yapılan formant analizi sonucunda Türkçe'de Arapça'dan alınan sözcüklerde var olabileceği düşünülen [aı] karma ünlüleşmesi frekans ortalamasının, İngilizce sözcüklerde var olan [aı] karma ünlüleşmesi frekans ortalaması Bağımsız Örneklem T-testi yardımıyla karşılaştırıldığında anlamlı bir farkın olmadığı bulunmuştur. Elde edilen sonuçlar ışığında Arapça'dan Türkçe'ye geçmiş alıntı sözcüklerdeki [aı] karma ünlüleşmesinin İngilizcedeki [aı] karma ünlüleşmesi ile frekans bakımından benzerlik gösterdiği söylenebilir.

Anahtar Sözcükler

Karma ünlüleşmesi, formant analizi, bilgisayar destekli ses analizi

ABSTRACT

In this case study, it is aimed at scrutinizing the existence of [aı] diphthongization in Turkish for the borrowed words from Arabic. Seven Turkish and seven English words containing [aı] diphthong were read by eight Turkish and eight English native adult speakers who do not have any speech disorders and the sounds of the words were recorded with a quality of 44.100 Hertz, 16 bit resolution and mono channel onto a computer. Formant analyses of frequencies of the related words were realized with the help of a computer based speech analysis software called CSL (Computerized Speech Lab). In the light of the independent samples t test analyses, it was found that [aı] diphthongization in Turkish has great similarities with the one in English not only from the standpoint of formant shapes but also the numerical data of the frequencies. It can be proposed that in Turkish there is the [aı] diphthong for the words which were borrowed from Arabic.

Key Words

Diphthongization, formant analysis, computer based speech analysis

1.0 Introduction

Generally speaking a diphthong can be defined as the combination of two different pure vowels which function as a single phoneme in English. In other words, a diphthong is comprised of two different articulations of two different sounds as in the words like *train*, *phone*, *bike*, *owl*, *boy*, *ear*, *chair*, *tourist*, etc. In English, there are eight diphthongs which can be classified into three groups like diphthongs ending in [ə], [ı], and [ʊ].

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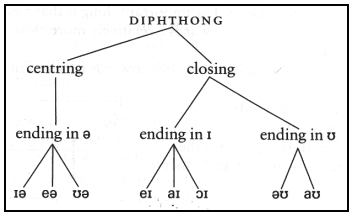


Figure 1. Diphthong classification in English (Roach 1983:19)

Tongue and jaw movements for [aɪ] diphthong for English are revealed in a sagittal section in Figure 2. As to the tongue position, it moves central to high front and as it moves high, the jaw moves downwards. By the way, the lips are open at the beginning and then they have a spread appearance through the end of the production.

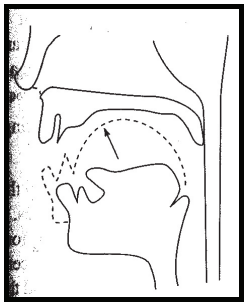


Figure 2. Sagittal section for the movement of tongue for [aɪ] diphthong (Celce-Murcia et al 1996:101)

Needless to say, as to the sound patterns of Turkish, two vowels do not approach immediately after each other for the words that do not have Turkish origin, which thereby might create problematic cases for Turkish phonology. For this reason, a classification called "diphthongs" does not exist with regard to this vowel coexistence (Yardımcı 1996:17). Those words which have two vowels follow each other are used by adding a consonant one of which is mostly "y" [j] between the two vowels as is exemplified in the words like faide > /fayda/ [fa^{j}ıda], taife > /tayfa/ [ta^{j}ıfa], acaib > /acayip/ [aca^{j}ıp], hain > /hayin/ [ha^{j}ın], daire > /dayire/ [da^{j}ıre], ait > /ayit/ [a^{j}ıt] (Aksan 1978:54). On the whole, it can be said that the first part of the vowel combination has a weaker stress when compared with the second vowel. Furthermore, the second vowel which is attached to a consonant has a longer duration of time. By way of illustration, the word "ait" (meaning concerning, relating to) has a duration of 165 msec. for [a] but [ı] ("y" [j] added while pronouncing) has a length of 198 msec. The related image gained through a phonogram at Hamburg University is revealed in Figure 3 (Selen 1979:64). It can also be accepted that the sounds of a diphthong comprise gliding from one vowel to another in the same syllable. In other words, [j] attaches the vowels [a] and [ı] as a result of a gliding case. Demircan (1979:84) categorizes the achievability of the diphthongization instance in Turkish in the light of minimal pairs and he points out that "vowel + vowel" combinations often contain for the most part [y] and [v] gliding as follows: [ı^{v}+], [ı^{j}+], [e^{v}+], [e^{j}+], [ə^{v}+], [ə^{y}+], [a^{v}+], and [a^{y}+]. He also remarks that instrument based analyses should be realized in order for enlightening the matter of diphthongization in Turkish. Although the discussions about diphthongization in Turkish are still going on (Demirezen 1986:70), diphthongization case can be seen for the words which were borrowed from Arabic; the

Turkified words might well contain diphthongs like [aɪ] as in *mesai*, [ɪa] as in *iade*, and [eɪ] as in *suistimal*.

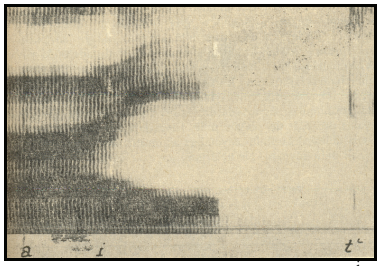


Figure 3. Phonogramic image of frequency analysis for the word "ait" [aʲɪt] in Turkish (Selen 1979:66)

This case study aims at scrutinizing the possible frequency resemblance between [aɪ] diphthong of the words in English like *eye*, *bike*, *fried*, *height*, *buy*, *high*, and *shy* with the potential [aɪ] diphthong for the Turkish words which were borrowed from Arabic like *aidat*, *hain*, *şair*, *daima*, *fedai*, *mesai*, *and nihai* by means of a computer based speech analysis software called CSL (Computerized Speech Lab) (2003) and a statistical data processing software called SPSS Ver. 13 (2004). It is believed that the statistical data which reveals the difference between the formant frequencies for the [aɪ] diphthong in English and the possible [aɪ] diphthongization for the borrowed words in Turkish is statistically *insignificant* will provide worthwhile information in terms of the discussions related to the potential existence of classification of diphthongization in Turkish.

2.0 Material and Method

In this study, sound recordings of the eight healthy Turkish and eight English native speakers were realized in two groups of words containing [aɪ] diphthongs in English and in Turkish. The sound recordings has a quality of 44.100 Hertz, 16 bit resolution and mono channel. In terms recording and formant analysis of frequencies, computer based speech analysis software called CSL (Computerized Speech Lab) (2003) was utilized at the Department of Audiology, Gazi University Hospital, Ankara - Turkey. In the recording phases, a *Shure* brand *EC 58* model microphone which has a sensitivity of *50 – 15.000 Hertz* recording range was used. The list of the sample words can be seen in the following list:

Turkish words containing [aɪ] diphtong		English words containing [aɪ] diphtong	
[aɪ] at the beginning	**ai**dat	[aɪ] at the beginning	eye
[aɪ] in the middle	h**ai**n	[aɪ] in the middle	bike
	ş**ai**r		fried
	d**ai**ma		height
[aɪ] at the end	fed**ai**	[aɪ] at the end	buy
	mes**ai**		high
	nih**ai**		shy

After the voice recordings were realized through the computer, 1st and 2nd formant analyses were measured with the help of CSL (2003) for the English and Turkish words for the possible [aɪ] diphthongization in the related words. The average formant frequencies as numerical data of each word read by the subjects were transferred into SPSS statistical

software by the help of which *independent samples t test* was applied to the means of the frequency averages.

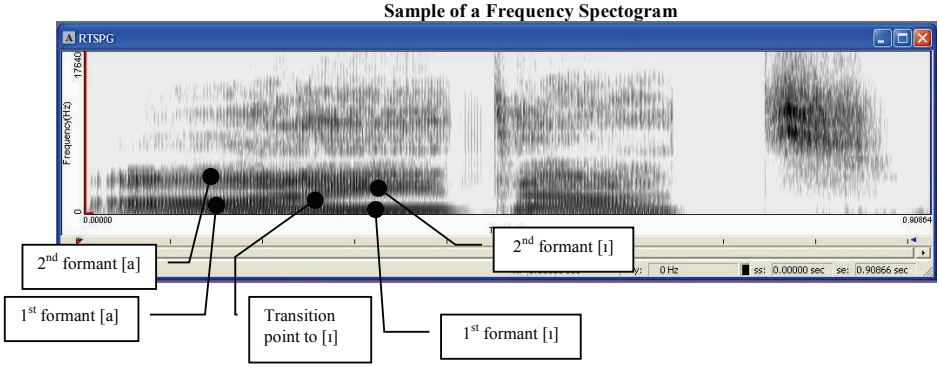
3.0 Results and Discussion

The research involves collecting numerical data related to the means of the averages of the formant frequencies for each word which contains [a] and [ı] phonemes. The first and the second formant values in frequencies were measured with the assistance of CSL (2003) and then the means of the averages were taken. Such data is presented together with the appearance of the formants presenting the correspondence of the possible diphthongs. It is believed that graphic presentation would be functional as a visual source for the outcomes of the case study.

Turkish Words:

aidat (dues)

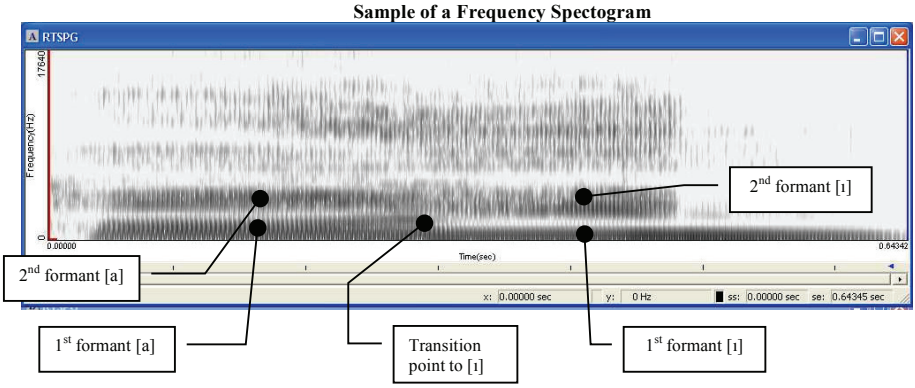
Sample of a Frequency Spectogram



1st Formant Analysis - [a] (hertz) [means of the averages]	**2nd Formant Analysis – [a]** (hertz) [means of the averages]
TR. [a] 1195	TR. [a] 3668
1st Formant Analysis - [ı] (hertz) [means of the averages]	**2nd Formant Analysis – [ı]** (hertz) [means of the averages]
TR. [ı] 763	TR. [ı] 3338,5

hain (traitor)

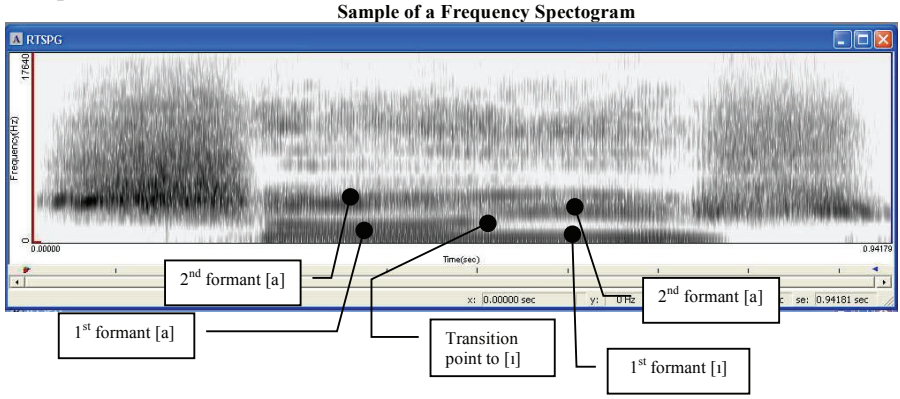
Sample of a Frequency Spectogram



1st Formant Analysis - [a] (hertz) [means of the averages]	**2nd Formant Analysis – [a]** (hertz) [means of the averages]
TR. [a] 1113	TR. [a] 3548
1st Formant Analysis - [ı] (hertz) [means of the averages]	**2nd Formant Analysis – [ı]** (hertz) [means of the averages]
TR. [ı] 783	TR. [ı] 3256,5

şair (poet)

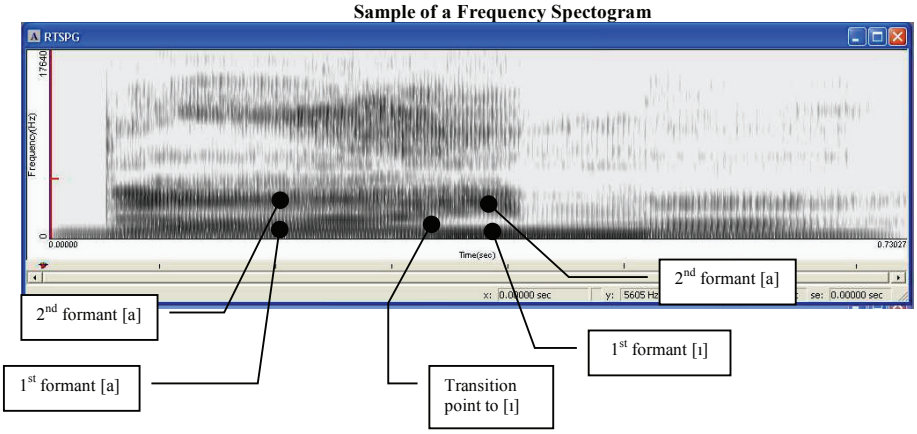
Sample of a Frequency Spectogram



1st Formant Analysis - [a] (hertz) [means of the averages]	**2nd Formant Analysis – [a]** (hertz) [means of the averages]
TR. [a] 1236	TR. [a] 3668,5
1st Formant Analysis - [ı] (hertz) [means of the averages]	**2nd Formant Analysis – [ı]** (hertz) [means of the averages]
TR. [ı] 791	TR. [ı] 3297

daima (always)

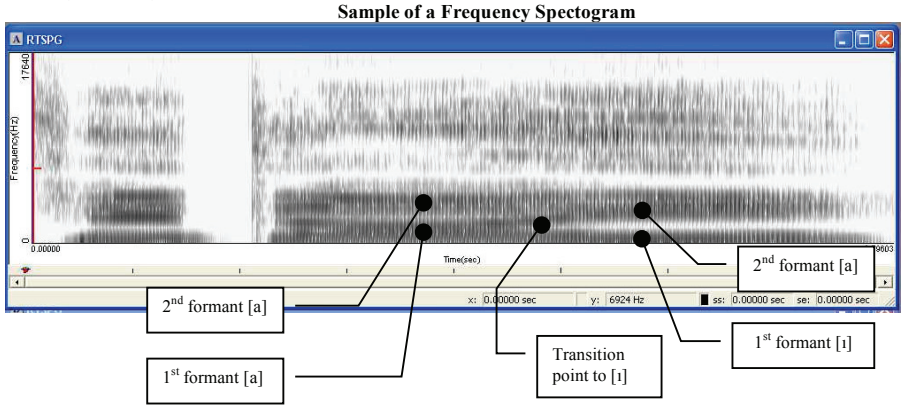
Sample of a Frequency Spectogram



1st Formant Analysis - [a] (hertz) [means of the averages]	**2nd Formant Analysis – [a]** (hertz) [means of the averages]
TR. [a] 1384	TR. [a] 3667,5
1st Formant Analysis - [ɪ] (hertz) [means of the averages]	**2nd Formant Analysis – [ɪ]** (hertz) [means of the averages]
TR. [ɪ] 700	TR. [ɪ] 3303,5

fedai (bouncer)

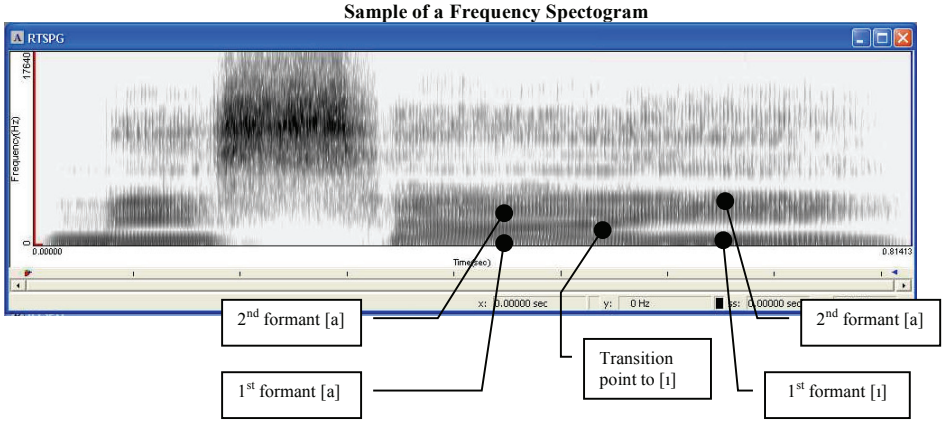
Sample of a Frequency Spectogram



1st Formant Analysis - [a] (hertz) [means of the averages]	**2nd Formant Analysis – [a]** (hertz) [means of the averages]
TR. [a] 1113,5	TR. [a] 3502,5
1st Formant Analysis - [ɪ] (hertz) [means of the averages]	**2nd Formant Analysis – [ɪ]** (hertz) [means of the averages]
TR. [ɪ] 741,5	TR. [ɪ] 3379,5

mesai (work)

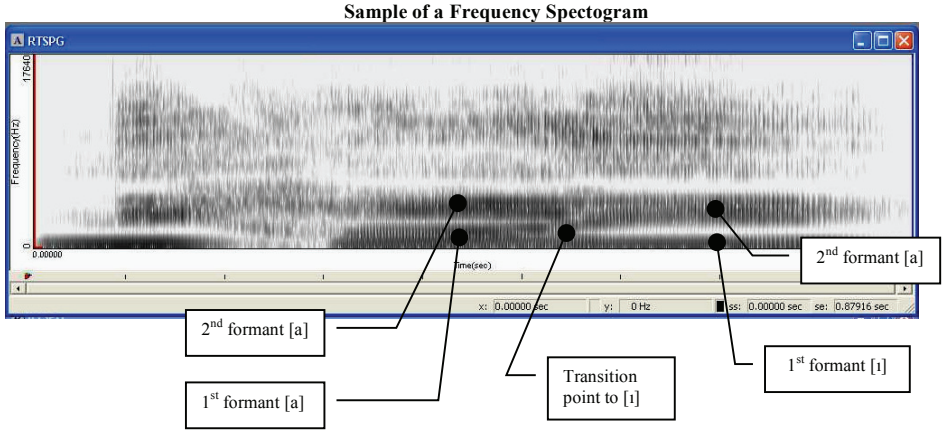
Sample of a Frequency Spectogram



1st Formant Analysis - [a] (hertz) [means of the averages]	**2nd Formant Analysis – [a]** (hertz) [means of the averages]
TR. [a] 1172	TR. [a] 3379,5
1st Formant Analysis - [ı] (hertz) [means of the averages]	**2nd Formant Analysis – [ı]** (hertz) [means of the averages]
TR. [ı] 701	TR. [ı] 3368

nihai (final)

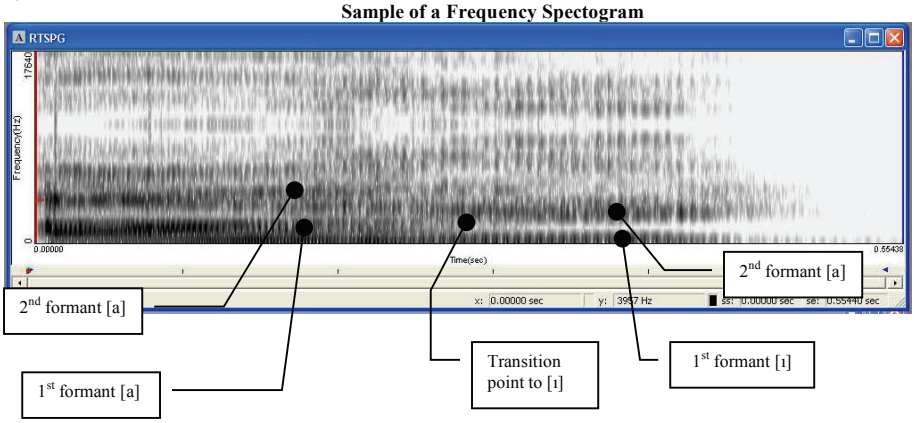
Sample of a Frequency Spectogram



1st Formant Analysis - [a] (hertz) [means of the averages]	**2nd Formant Analysis – [a]** (hertz) [means of the averages]
TR. [a] 1195	TR. [a] 3627
1st Formant Analysis - [ı] (hertz) [means of the averages]	**2nd Formant Analysis – [ı]** (hertz) [means of the averages]
TR. [ı] 741	TR. [ı] 3173

English words:
eye

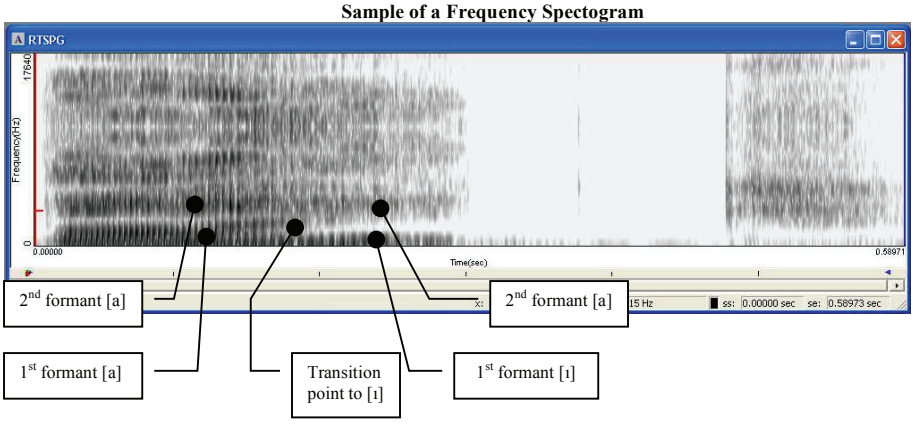
Sample of a Frequency Spectogram



1st Formant Analysis - [a] (hertz) [means of the averages]	**2nd Formant Analysis – [a]** (hertz) [means of the averages]
ENG. [a] 1161	ENG. [a] 3682,5
1st Formant Analysis - [ɪ] (hertz) [means of the averages]	**2nd Formant Analysis – [ɪ]** (hertz) [means of the averages]
ENG. [ɪ] 763,5	ENG. [ɪ] 3215

bike

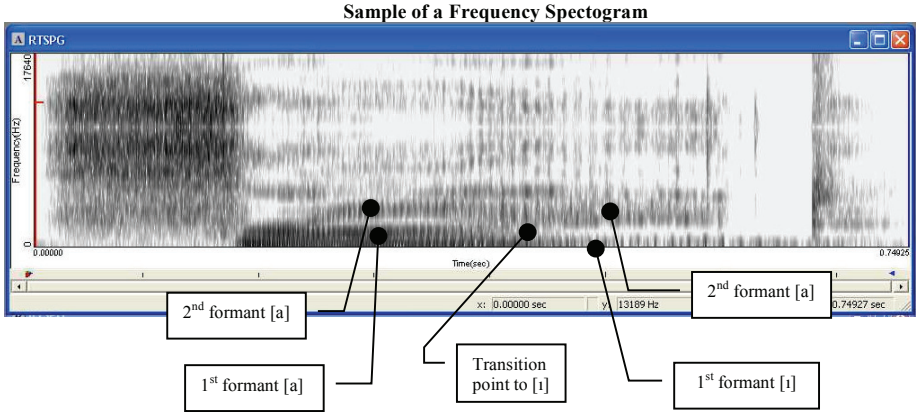
Sample of a Frequency Spectogram



1st Formant Analysis - [a] (hertz) [means of the averages]	**2nd Formant Analysis – [a]** (hertz) [means of the averages]
ENG. [a] 1334	ENG. [a] 3634
1st Formant Analysis - [ɪ] (hertz) [means of the averages]	**2nd Formant Analysis – [ɪ]** (hertz) [means of the averages]
ENG. [ɪ] 742	ENG. [ɪ] 3301

fried 3

Sample of a Frequency Spectogram

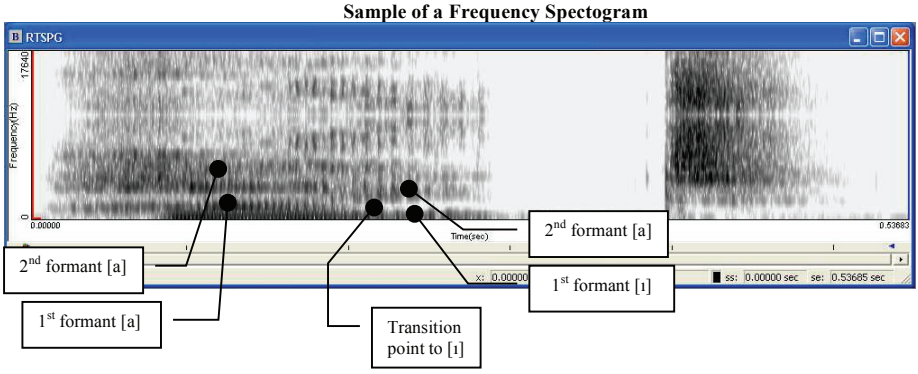


1st Formant Analysis - [a] (hertz) [means of the averages]	**2nd Formant Analysis – [a]** (hertz) [means of the averages]
ENG. [a] 1154	ENG. [a] 3626,5

1st Formant Analysis - [ɪ] (hertz) [means of the averages]	**2nd Formant Analysis – [ɪ]** (hertz) [means of the averages]
ENG. [ɪ] 741,5	ENG. [ɪ] 3345

height

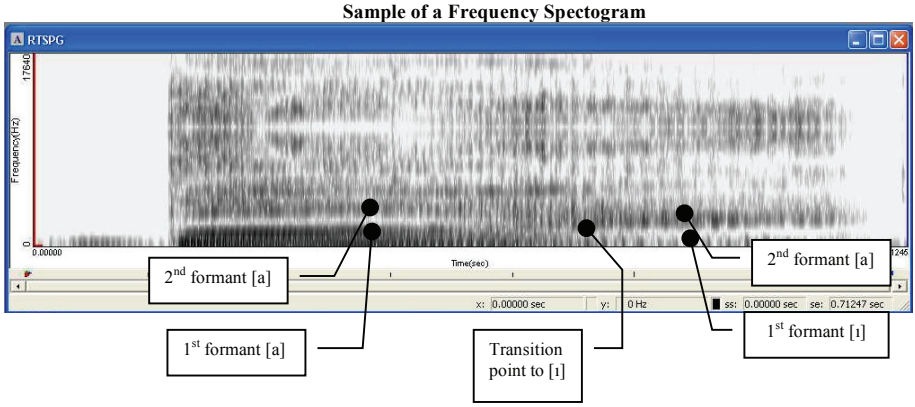
Sample of a Frequency Spectogram



1st Formant Analysis - [a] (hertz) [means of the averages]	**2nd Formant Analysis – [a]** (hertz) [means of the averages]
ENG. [a] 1185,5	ENG. [a] 3448
1st Formant Analysis - [ɪ] (hertz) [means of the averages]	**2nd Formant Analysis – [ɪ]** (hertz) [means of the averages]
ENG. [ɪ] 758,5	ENG. [ɪ] 3427

buy

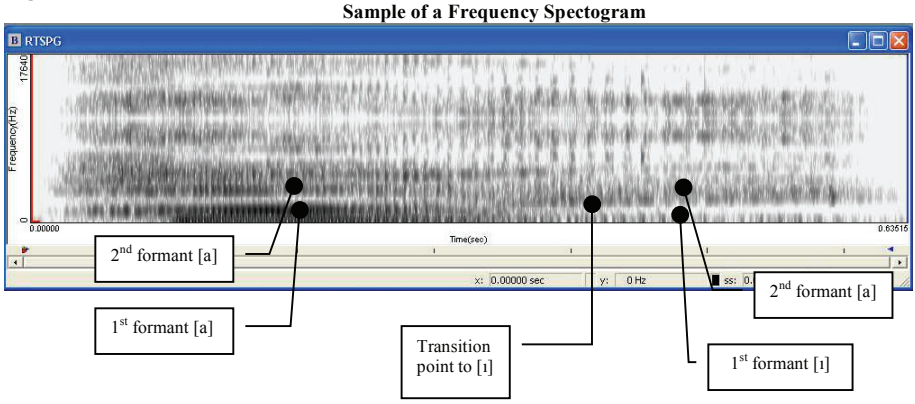
Sample of a Frequency Spectogram



1st Formant Analysis - [a] (hertz) [means of the averages]	**2nd Formant Analysis – [a]** (hertz) [means of the averages]
ENG. [a] 1237	ENG. [a] 3660,5
1st Formant Analysis - [ɪ] (hertz) [means of the averages]	**2nd Formant Analysis – [ɪ]** (hertz) [means of the averages]
ENG. [ɪ] 700,5	ENG. [ɪ] 3261,5

high

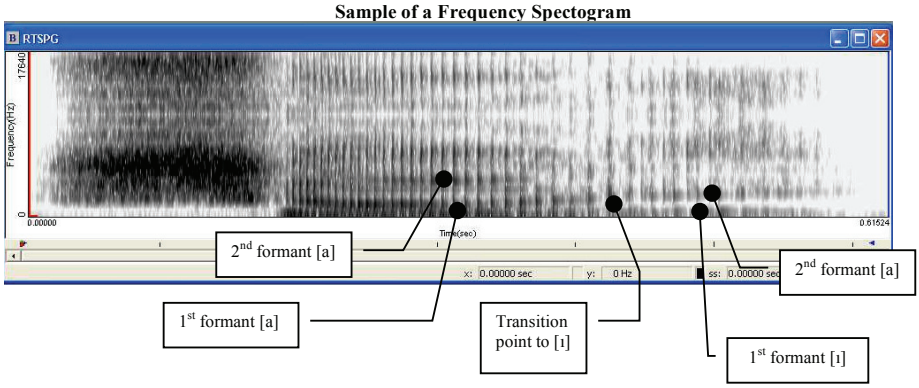
Sample of a Frequency Spectogram



1st Formant Analysis - [a] (hertz) [means of the averages]	**2nd Formant Analysis – [a]** (hertz) [means of the averages]
ENG. [a] 1236	**ENG. [a]** 3566
1st Formant Analysis - [ɪ] (hertz) [means of the averages]	**2nd Formant Analysis – [ɪ]** (hertz) [means of the averages]
ENG. [ɪ] 741	**ENG. [ɪ]** 3324,5

shy

Sample of a Frequency Spectogram



1st Formant Analysis - [a] (hertz) [means of the averages]	**2nd Formant Analysis – [a]** (hertz) [means of the averages]
ENG. [a] 1185,5	ENG. [a] 3461,5
1st Formant Analysis - [ɪ] (hertz) [means of the averages]	**2nd Formant Analysis – [ɪ]** (hertz) [means of the averages]
ENG. [ɪ] 758,5	ENG. [ɪ] 3304

The numerical data of the frequencies of the formants were categorized into two groups and then the independent samples t test was applied in order to compare the means for the frequencies of 1st and 2nd formants for [a] phoneme in Turkish and English and 1st and 2nd formants for [ɪ] in Turkish and English. The test results are presented as follows:

Independent samples t test results for [a] in Turkish and English

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Tr [a] and Eng [a] 1st Formant Analysis	Equal variances assumed	,277	,608	-,287	12	,779	-12,07143	42,10810	-103,817	79,67423
	Equal variances not assumed			-,287	10,552	,780	-12,07143	42,10810	-105,233	81,08994
Tr [a] and Eng [a] 2nd Formant Analysis	Equal variances assumed	,170	,687	-,047	12	,963	-2,57143	54,84769	-122,074	16,93141
	Equal variances not assumed			-,047	11,735	,963	-2,57143	54,84769	-122,375	17,23171

,779

,963

Independent samples t test results for [ɪ] in Turkish and English

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Tr [ɪ] and Eng [ɪ] 1s Formant Analysis	Equal variances assumed	2,454	,143	,135	12	,895	2,14286	15,87172	32,43865	36,72437
	Equal variances not assumed			,135	9,696	,895	2,14286	15,87172	33,37243	37,65814
Tr [ɪ] and Eng [ɪ] 2n Formant Analysis	Equal variances assumed	,044	,837	-,240	12	,814	-8,85714	36,85292	89,15276	71,43847
	Equal variances not assumed			-,240	11,946	,814	-8,85714	36,85292	89,19278	71,47850

,895 ,814

It can be said that in the light of the statistical analysis of the two groups of there is no significant difference ($p \geq 0,05$) between the first and the second formant analyses for [a] in Turkish and English and [ɪ] in Turkish and English when the diphthongization is taken into consideration.

In the light of this case study, it can be proposed that [aɪ] diphthong in English seems to have a similar corresponding sound structure in Turkish and in this context; it can be proposed that [aɪ] diphthongization might exist for the borrowed and Turkified words from Arabic. Furthermore, when the spectrograms were analyzed according to their appearance, for both languages, after the [a] vowel, there appears to be a similar transitory point which contains [y] gliding which is followed by [ɪ] vowel. Needless to say, it is believed that this case study might shed light on further studies in which the number of the subjects is expanded. It can also be pointed out that through computer based sound analysis the possible diphthongization problem in Turkish could be better explained. This study demonstrates an effective means of the application of medical sound analysis software which is used for researches on audiology for linguistic purposes as well.

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