The Perceptibility of English Sonority Profiling by Advanced Iraqi Learners of English: A Qualitative Auditory-Acoustic Study

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Abstract

The study explores the perceptibility of English sonority profiling by advanced Iraqi learners (AIL) of English from the perspective of the Sonority Sequencing Principle (SSP) . By implementing this principle, we disfavour the analyses formulated using strict prosodic hierarchies. Put in technical terms, due emphasis is dedicated in this study to the role of segment juxtaposition in syllabic patterning (i.e. the syllabic combinatory constraints) to determine English sonority profiling. The subjects of the study are 10 postgraduate M.A. students (5 males and 5 females) at the Departments of English-Colleges of Arts and Education-University of Basra-Iraq (Academic Year 2014-2015). Twenty tokens (10 monosyllabic words and 10 bisyllabic words) are deployed as the targets. The subjects' responses are treated statistically via mean values and percentage analyses. A sample spectrograms are also carried out to help highlight the significance of the acoustic correlates in signifying the relative English sonority. Based on Hogg and McCully's (1987) 10-point sonority scale and the spectrographic analysis of sample spectrograms, intensity charts, and waveforms, the study concludes, given the (80 %) compliance and (20 %) violation (in a pattern of reversals) for the monosyllabic targets, and the relative compliance (60%), and (40%) violation (in a form of reversals) for the bisyllabic tokens, that SSP is a considerably reliable phonological predictor for identifying sonority profiling. Acoustically speaking, intensity profiling, waveform charts, and F1 values totally support the SSP and sonority scaling.

1- Introduction

The bulk of phonological theories that approach the syllable agree that it is a basic unit of speech that can be studied on both the phonetic and phonological levels of analysis. Phonetically, syllables are usually described as consisting of a nucleus which has little or no obstruction to airflow and which sounds comparatively loud. The marginal elements that precede and follow that peak (the onset and coda) are produced with greater obstruction to the airflow and are less loud sounds (Among many others, Lass, 1984; Ladefoged, 1993; Laver,1994; Wells, 2000; McMahon, 2002; Roach, 2009;Yavas, 2013; Nathan, 2014).

According to sonority theory, the pulses of pulmonic air stream in speech " correspond to peak in sonority" (Giegerich, 1992:132). The sonority of speech sound is " its relative loudness compared to other sounds" (ibid.). Put it technically, sonority is " the overall loudness of a sound relative to others of the same pitch, stress and duration" (Crystal, 2003:423). This theory proposes that each syllable corresponds to a peak in the flow rate of pulmonic air. Thus nuclear elements, or syllabic segments can be described as intrinsically more sonorous than marginal, non-syllabic elements. Based on this proposal, speech sounds can be ranked in terms of sonority according to a sonority profile (Hauser, 2013).

In the framework of optimality theory (OT), sonority is typically taken to be a universal scalar feature ordering the various types of segments with respect to loudness or intensity (Parker,2013). Sonority Sequencing Principle (SSP) is one version of this theory, which stipulates that onsets rise in sonority toward the nucleus, while codas fall in sonority. (Clements, 1990; Parker,2002). From this, we can predict which consonant clustering is more licensed for onsets and codas (Harrington and Cox, 2009). SSP is claimed to account for cross-linguistic distributional and sequential tendencies (Geirut,1999), and different languages have been investigated within its frame (Al-Tamimi and Al-Shboul, 2012).

To the best of my knowledge, a great number of linguists and researchers(among them are Dogil,1992; Kenstowicz, 1994; Zec, 1995; O'Brein,2006; Moreton et al., 2008; Hauser,2013 to mention but a few) have been keenly interested in studying different aspects of sonority, yet the search for a reliable phonetic indicator that contributes to a direct measurement of sonority has remained unfulfilled. Moreover, "sonority has never been defined in a universally agreed upon and satisfactory way, consequently, this issue merits an in-depth study" (Parker, 2002:39).

This paper is an attempt to draw some conclusions relevant to sonority perceptibility as it is encoded by non-native speakers. Such conclusions might be of value to this field of research. The approach adopted in this study is the Positional Faithfulness Approach (PFA) (O'Brein,2006) since we find it a more convenient model to attain the key objective of the current study, specifically, to show the efficacy of segments adjacency (stringency constraint) on sonority recognition.

2- Sonority Profiling Approaches (**Models**)

In phonology and more generally in linguistic theory, sonority profiling has been analyzed in terms of markedness hierarchies. These hierarchies are multi-steps scales designed to shape implicational universals. In (OT), the sonority scale and other markedness hierarchies have been formalized via two different approaches; a scale-partition constraint families, with a universally fixed ranking, in which there is one sonority constraint per level of the hierarchy and the constraints in the family are ordered in a universally fixed ranking (Prince and Smolensky, 1993, 2004), and as stringency constraint families, where the constraints stand in subset relation and their ranking is not universal (Prince 1997,1999; de Lacy 2002, 2004, 2006), among others.

A new empirical domain has been identified via the Stochastic Optimality Theory (SOT) where the aforementioned profiling approaches reveal different predictions within speaker variation (Boersma and Hayes, 2001; and Smith et.al. 2011). Specifically, it has been shown that the scale-partition approach predicts sonority harmony reversals and plateaus due to the speaker variation. That is, sometimes a more marked (complex) sonority form should be chosen in preference to a less marked form, whereas such a preference has not been routed in the stringency approach.

Irrespective of the controversy outlined so far, there is a tendency among scholars to base the sonority hierarchy on phonetic ground, specifically in terms of manner of articulation (the degree of openness of the various parts of the vocal tract) (allinguistic.com.; zec, 1995; Roach, 2009). In physiological terms, sonority is taken as a concept which is closely related to the extent to which the vocal apparatus is constricted. Generally, open vowels (low vowels) like the long open back vowel /a:/ inherit the highest sonority because the vocal tract is open and therefore a large amount of acoustic energy radiates. At the other extreme, voiceless oral stops have least sonority because there is no acoustic energy during the closure in which the vocal tract is constricted (Harrington and Cox , 2009:2).

Most sonority hierarchies are finely graded within the bidirectional scale, greatest sonority $\succ$least sonority. As such, English segments are ranked as follows: vowels $\succ$ sonorant consonants $\succ$obstruents (zec, op.cit.). Sonority profiling is based on ranking segments in terms of their general phonetic categories. The following scales are proposed: vowels $\succ$glides $\succ$liquids $\succ$nasals $\succ$obstruents (After Clements, 1990); vowels $\succ$approximants $\succ$nasals $\succ$ fricatives $\succ$plosives (After Radford, 1999), vowels $\succ$glides $\succ$ liquids $\succ$ nasal stops $\succ$ fricatives $\succ$ oral stops (After Harrington and Cox, 2009).

However, some scholars argue that universally some languages require the sonority scale to be further subdivided at various points where the members of the segments categories have to be included within the scale (Parker, 2008,2013). The following detailed hierarchies are routed in sonority literature: low vowels$\succ$ mid vowels $\succ$high vowels $\succ$ lateral approximant $\succ$ nasals $\succ$ voiced fricatives $\succ$ voiceless fricatives $\succ$voiced plosives $\succ$ voiceless plosives (After, Ladefoged, 1993); low vowels $\succ$ mid vowels $\succ$high vowels (and glides)$\succ$ flaps $\succ$ laterals $\succ$ nasals $\succ$ voiced fricatives $\succ$ voiceless fricatives $\succ$ voiced stops $\succ$ voiceless stops (After Hogg and McCully, 1987) ; low vowels $\succ$ mid peripheral vowels $\succ$ high peripheral vowel $\succ$ mid interior vowels $\succ$ glides $\succ$ rhotic approximants $\succ$ flaps $\succ$laterals $\succ$ trills $\succ$ nasals $\succ$ voiced fricatives $\succ$ voiced affricates $\succ$ voiced stops $\succ$voiceless fricatives $\succ$ voiceless affricates $\succ$ voiceless stops (After Parker, 2008).

Throughout this paper, Hogg and McCully (1987) sonority scale will be adopted since it is the most comprehensive and compromised model. More general and more detailed versions are excluded due to their extreme generality and redundancy that might militate the intended research questions.

3- Research Questions

The present paper explores the following research questions: (i) How do (AILs) of English realize the sonority profiling of the English segments? (ii) What is the degree of recognition coincidence to the model adopted in the study? (iii) What are the sonority ratings scored by the different categorical segments as compared to the implemented sonority scale, (iv) What are the patterns of violation to the SSP , (v) Does the number of syllables of the word have any efficacy on the sonority recognition (monosyllabic vs. polysyllabic tokens)?, (vi) Is there any default sonority pattern in monosyllabic and bisyllabic targets? and (vii) Is there any correlate between the acoustic parameters of the token segments and sonority profiling?

4- The Experimental Work

This section is the practical part of the present treatise. It outlines the subjects' selection criteria, perceptual methodology, and provides a detailed statistical analysis of the sonority profiling for the research targets. Statistical outcomes are tabulated where mean values and percentages of sonority ratings are computed. Line graphs tracing sonority scaling are provided to help binding the compliance and violation to the implemented sonority scale.

4.1 Selection and Categorization of Data

The data deployed in this experimental work are twenty English tokens adopted from online Oxford Advanced Learner's Dictionary (www.oxfordlearnersdictionaries.com),(10 monosyllabic), and (10 bisyllabic) . Most of these tokens have different syllabic nuclei. Each group of these tokens is included within a separate list, list A, and B respectively (Appendix 1).

4.2 The Subjects

The participants of the study are 10 (5 males and 5 females) M.A. students with no hearing defect (aged between 24-37), 8 of them are joining the second semester in their M.A. programme. They have already studied a course in Phonetics and Phonology within the first semester study plan. Sonority profiling is one of the syllabus items of this course. The other two M.A. students have already finished the preparatory stage and are writing their M.A. theses. This sample group has been deliberately chosen since the subjects are more acquainted and knowledgeable with the topic under investigation. Undergraduate students have been excluded due to the lack of knowledge they have about the research topic that may negatively affect the reliability and objectivity of the research outcome.

4.3 The Perceptual Technique

The selected tokens were downloaded on a computer connected with a stereo digital speaker. It is 3 watt speaker and operates with S/N ratio of 85db capacity. The test was conducted in the higher study room where the computer was placed on a table and the subjects were seated on both sides of the table, 5 subjects on each side. The stimuli sheets were distributed to the subjects and they were fully instructed about the objectives of the test and the method of identifying the sonority profiling. To avoid any variable that may affect the accuracy of recognition, one minute of silent reading was given for each list. Thirty seconds was the average time allotted for each token identification, and the duration between a token and another was 5 seconds.

4.4 Statistical Analysis

4.4.1 General Overview

In what follows is a statistical outline of the sonority ratings scored by the tokens' vocalic and consonantal segments with mean values, average, and percentages. This computing offers a scheme to compare the performance of sonority perceptibility with the standard sonority scale.

4.4.1.1 Mean Values and Percentages of Sonority Profiling for Monosyllabic Tokens

Table (1)

A Summary of the Mean Values and Percentages of Sonority Profiling for Monosyllabic Tokens as Compared to Hogg and McCully (1987) 10-Point Scale

Segments	Sonority Scale	Segments	Frequency of the highest sonority value	Mean Value	Average	Percentage	Sonority Scale
Low Vowels	10	æ a:	7 9 10	0.7 0.9 1	0.86	86.66%	10
Mid Vowels	9	e ɔ	5 6 10	0.5 0.6 1	0.7	70%	9
High Vowels & Glides	8	i i: u: w j	7 5 8 6 3 4 3	0.7 0.5 0.8 0.6 0.3 0.4 0.3	0.51	51.42%	8
Flaps	7	r	1 0	0.1 0	0.05	5%	6
Laterals	6	l	2 2 1 1 3	0.2 0.2 0.1 0.1 0.3	0.18	18%	7

(Cont.)

Nasals	5	m n	0 0 0	0 0 0	0	0%	3
Voiced Fricatives	4	v z	0 1	0 0.1	0.1	0.5%	2
Voiceless Fricatives	3	s ʃ	0 0 0 0 1 1	0 0 0 0 0.1 0.1	0.033	3.33%	4
Voiced Stops	2	b d g	0 0 0	0 0 o	0	0%	3
Voiceless Stops & Voiceless Affricate	1	P t k tʃ	0 0 0 0 0 0 0 3 0 1	0 0 0 0 0 0 0 0.3 0 0.1	0.04	4%	5
Total	55	24	100	9.9	2.473	238.91	57
Average	5.5	2.4	4.166	0.412	0.103	9.954	5.7

Table (1) is a summary of the mean values and percentages of the highest sonority rating scored by the sounds of the monosyllabic tokens compared to Hogg and McCully (1987) 10-point sonority profile (for a full tabulating of the different levels of sonority read by these segments, see appendix 2, table 2). A cursory look at this table reveals that low vowels score the highest sonority value as realized by the subjects (86.66)%. As expected, the syllable nuclei are the most recognizable elements as they represent the peak of sonority. Marginal elements (consonants) score lower sonority values. Vowels sonority profile goes up as we move down towards the lowest tongue position. Put differently, the long low back vowel /a:/ registers the greatest rating, with a frequency of

ten points and a mean value (1).The short low front vowel /æ/occupies the second rank where sonority values scored are 7 and 9 with the mean values 0.7 and 0.9, respectively.

Mid vowels come next along sonority scale. Sonority percentage of these vowels is 70%. The highest rating was read by the short mid back vowel /ɔ/ with a mean value of 1 point and 1o points of frequency. The short mid front vowel /e/

comes later with the mean values (0.5) and (o.6). The total mean value scored is 0.7.

High vowels and glides occupy the third level of sonority (51.42%). The highest rating was registered by the long front high vowel /i:/ with a frequency of 8 times and 0.8 mean value. The short front high vowel /i/ and the long back high vowel /u:/ score identical mean value average (0.6) where the frequency of the former was 7 points and 5 points subsequently, and the frequency of the latter was 6 points.

The glides (approximants) /w/ and /j/ register lower sonority values in comparison with the high vowels. However, the voiced bilabial approximant /w/ is more realizable as compared to the voiced palatal approximant /j/. The frequencies of sonority for the former are 3 and 4 points with an average mean value of 0. 35, the frequency of sonority for the latter was 3 points with a mean value of 0.3.

Unlike vowels, consonants do not show full coincidence with the sonority hierarchy adopted in this study. They fluctuate up or down the scale being deployed. The approximant /r/ occupies the sixth rank of sonority while the lateral /l/ registers a higher level, level seven. On the other hand, the sonorant nasals /m,n,ŋ/ score two levels down the scale, level 3 instead of 5.In a similar vein, the voiced fricatives/v,z/ show two levels down, 2 instead of 4. The reverse case was elicited in the voiceless fricatives /s,ʃ/ which go up one grade, 4 instead of 3.

According to the standard scale used, voiced stops and voiceless stops are arranged on the last two points of the scale, 2,1. The former score one level higher, 3 for 2, while the latter raise to the fifth rank, 5 for 1, which is beyond the expectation, an incidental outcome.

4.4.2 Sonority Profiling of Monosyllabic Tokens

This section is devoted to sorting out patterns of sonority sequence (sonority sequencing generalization) for monosyllabic tokens in terms of optimality theory. Technically speaking, the sonority principle that governs the phonotactic constraints of these tokens will be sketched out. This principle requires that syllable onsets increase in sonority and codas decrease in sonority, and the sonority peak is inherited in the syllable nucleus (cf. Radford et.al, 1999:90; Crystal, 2003:423; Yavas, 2013: 135; Nathan, 2014: 36), among others.

Figure (1) is a line graph for sonority hierarchy of monosyllabic tokens. It outlines the sonority profiling of these tokens segments via sonority frequency rating. The phonotactic constraint for the token /splæʃ/ reveals that it is a triple onset, a three-element consonant cluster /spl/. Sonority scale increases with the voiced lateral sonorant /l/ ,which registers sonority value (2), reaching to the highest value with the short front mid-vowel /æ/ (value 7), and gradually decreases at the voiceless post-alveolar fricative obstruent /ʃ/ with the sonority value (1).

The second token /twelv/ is double onset /tw/. The onset sonority gradually increases form (0) to (3) at the voiced bilabial sonorant /w/. The most sonorous segment is the short mid-vowel /e/ with the sonority value (5). The two-consonant coda /-lv/ gradually decreases in sonority from (2) at the voiced lateral sonorant /l/ to (0) value at the voiced labio-dental fricative obstruent /v/.

Token 3, /pri:tʃ/, starts with double onset /pri:/ where sonority value goes up from (0) to (1) at the voiced post-alveolar sonorant /r/. Sonority peak is realized on the nucleus, the long front high vowel /i:/ (value 8), and goes down at the one-consonant voiceless post-alveolar obstruent coda , /tʃ/ (value 1).

The fourth token, /læpst/, contains a single onset, the voiced alveolar lateral sonorant /l/. Within sonority constraint, this onset reads (1) sonority value. Sonority reaches its highest grade with the peak, the short front mid vowel /æ/ scoring value (9). The respective target terminates with triple coda /-pst/ where all elements register null sonority value.

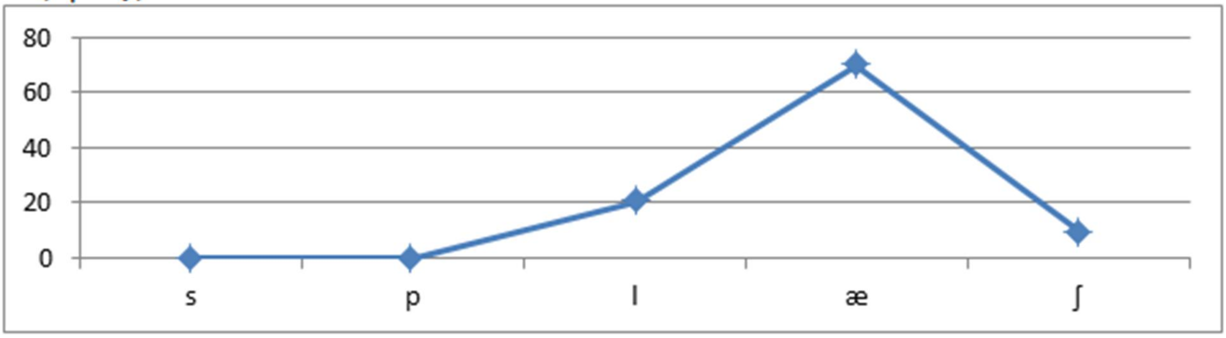
The incidental sonority constraint is elicited in token 5, /stik/. The double onset /st/ registers null value for both elements. As usual, sonority peak is inherited in the nucleus, the short front high vowel /i/ scoring sonority frequency (7). The coda, the voiceless velar stop obstruent /k/ registers higher sonority rating (3) as compared to the onset.

The token /bɔnd/ starts with the voiced bilabial obstruent /b/ which registers null sonority grade. The highest sonority rating (10) is taken by the nucleus, the short back mid-vowel /ɔ/. The double coda, /-nd/ also shows null sonority value. In a similar vein, token 7 /gra:s/ initiates with null sonority value as scored by its onset, reaching the greatest sonority rating (10), and terminates with null sonority value.

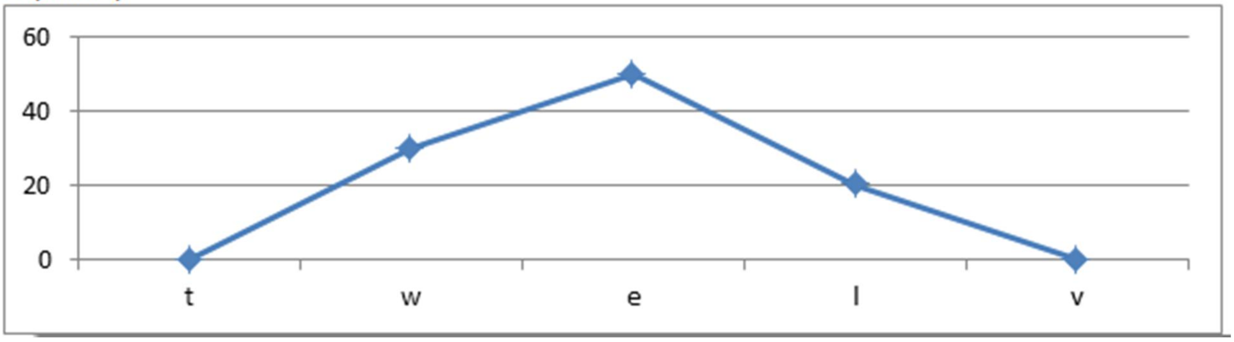
Sonority profiling for the target /nju:z/ is in full coincidence with the sonority sequencing constraint. The double onset /nj/ reads gradable rating (0-3), respectively. Sonority peak is occupied by the nucleus (grade 6), the long back high vowel /u:/, then it falls down on the single coda, the voiced alveolar fricative obstruent /z/. A similar situation is found in the token /kwilt/, where sonority rating gradually raises on the double onset, /kw/ (0-4), moving up to the peak, the short front high vowel /i/ with sonority value (5). The double coda /-lt/ registers a lower sonority rating as compared to the onset, (0-1).

Another sonority profiling discrepancy is embodied by the last token /smel/. Sonority rating decreases from (1-0) on the two-element onset /sm/, nasals are supposed to inherit higher sonority value than the voiceless fricatives. The peak of sonority (grade 6), as usual, falls on the nucleus, the short front mid-vowel /e/, and coda sonority value is higher than the onset value (3-1), in the order mentioned. The line graphs below trace sonority profiling of the tokens analyzed so far.

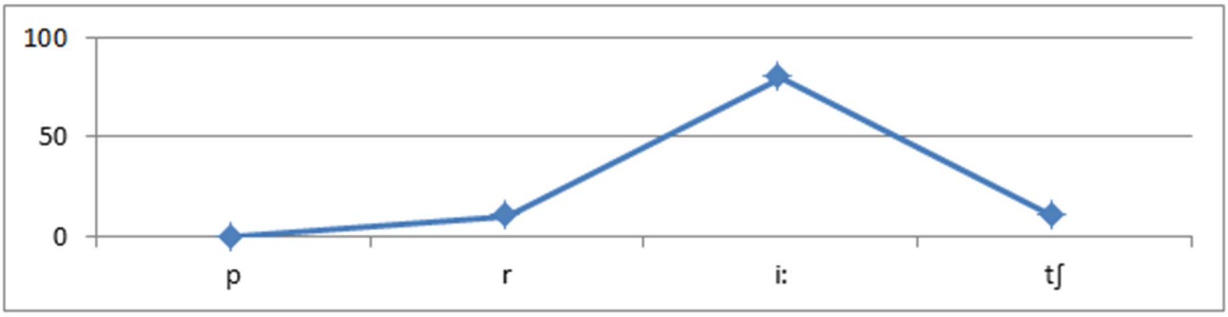
1- /splæʃ/



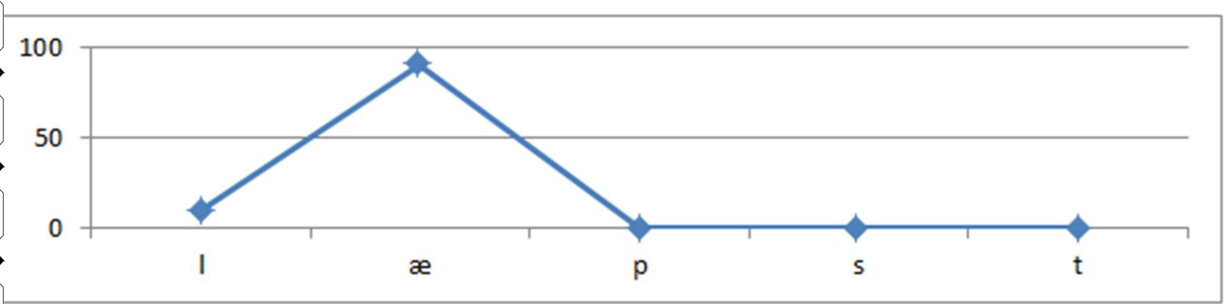
2- /twelv/



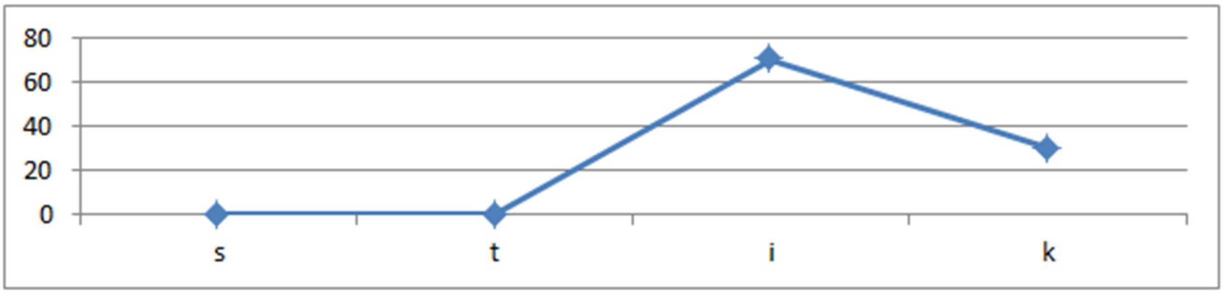
3-/pri: tʃ/



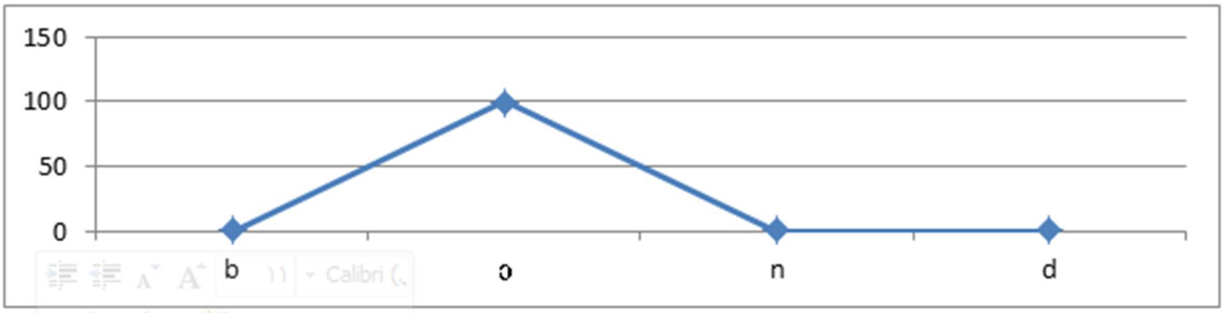
4-/læpst/



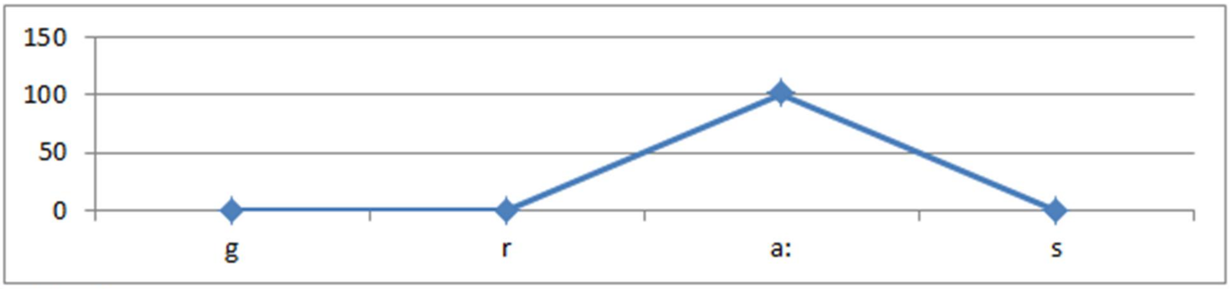
5-/stik/



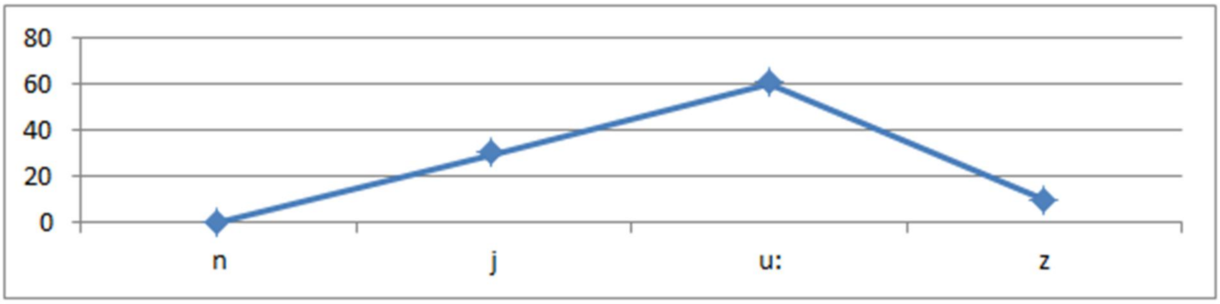
6-/bɔnd/



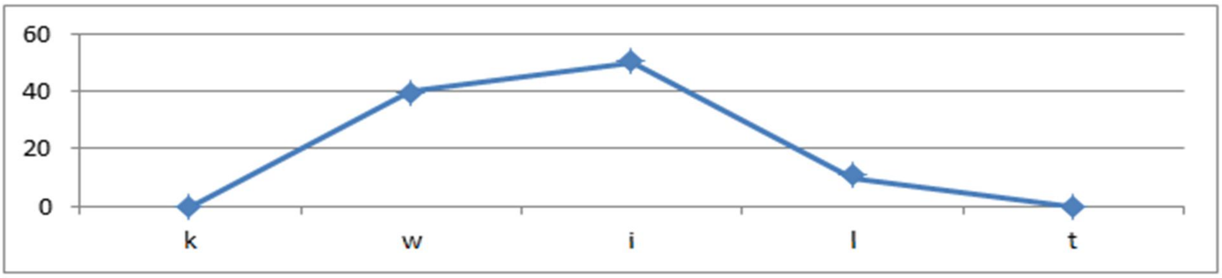
7-/gra:s/



8-/nju:z/



9-/kwilt/



10-/smel/

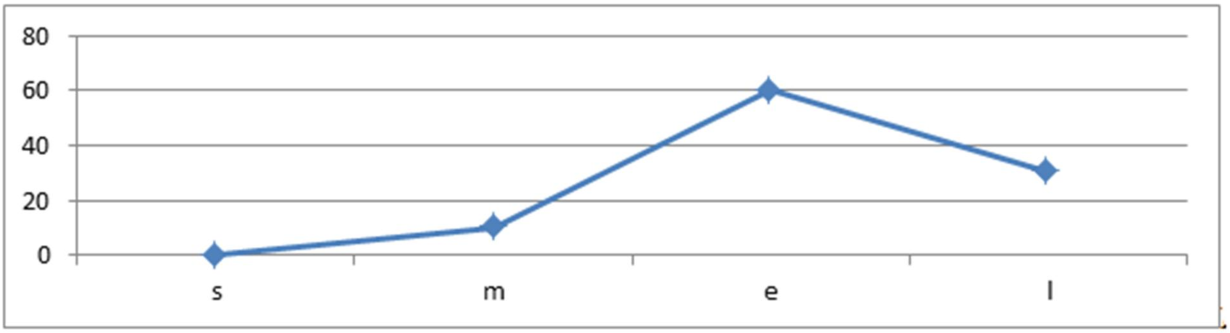


Figure (1) Line graphs of monosyllabic targets sonority profiling

4.4.3. Percentage Analysis and Mean Values for Bisyllabic Tokens

Table (2)

A Summary of the Mean Values and Percentages of Sonority Profiling for Bisyllabic Tokens as Compared to Hogg and McCully (1987) 10-Point Scale

Voiced Fricatives	4	v □	0 1	0 0.1	0.1	10%	5
Voiceless Fricatives	3	s ʃ θ	1 1 0 3 2 1	0.1 0.1 0.1 0.3 0.2 0.1	0.15	15%	6
Voiced Stops	2	b d	1 0 1	0.1 0 0.1	0.1	10%	5
Voiceless Stops & Voiceless Affricate	1	P t k	0 0 0 0 0 0	0 0 0 0 0	0	0%	4
Total	55	24	100	9.2	2.67	267.66	63
Average	5.5	2.4	3.33	0.30	0.089	8.922	6.3

Table (2) is an outline of the percentages and mean values of the highest sonority values as scored by the sounds of the bisyllabic tokens (for details on the mean values and percentages of the various levels of

sonority scored by these segments, see appendix 2, table 2). The objective behind implementing two-syllable tokens is to check if there is any efficacy to the size of the word on the perceptibility of sonority. Stated otherwise, to conclude whether increasing the number of the syllables of the token deteriorates sonority profiling recognition.

A quick glance to the figures presented by this tabulation reveals that vowels sonority recognition is in total agreement with the sonority scale implemented in this study. The highest rating of sonority is registered by the low vowels /æ,a:/ with the mean values 0.7,0.8 for the former, and 0.9 for the latter. The general percentage for these vowels is 80%. The mid vowels /e, □, ə, ɔ:/ are placed on the second level of the scale with a total percentage of 64%. The mean values registered by these vocalic elements are 8,7,0,1 for the first, 7 for the second, null value for the third and 10 for the last. The high vowels / i, i:, u / come in the third rank with a total percentage of 62%. The mean values scored by these segments are 6,0,1 for the first, 8,10, for the second, and null value for the third.

The ratio of sonority values of the consonants of bisyllabic tokens reads a big divergence to the available scale. This ratio stands at 7-4 for flaps, 6-5 for laterals, 5-7 for nasals, 4-5 for voiced fricatives, 3-6 for voiceless fricatives, 2-5 for voiced stops and 1-4 for voiceless stops. It therefore follows that sonority hierarchy for these segments can be arranged as follows: nasals, voiceless fricatives , laterals -voiced fricatives- voiced stops, flaps- voiceless stops.

4.4.4. Sonority Profiling for Bisyllabic Tokens

Having stated the relative sonority of bisyllabic tokens sounds, we are now ready to examine the principle of peaks of sonority (sonority constraint principle) of each syllable of these stimuli. Figure (2) below is a line graph which outlines sonority profiling for the first and second syllables of the bisyllabic tokens. The data included in this figure are adopted from table (2), appendix (2).The first syllable in the token /b□ndl/, /b□n /, is a single onset which registers sonority value (1). The

peak of sonority is inherited in its nucleus, the short mid vowel /□/ with sonority frequency (7). Sonority drops on the single coda , the voiced alveolar sonorant /n/ with sonority rating (1). The second syllable ends with the syllabic consonant /l/. Frequency of sonority tabulated in the second level of sonority value, table (2), appendix (2) clearly shows that these values coincide with sonority constraint to a great extent.* The single onset of this syllable, the voiced obstruent /d/ scores sonority rating (1), and sonority peak is taken by the syllable nucleus , the syllabic sonorant /l/ with sonority value (3).

The first syllable of the second token /mi:niŋ/, /mi:/ is a single onset where the nasal sonorant /m/ registers sonority rating (2). Sonority peak is inherited by the nucleus, the long high vowel /i:/ on which sonority value goes up to (8). Once again sonority sequencing principle operates properly on the second closed syllable /niŋ/. Sonority raises gradually from the onset to the nucleus 3-4, and finally drops on the nasal sonorant single coda /ŋ/, with sonority value (2).

Token 3, /væniʃ/ begins with the voiced fricative obstruent /v/ with null sonority value. Sonority peak is occupied by the nucleus, the low front vowel /æ/ where sonority rating reads (7). The adjacent syllable /niʃ/ is a single onset and coda. Sonority profiling initiates with value (2), reaching the highest value (6), and finally falls on the voiceless fricative obstruent /ʃ/, which registers null value.

The next token, /tɔ:kə/ comprises two open syllables, /tɔ:/and /kə/.The sonority value will raise as we move from the onset towards the nucleus of each syllable, 0-10 in the first syllable, and 2-5 in the second one.

Stimulus 5 /sækful/ comprises two short closed syllables patterning as /cvc/. In the first syllable, /sæk/ sonority sequencing goes up from 1 to 8,

*Sonority profiling for the second syllable of these tokens is based on the second higher level of sonority values included in table (2), appendix (2), since these values represent the actual sonority profiling for these syllables as revealed by the subjects' responses where auditory focus is distributed over the two syllables.

then it drops on the single coda, the voiceless obstruent /k/. Sonority behaves exceptionally in the second syllable, where both the onset and the coda have equal value (null value each). However sonority peak is upheld by the nucleus, the short high vowel /u/, which scores level (7).

The sixth token, /pri:sel/ contains an open long syllable /pri: /which initiates with double onset /-pr/. Both elements of the onset read null sonority value, while sonority is inherited in the peak, the long high vowel /i:/ scoring level (9). The second syllable, /sel/ is a short closed one with single onset and coda, which both score equal sonority value (level 1). Peak of sonority (value 6) is received by the centre, the short mid-vowel /e/.

Stimulus 7, /fiʃnet/ consists of two short closed syllables concatenated as /cvc/. The single onset /f/ receives unexpected null sonority value as compared to the coda of the same syllable, / ʃ/,which takes sonority value (3). Sonority reaches its peak with the nucleus (value 6), the short high vowel /i/. The same stance is traced in the second syllable since the single coda, the voiceless plosive obstruent /t/ acquires level (1) as compared to the single onset, the voiced nasal sonorant /n/, with null value. The highest rating of sonority is received by the nucleus, the short mid vowel /e/.

The eighth token /pla:stə/ is made up of one long closed syllable /pla:s/ and a short open one /tə/. The double onset of the first syllable /-pl/ registers unexpected null sonority value for both elements. Sonority peak, as usual, raises to its highest level (grade 9) on the nucleus, the long low vowel /a:/, then it drops on the single coda, the voiceless fricative obstruent /s/ which acquires sonority level (1). The single onset of the second syllable, the voiceless plosive obstruent /t/ takes sonority value (1), raising to value (4) on the peak, the short mid-vowel schwa /ə/.

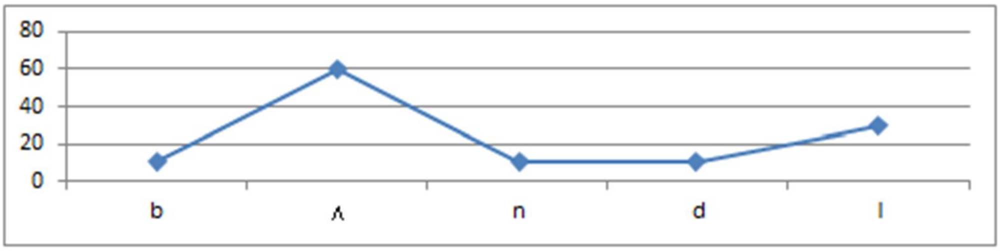
Stimulus 9 /meɵəd/ contains a short open syllable /me/ and a short closed one /ɵəd/. The single onset, the voiced nasal sonorant /m/ scores null sonority value, which is beyond expectation. The nucleus, the short

17

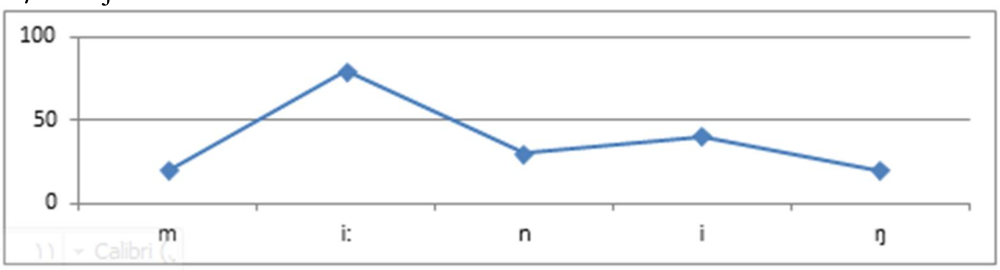
mid vowel /e/ inherits sonority value (level 7). Sonority sequencing constraint operates properly on the second syllable. Sonority relatively raises at the single onset, the voiceless fricative obstruent /ɵ/ (value 2), reaching its peak on the schwa, the syllable centre (value 4), and finally decreases on the single coda, the voiced plosive obstruent /d/ (value 1).

The last stimulus /me□ə/ is built from two short open syllables /me/, /□ə/. The single onset of the first constituent, the voiced nasal sonorant /m/ acquires sonority value 2 and the nucleus, the short mid-vowel /e/ receives the sonority peak (value 7). A total different scenario is routed in the second constituent where the single onset, the voiced fricative obstruent /□/ registers more sonority value in comparison with the nucleus (4-3), which is the only default sonority constraint exhibited in the nuclei of the test stimuli.

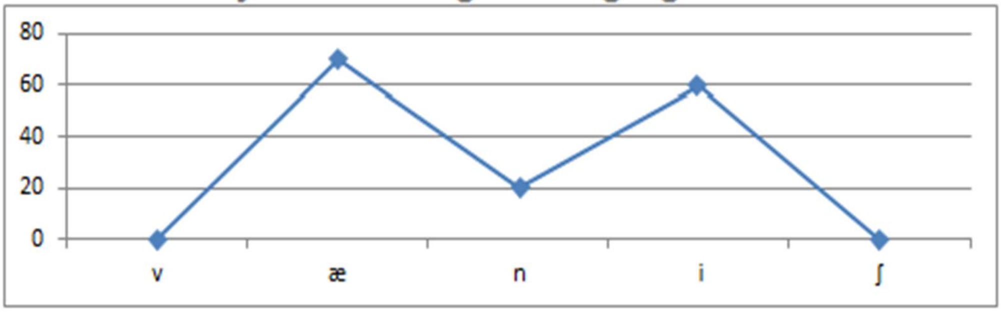
1-/b□ndl/



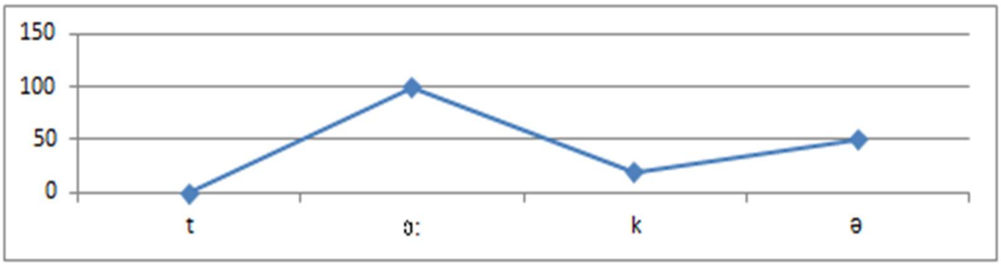
2-/mi:niŋ/



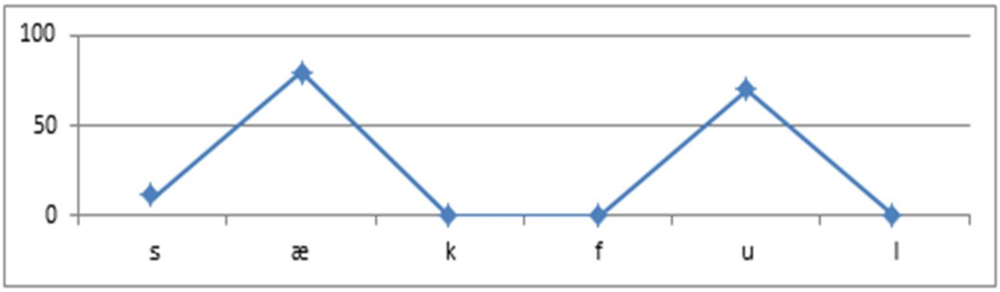
3-/væniʃ/



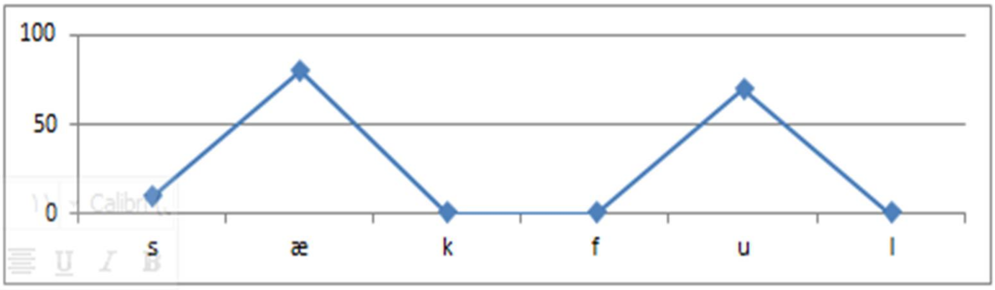
4-/tɔ:kə/



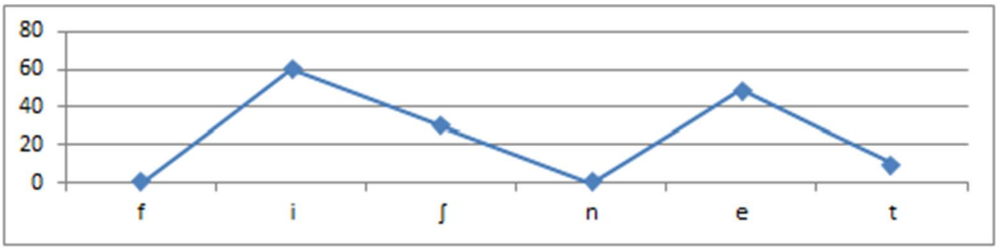
5-/sækful/



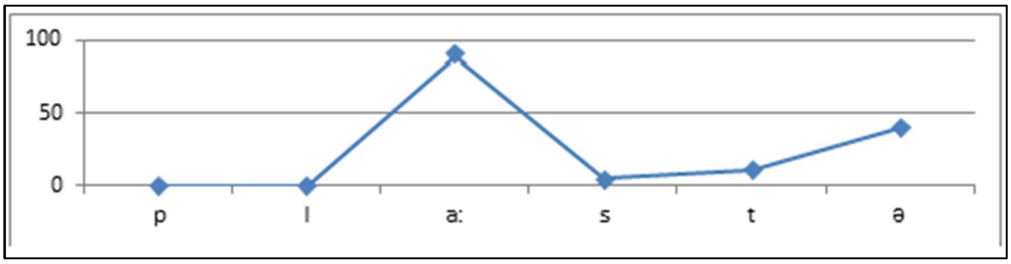
6-/prisel/



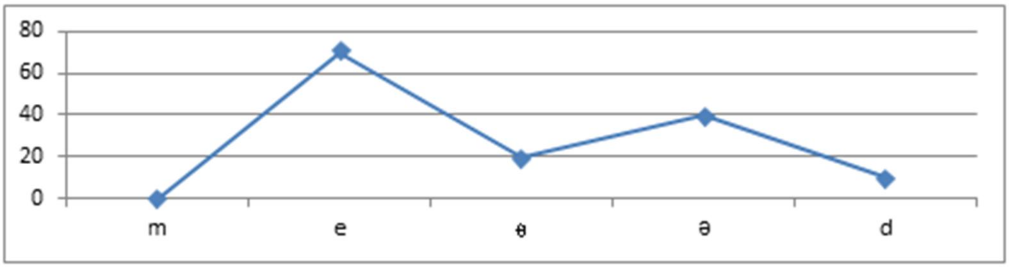
7-/fiʃnet/



8-/pla:stə/



9-/meθəd/



10-/me□ə/

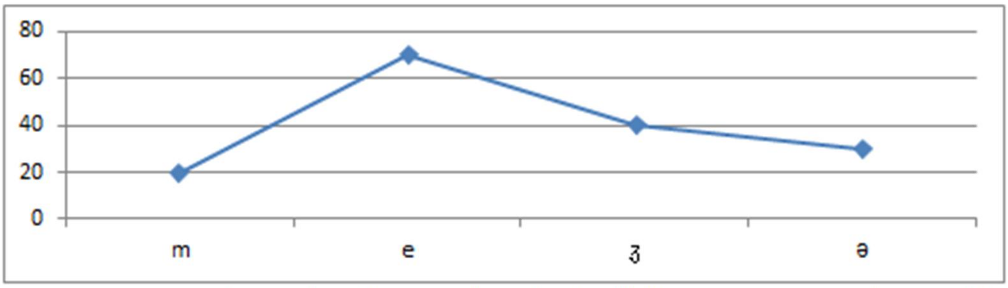


Figure (2) Line Graphs of Bisyllabic Targets Sonority Profiling

4.5. Analysis of the Sample Spectrograms

A long-stand controversy in the interface between phonetics and phonology implies the nature of sonority. The impetus of this controversy revolves around the inadequacy of relying on a single property to identify the relative sonority of segments. Clements (1990:298), for example, advocates this proposal and claims that " sonority cannot be defined in terms of any single, uniform physical or perceptual property". A similar view is upheld by Parker (2002, 2008) who thinks that sonority is generally defined either articulatorily, based on the degree of openness of the vocal tract, or in terms of acoustic correlates such as the intensity of a given segment. Generally, it is assumed that " acoustic evidence is often referred to when one wants to support an analysis being made in articulatory or auditory phonetic terms" (Crystal, 2003:7).

Such controversy led to the assumption that sonority is best identified in terms of a linear regression equation derived from the observed acoustic results (www.researchgate.net), and that sonority profiling is grounded in physical properties of sounds such as intensity, peak intraoral pressure, F1 frequency and peak air flow duration (Parker,2002). The aforesaid perspectives furnished the way towards a more comprehensive and the least phonologically biased study on sonority (Moren, 2007).

However, some scholars are still skeptical about the influential role of these acoustic parameters. This is confirmed by enstowicz (1994: 54) who maintains that " a simple phonetic correlate to the phonological property of sonority has yet to be discovered", and that none of the sonority proposals " has succeeded in reducing sonority to some more basic theoretical principle" (Dogil, 1992: 392). It has been found in Parker (2002), as a case in point, that the relative sonority can slightly oscillate depending on the phonetic context and on the physiological properties of the speaker where slight differences on sound sonority are detected in males and females. From a mechanical perspective, it is stated that acoustic analyses are subject to mechanical limitations, " which are often themselves open to multiple interpretations" (Crystal, op.cit.). This substantive uncertainty in finding theoretical or empirical correlates of sonority has led many researchers to give up the explicit definition of sonority and refer to a gradual scale- the sonority hierarchy" (Dogil, op.cit.).

To help highlight the nature of this interface, and to supplement a further empirical physical evidence relevant to sonority, we will examine the acoustic correlates of the segments of sample tokens. Due emphasis will be given to intensity (since it is the most reliable acoustic predictor of sonority, Parker, 2000) and F1 formant reading.*

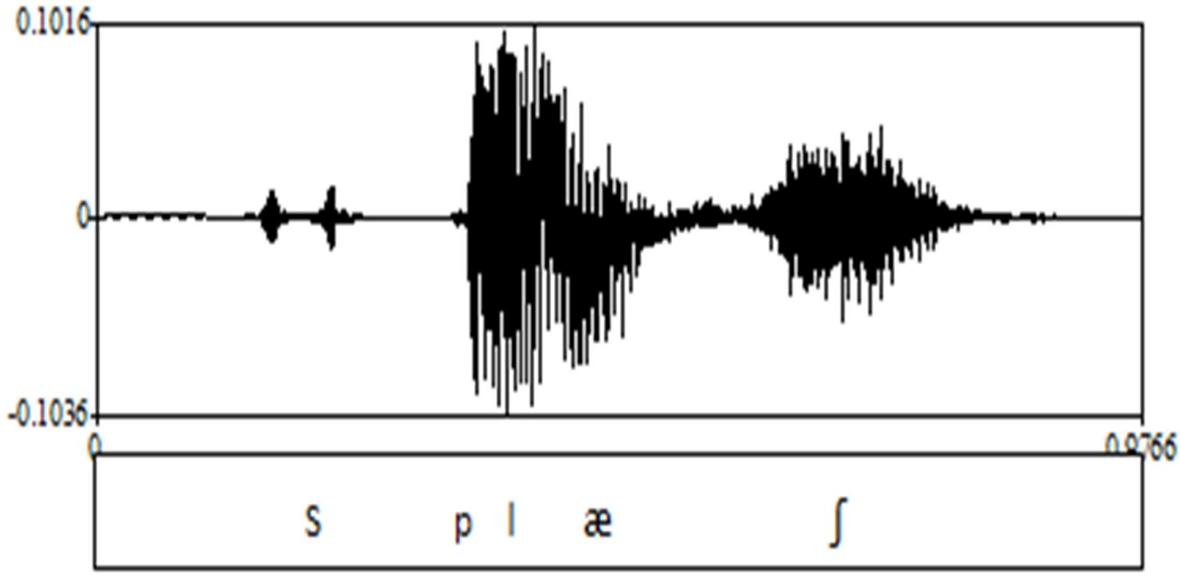
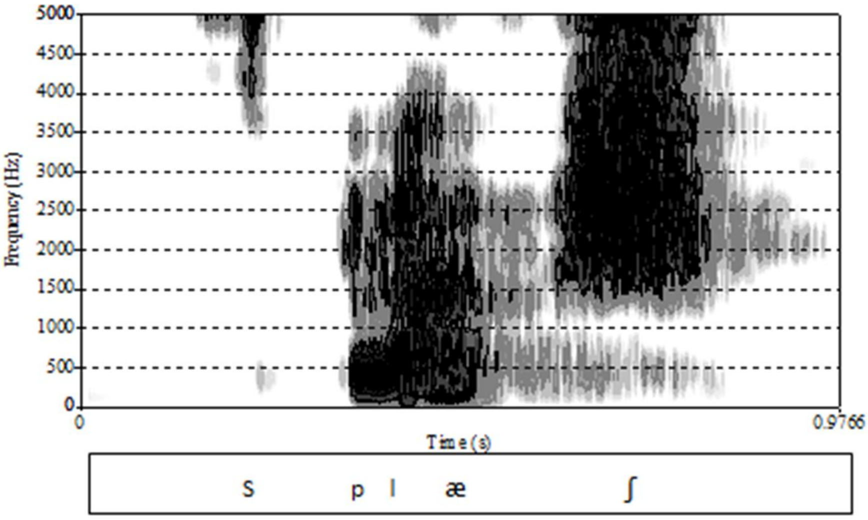


Figure (3) Waveform of the target /splæʃ/



F0: s:4500 Hz, p: 2400 Hz, l: 425 Hz , æ: 420 Hz, ʃ: 2850 Hz

Figure (4) Spectrogram of the target /splæʃ/

* Waveforms, spctrograms, and intensity records included in this section are the output of the analysis of the speech of the same talker of whom the tokens were recorded, Oxford Dictionary Online. The software deployed for acoustic measurements is PRAAT (Version 9. 0).

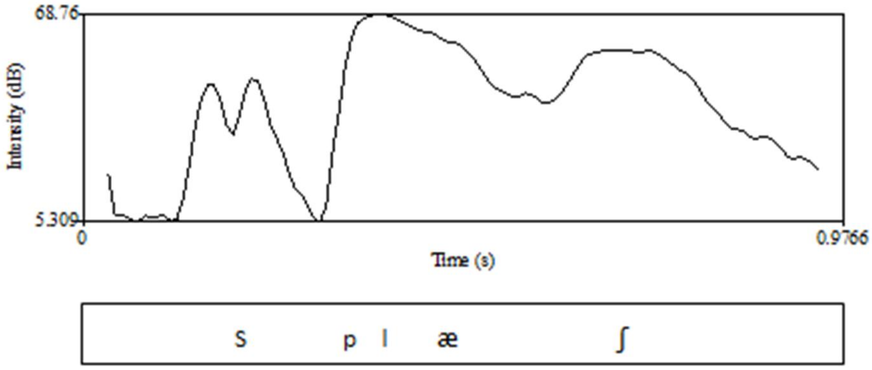


Figure (5) Intensity of the target /splæʃ/

As stated by Ladefoged (1993:187), " acoustic intensity is the appropriate measure corresponding to loudness". This intensity is proportional to the amplitude of the variations in air pressure. A rough assessment of the comparative intensity of two sounds can be attained with reference to their waveforms.

According to the intensity scale, vowels have the highest intensity. The lateral and nasals have slightly less intensity than vowels, voiced fricatives have very little intensity. Voiceless plosives show no intensity during closure (ibid.).

Figure (5) is a record of the intensity of the segments of the token /splæʃ/. It starts with (5.309) dB (decibels) with the voiceless fricative obstruent /s/, then it descends to zero (dB) during the closure of the voiceless plosive obstruent /p/. It increases to less than 68.76 (dB) with the lateral sonorant /l/ reaching to its highest level (68.76) (dB) with the peak /æ/, then it drops down to (0.9766) with the coda, the voiceless fricative obstruent /ʃ/. This intensity profiling can be easily calculated by counting the number of the small vertical lines in the waveform of the same target (Figure 3) which correspond to the pulses produced by the vibrating vocal cords. As for F1 value of the short front vowel /æ/, shown in (Figure 4), it reads (690 Hz).

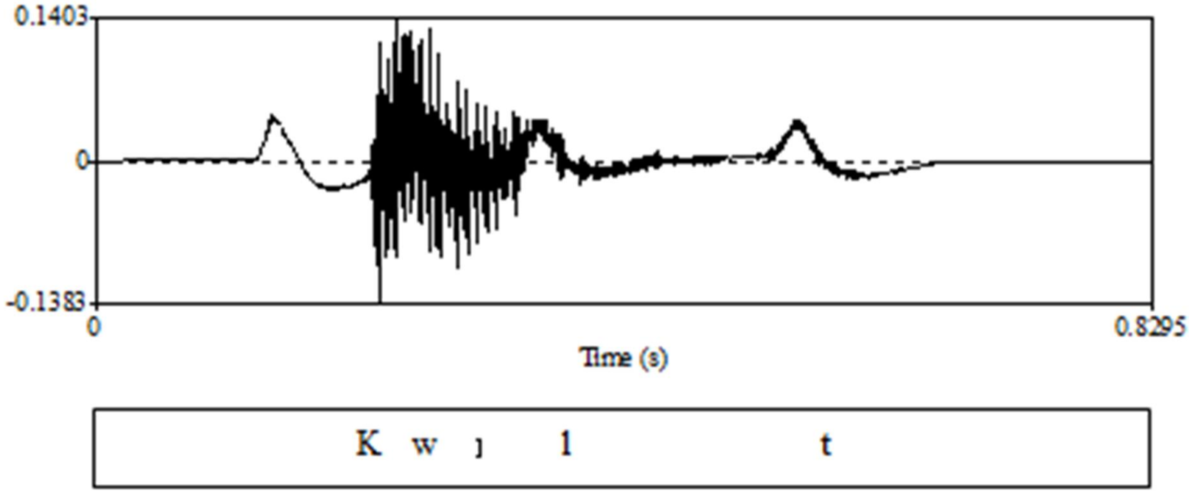
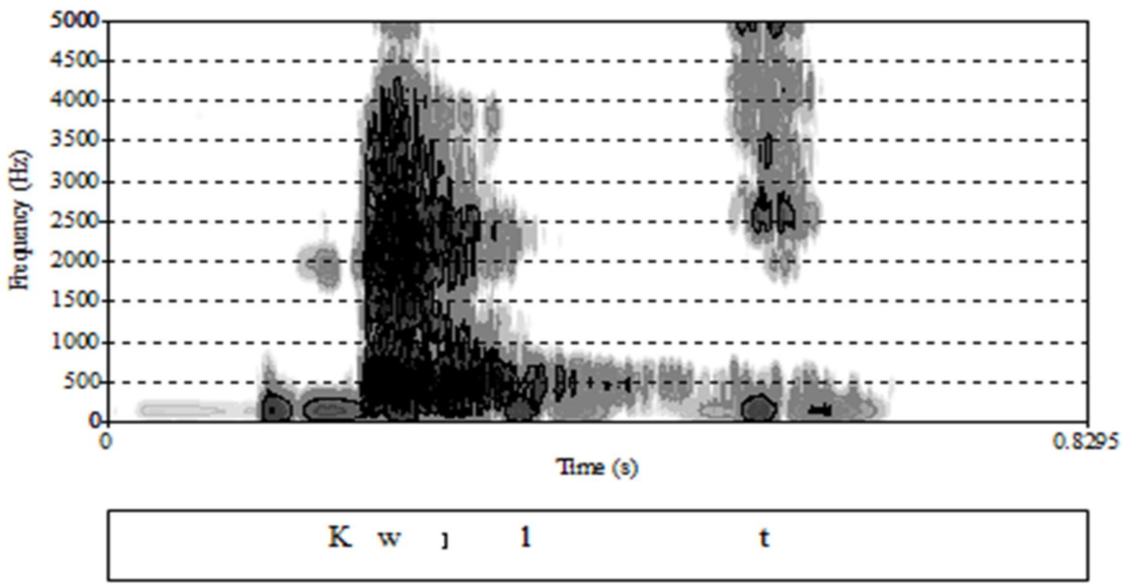
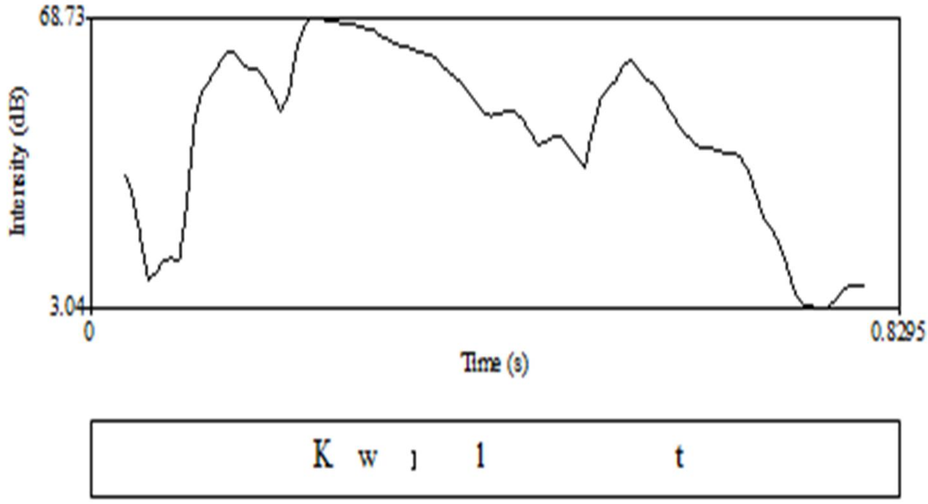


Figure (6) Waveform of the target /kwɪlt/



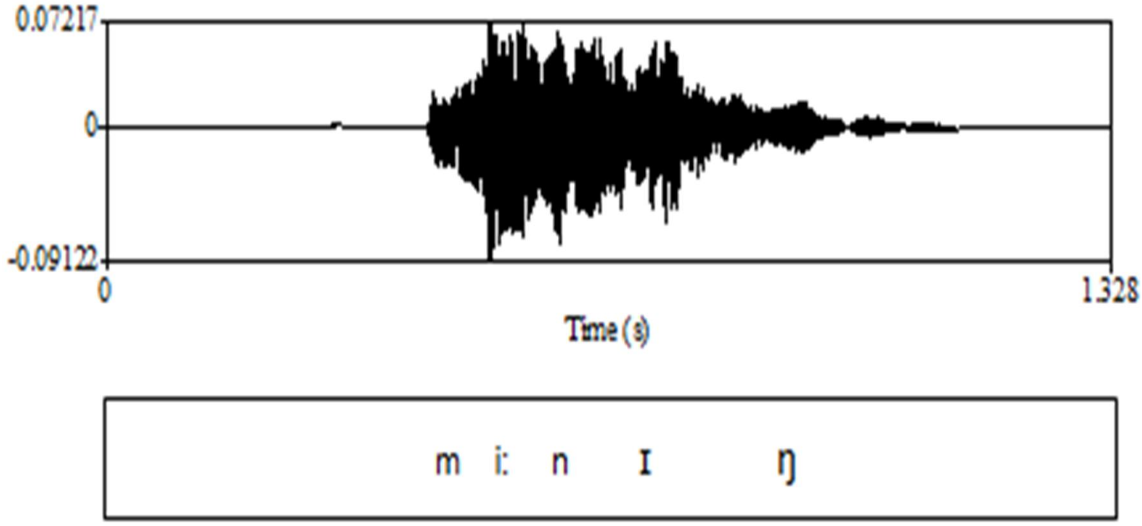
k: 2100 Hz, w: 500 Hz, ɪ: 450 Hz, l: 380 Hz, t: 250 Hz

(Figure 7) Spectrogram of the target /kwɪlt/

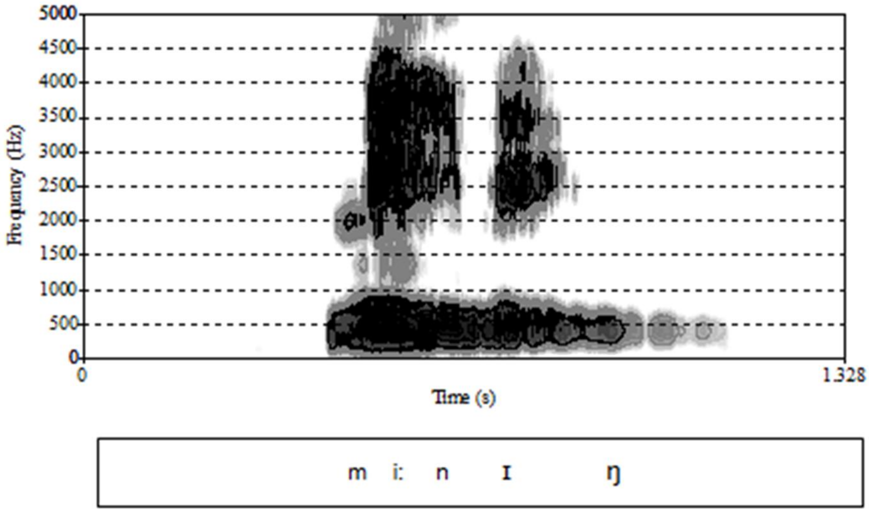


(Figure 8) Intensity of the target /kwɪlt/

Figure (8) represents intensity values for the segments of the token/kwɪlt/. Intensity scale initiates with 3.04 (dB) for the voiceless plosive obstruent /k/. It increases to less than 68.73 (dB) with the approximant sonorant /w/, reaching to the peak (68.73) with the nucleus, the short front vowel /ɪ/. It drops down with the pre-final lateral /l/ (less than 68.73 (dB). It finally descends to (0. 8295) (db) during the closure of the voiceless plosive obstruent /t/ followed by a silence. This intensity profiling can be easily read by calculating the pulses of each segment illustrated in the waveform of this target (Figure 6). As for F1 value of the peak /ɪ/ (shown in figure (7)), it reads (400 Hz) as illustrated in the respective spectrogram.

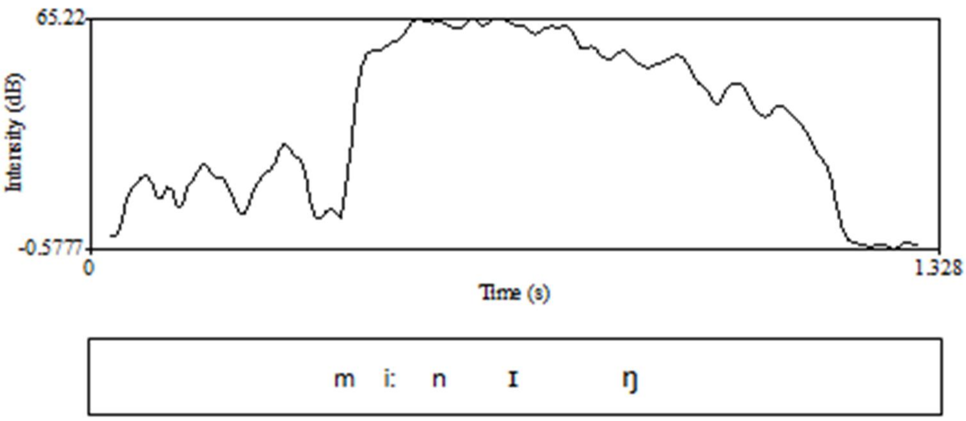


(Figure 9) Waveform of the target /mi:nɪŋ /



F0: m: 400 Hz, i: 470 Hz, n: 380 Hz, ɪ : 450 Hz, ŋ: 390 Hz

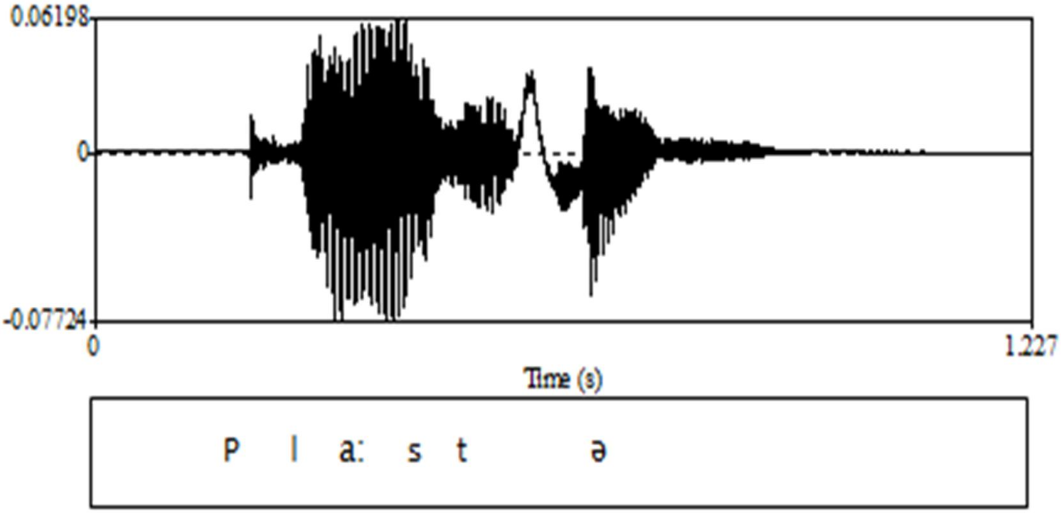
(Figure 10) Spectrogram of the target /mi:nɪŋ/



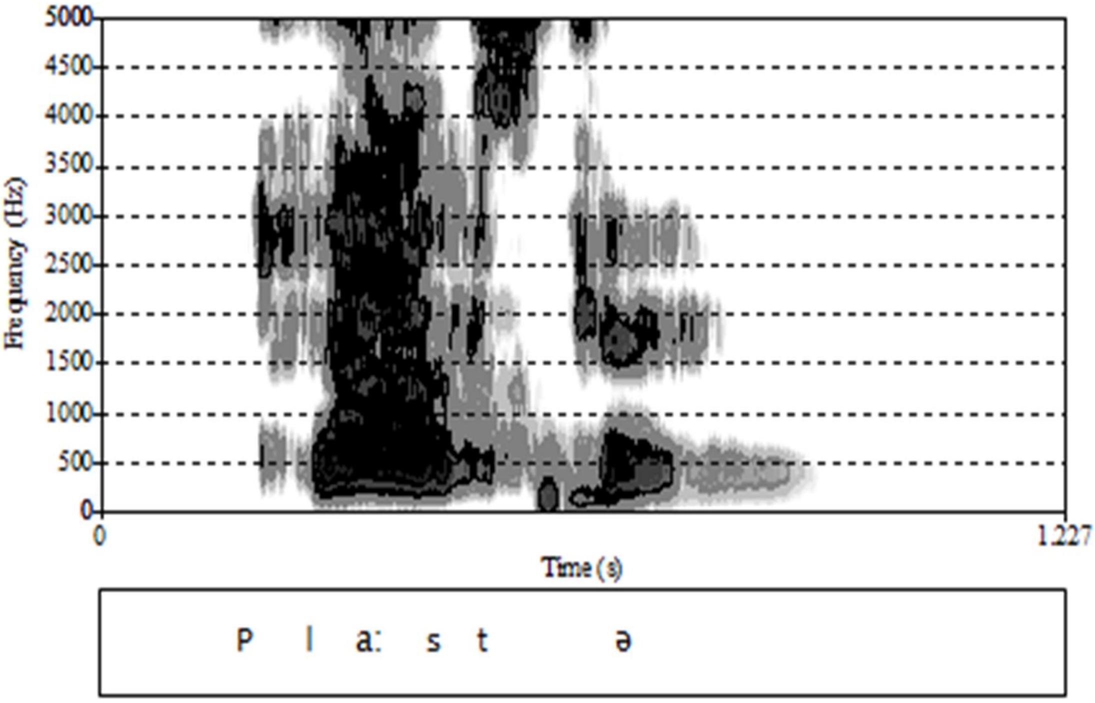
(Figure 11) Intensity of the target /mi:nɪŋ/

If we look at Figure (11), we can make the following observations. Intensity value starts with (0.5777) dB with the single onset of the first syllable /mi:/. It goes up to the highest level (65.22) dB with the nucleus of that syllable, the long front vowel /i:/. Intensity value drops down on the single onset of the second syllable /nɪŋ/. Then it goes up to a second peak with the nucleus /ɪ/ scoring sonority value more than (65.22) dB. Intensity profiling finally drops down on the single coda of the second syllable, the nasal sonorant /ŋ/. Loudness rating descends to 1.328 dB. This intensity scale can be compared with the number of pulses registered by the segments of this target as read in Figure (9), the waveform chart.

As for F1values of the long front vowel /i:/ and the short front vowel /ɪ/ , as shown in Figure (10), these vowels portions on the spectrogram contain a series of thin vertical lines (striations) whose darkness varies with loudness. The former vowel is characterized with less darkness with F1 value (270) Hz, while the latter is characterized with more darkness with F1 value (400) Hz.

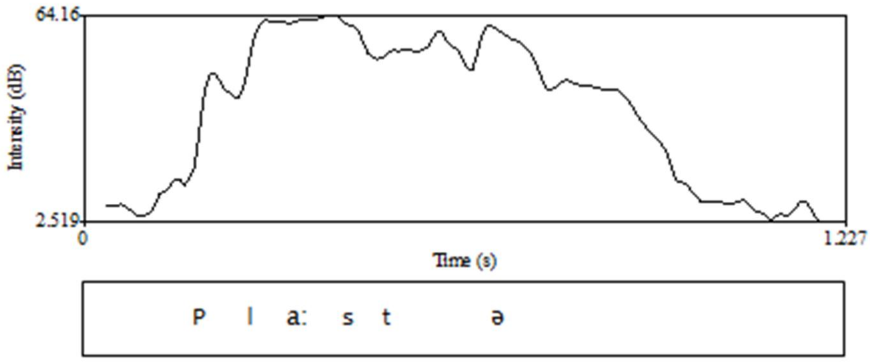


(Figure 12) Waveform of the target /plɑ:stə/



p: 2740 Hz, l: 500 Hz, ɑ: :550 Hz, s: 3500 Hz, ə : 400 Hz

(Figure 13) Spectrogram of the target /plɑ:stə/



(Figure 14) Intensity of the target /plɑ:stə/

The intensity chart of the target /plɑ:stə/ (Figure 14), traces the intensity scale of the two syllables. It starts with the value (2.519) dB with the voiceless obstruent plosive /p/ and moves up to less than (64.16) dB with the lateral sonorant /l/. It reaches the highest level (64.16) dB with the peak, the long front vowel /ɑ:/. It then gradually falls down on the voiceless obstruent /s/ and the voiceless obstruent plosive /t/ reaching to its lowest level on the nucleus of the second syllable, the schwa /ə/ scoring (1.227) dB value.

This intensity profiling once again can be simply calculated by counting the number of pulses illustrated by the waveform of this target (Figure 12). If we examine the spectrogram of this token (Figure 13), we can identify F1 values for the two peaks /ɑ:/ and /ə/ which are respectively, (710) Hz and (500) Hz. The portion of the former, as can be detected on the spectrogram, is characterized by more darkness compared with the portion of the latter.

5. Results and Analysis

The sonority perceptibility ratings scored in tables 1and 2 as compared to the implemented scale, generally reveal that there is a total coincidence in the vowels scaling (as segment groups). As such, the subjects' responses support the auditory principle which states that sonority peak is inherited in the syllable nucleus. This is verified both in monosyllabic and bisyllabic words, regardless of the number of syllables a particular word has (see table 3 below for contrastive outlook). Technically speaking, vocalic elements are the most prominent segments within the syllable licensing.

Sonority ratings irregularity and fluctuation are clearly seen in consonantal scaling. They either move up or down the scale. This is due to the fact that recognition is primarily a cognitive process that is affected by a variety of parameters; the speech tempo, the acoustic properties of sounds as embodied in

the acoustic formants, the sound overlap, the efficacy of articulatory factors such as the degree of vocal
tract openness, viz, the amount of stricture, sound intensity, phonetic context, sound input processing, perception accuracy, among other parameters. The consonants of monosyllabic targets that register higher rating than the scale are laterals, voiceless fricatives, voiced stops, and voiceless stops. The ratios of these segments to the available hierarchy respectively stand at 6-7, 3-4, 2-3, and 1-5 (pointing to the biggest reversal gap). The reverse ratios (those that drop down the scale) of consonants of monosyllabic tokens are those found in flaps, nasals, and voiced fricatives. The scored ratios are: 7-6, 5-3, and 4-2, in the order mentioned.

With respect to the predictability of the SSP , 80% of the monosyllabic targets (8 out of 10) show full compatibility. This finding justifies the emergence of most of the optimal (well-formed) sequences of the targets segments (cf. Geirut, 1999; Parker,2002).The incidental findings are elicited in the tokens /stik/, where the onset sonority is lower than the coda, 0-3, and /smel/ in which sonority profiling goes down over the two elements of the double onset /sm/ (1-0), and rises on the single coda, the alveolar sonorant /l/ scoring level 3.

The segments of bisyllabic tokens that exceeded the available sonority hierarchy (scoring higher rating compared to the scale) are nasals (5-7), voiced fricatives (4-5),voiceless fricatives (3-6), voiced stops (2-5), and voiceless stops (1-4). However, this discrepancy is greater than the one elicited in monosyllabic targets except for the case of the voiceless stops (1-5).The counterpart segments (those that read less ratings against the available scale) are flaps (7-4), and laterals (6-5), which are lesser groups in comparison with their counterparts in monosyllabic targets. (For a summary of the ratios of sonority ratings both in monosyllabic and bisyllabic tokens, see table 3 below).

SSP operates positively in six of the bisyllabic targets. Exceptional discomformity was elicited in the other four targets. In the token /sækful/, both onset and coda of the second syllable are equally weighted (null value each). The two elements of the onset /pla:/ in the token

/pla:stə/ score null value (equally weighted), it is supposed that the lateral approximant is more sonorous than the voiceless stop. As such, the grammar of English regards the sonority of a plosive as being the same to that of the approximant since they concatenate to form double onset. The same assumption might be true for the segments that merge to form a complex coda, regardless of sonority profiling. Radford (1999:90), as a case in point, advocates this proposal and states that " the grammar of English, it seems, regards the sonority of a nasal as being too similar to that of a plosive" since they cluster together to form complex codas as in /sent/ , /dump/, etc. The nasal sonorant /m/ in the stimulus

/meɵəd/ acquires null value. This is a distinct flouting to sonority profiling which states that the onset sonority is higher than the coda. The last flouting to the SSP is embodied in the target /me□ə/ where the voiced fricative obstruent /□/, the single- consonant onset, is realized more sonorous than the nucleus, the short mid-vowel schwa /ə/. This could be interpreted in terms of the laxness of this mid-vowel

Table (3)
A Summary of Sonority Ratios and Percentages in Monosyllabic and Bisyllabic Targets as Compared to Hogg and McCully (1987) Sonority Scale

Segments Category	Available Scale Value	Sonority Ratio for Monosyllabics	Compliance Percentage	Sonority Ratio for Bisyllabics	Compliance Percentage
Low Vowels	10	10-10	86.66%	10-10	80%
Mid Vowels	9	9-9	70%	9-9	64%
High Vowels & Glides	8	8-8	51.52%	8-8	62%
Flaps	7	7-6	5%	7-4	0%
Laterals	6	6-7	18%	6-5	10%
Nasals	5	5-3	0%	5-7	16.66%
Voiced Fricatives	4	4-2	0.5%	4-5	10%
Voiceless Fricatives	3	3-4	3.33%	3-6	15%
Voiced Stops	2	2-3	0%	2-5	10%
Voiceless Stops & Affricates	1	1-5	4%	1-4	0%

6- Conclusions

Based on the exhaustive and thorough account of the predictability of the SSP on the perceptibility of the study targets, and on the acoustic analysis of the sample spectrograms, intensity scales, and waveforms, the subjects' responses either show conformity to this principle or flout it in the manner of sonority reversals and plateaus[*] . In a significant agreement to what is taken for granted in the related literature that sonority profiling normally complies with the SSP, it has been found that monosyllabic tokens reveal compliance of 80% (which is a positive finding), breaking in 20% in a form of sonority reversals (opposite (low)sonority rating). These cases of reversals are embodied in the double onset of the target /stik/ where both elements are equally weighted (scoring null value each), which is lower than the single coda (the obstruent plosive /k /) scoring sonority value (3). The second reversal is elicited in the target /smel/ in which the ratio of the pre-initial sonorant /s/ to the initial sonorant /m/ is 1-0 (an evidence of sonority inclination), and where sonority profiling goes up on the sonorant single coda /l/ (scoring level 3).

With respect to the conformity of bisyllabic tokens, both the first and second syllable show relative compliance with the SSP (60% each), breaking in (40%) in a pattern of sonority reversals (see appendix 2-table-2 for a comprehensive view). Default patterns in the first syllable are elicited in targets 1, 6, 7, 8, while targets 5, 6, 8, and 10 reveal default patterns in the second syllable. The only default pattern of the SSP routed in the nuclei of the test stimuli is shown by the nucleus of the second syllable of the token /me□ə/where the ratio of the onset to the peak is 4-3.This relative predictability in these tokens could be interpreted in terms of the overlap in the processing of the different inputs encoded by the subjects where their attention focusing scatters over two syllable units resulting in some marked (dispreferred) sonority outputs.

* The terms reversals and plateaus are used here antonymously. The former refers to sonority violation to the SSP where sonority sequence patterns as high-low instead of the normal curve, low-high, or when sonority rating drops down the standard scale. The latter is used in a total reverse sense (low-high), though it is originally used in autosegmental phonology (Harmonic Phonology) for a type of a rule in which a sequence of high-low-high is changed to high-high-high (cf. Crystal,2003:357).

In terms of segment categories, all types of vowels (low, mid and high) both in monosyllabic and bisyllabic targets prove full conformity to the implemented scale (this backs up the auditory principle which proposes that sonority peak is rooted in the syllable nucleus). Although monosyllabic words register higher ratings in low and mid vowels in comparison to bisyllabic ones (86.66% vs. 80%, 70% vs. 64%, respectively), bisyllabic tokens register higher ratings in high vowels (62% vs.51.52%).

All consonantal sonority ratings (both in monosyllabic and bisyllabic) do not exhibit full degree of conformity. In monosyllabic targets, three consonantal categories (42.85%)reveal sonority reversal where sonority ratio is slightly lower than the implemented scale. These reversals are scored by flaps (7-6), nasals (5-3), and voiced fricatives (4-2). The other four categories (57.14%) show higher ratings than the standard scale (patterning as sonority plateaus). These are laterals (6-7), voiceless fricatives (3-4), Voiced stops (2-3), and voiceless stops and affricates (1-5).

A different stance is found in bisyllabic targets where five categories (71.42%) show sonority plateaus, while only two (28.57%) exhibit sonority reversal, as compared to the standard sonority scale. The former case is registered by nasals (5-7), voiced fricatives (4-5), voiceless fricatives (3-6), voiced stops (2-5), and voiceless stops (1-4). The latter case is elicited in flaps (7-4), and laterals (6-5).

The incidental outcomes of this study are revealed by the significant higher ratings scored by four consonantal categories in bisyllabic tokens in comparison to the monosyllabic ones. These categories are nasals (16.66% vs. 0%), voiced fricatives (10% vs. 0.5%), voiceless fricatives (15% vs. 3.33%), and voiced stops (10% vs. 0%). Conversely, three consonantal groups in monosyllabic targets register significant higher sonority ratings as compared to the bisyllabic targets.

These categories are flaps (5% vs. 0%), laterals (18% vs.10%), and voiceless stops and affricates (4% vs. 0%).

Acoustically speaking, intensity profiling for the sample targets (together with the waveforms and spectrograms), totally coincides with sonority profiling and the SSP. Intensity (loudness) increases gradually on the onset, reaching it maximum value on the peak. Then, it drops down on the coda. Spectrographic analysis heavily supports vowels sonority profiling where F1 value (tongue height parameter) inversely increases as we move downward. That is, loudness rating increases as we move downward to the open position, and gradually decreases as we move upward to the close position.

6- Suggestions for Further Work

Due to the considerable incompatibility to the sonority scale implemented in this work, and the relative divergence to the SSP, as a predictor of sonority profiling, perceptibility theory advocated by Wright (2004), and Moreton et.al. (2008), among others, might be thought of as an alternative model. The efficacy of gender variation in the recognition of sonority profiling merits further auditory and acoustic research works, as well.

المستخلص

تعنى هذه الدراسه بإدراك سلم رنين الاصوات الإنجليزية كما يؤديه المتعلمون العراقيون المتقدمون من خلال تطبيق مبدأ تدرج الرنين(SSP) .تمثل العينة التي استعملت في البحث (10) طلبة دراسات عليا في قسمي اللغة الإنجليزية- كليتي الاداب والتربية- جامعة البصرة للسنة الدراسية (2014-2015). أما الكلمات التي استعملت في البحث فهي عشرون كلمة، عشر منها أحادية المقطع والعشر ألأخرى ثنائية المقطع. وقد تم اخضاع نتائج البحث الى تحليل المتوسط الحسابي والنسب المئوية. ومن اجل الحصول على افضل النتائج، فقد تم استخدام نماذج من منضارالتحليل الصوتي (Spectrogram) لبعض الكلمات المستخدمة في البحث وكذلك الرسوم البيانية الخاصة بشدة الصوت والموجات الصوتية. وبإعتماد مقياس الرنين الذي اعتمده هوك ومكللي (1987) والمتضمن (10) نقاط ، توصل ألبحث الى الأتي: (1) تمثلت الخروقات الخاصة بمبدأ تدرج الرنين في كل من الكلمات احادية المقطع والثنائية بتسجيل معدلات أعلى وأدنى قياسا بالمقياس المستخدم، (2) سجلت الصوائت تطابقا كليا مع معيار الرنين المستخدم، (3) لم تسجل الصوامت تطابقا كاملا مع معيارالرنين المستخدم حيث أتخذ عدم التطابق هذا شكلي الأرتداد السالب والموجب متمثلا بتسجيل معدلات أعلى أو أدنى من المعيارالمذكور، (4) كانت النسبة بين معدلات الخروقات العليا والخروقات الدنيا في الكلمات ثنائية المقطع أعلى من تلك التي سجلتها الكلمات احادية المقطع حيث كانت النسب كالاتي (71,42٪ - 28,57٪) مقابل (57,14٪ - 42,85٪) على التوالي ، (5) من بين النتائج العرضية للبحث هي المعدلات العالية ألتي سجلتها أربع مجاميع للأصوات

الساكنة في الكلمات ثنائية المقطع مقارنة بالكلمات أحادية المقطع وكانت كالأتي:الاصوات الانفية (16,66٪ مقابل 0٪)،الأصوات الصفيرية المجهورة (10٪ مقابل 5٪)،الأصوات الصفيرية المهموسة (15٪ مقابل3,33٪) ،الأصوات الأنفجارية المجهورة (10٪ مقابل 0٪)، وعلى النقيض من ذلك ، فقد سجلت ثلاث مجاميع للصوامت في الكلمات أحادية المقطع معدلات إدراك رنين أعلى بالمقارنة مع معدلات الكلمات ثنائية المقطع وكالأتي: أصوات النقر (5 ٪ مقابل 0٪)، الأصوات الجانبية (18٪ مقابل 10٪) والأصوات الإنفجارية المهموسة والأصوات المركبة (4٪ مقابل 0٪)، (6) تم تسجيل الأنماط المغايرة في بعض المقاطع الأولى والثانية للكلمات ثنائية المقطع وبنسب متفاوتة، (7) ومن الناحية الفيزيائية، فقد أثبتت النتائج تطابق معدلات شدة الصوت والتردد ألاول للصوائت مع مبدأ تدرج الرنين ومعيار الرنين المستخدم في البحث.

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Appendices

Appendix 1 (Lists of the Stimuli)

List A

Please, you are going to listen to the following tokens twice. Identify the sonority value to the segments of these tokens after you listen to each twice. The profiling of this value starts with the most sonorous segment and ends with the least sonorous.

Token	Value 1	Value 2	Value 3	Value 4	Value 5
splæʃ					
twelv					
pri:tʃ					
læpst					
stik					
bondz					
gra:s					
nju:z					
kwilt					
smel					

List B

Please, you are going to listen to the following tokens twice. Identify the sonority value to the segments of these tokens after you listen to each twice. The profiling of this value starts with the most sonorous segment and ends with the least sonorous.

Token	Value 1	Value 2	Value 3	Value 4	Value 5	Value 6
b□ndl						
mi:niŋ						
væniʃ						
tɔ:kə						
sækful						
prisel						
fiʃnet						
pla:stə						
meθəd						
me□ə						

We highly appreciate your serious participation.

Appendix B

Table (1)

Table (1): Detailed Statistics of Sonority Profiling for Monosyllabic Tokens

The Token	The Segment	Frequency of Value 1	Percentage	Frequency of Value 2	Percentage	Frequency of Value 3	Percentage	Frequency of Value 4	Percentage	Frequency of Value 5	Percentage
splæʃ	s	0	0%	2	20%	0	0%	8	80%	0	0%
	p	0	0%	0	0%	1	10%	0	0%	9	90%
	l	2	20%	5	50%	1	10%	1	10%	1	10%
	æ	7	70%	2	20%	1	10%	0	0%	0	0%
	ʃ	1	10%	1	10%	7	70%	1	10%	0	10%
twelv	t	0	0%	1	10%	1	10%	2	20%	6	60%
	w	3	30%	5	50%	1	10%	1	10%	0	0%
	e	5	50%	3	30%	1	10%	0	0%	1	10%
	l	2	20%	1	10%	6	60%	0	0%	1	10%
	v	0	0%	0	0%	1	10%	7	70%	2	20%
pri:tʃ	p	0	0%	0	0%	1	10%	9	90%	-	-
	r	1	10%	8	80%	1	10%	0	0%	-	-
	i:	8	80%	2	20%	0	0%	0	0%	-	-
	tʃ	1	10%	0	0%	8	80%	1	10%	-	-
læmpst	l	1	10%	7	70%	1	10%	1	10%	0	0%
	æ	9	90%	0	0%	1	10%	0	0%	0	0%
	p	0	0%	1	10%	3	30%	2	20%	4	40%
	s	o	0%	2	20%	5	50%	3	30%	0	0%
	t	o	0%	0	0%	0	0%	4	40%	6	60%
stik	s	0	0%	10	10%	0	0%	0	0%	-	-
	t	0	0%	0	0%	6	60%	4	40%	-	-
	i	7	70%	0	0%	o	0%	3	30%	-	-
	k	3	30%	2	20%	4	40%	1	10%	-	-
bɔnd	b	0	0%	4	40%	4	40%	2	20%	-	-
	ɔ	10	100%	0	0%	0	0%	0	0%	-	-
	n	0	0%	6	60%	4	40%	0	0%	-	-
	d	0	0%	0	0%	2	20%	8	80%	-	-
gra:s	g	0	0%	2	20%	3	30%	5	50%	-	-
	r	0	0%	5	50%	3	30%	2	20%	-	-
	a:	10	100%	0	0%	0	0%	0	0%	-	-
	s	0	0%	3	30%	4	40%	3	30%	-	-
nju:z	n	0	0%	3	30%	6	60%	1	10%		
	j	3	30%	3	30%	2	20%	2	20%		
	u:	6	60%	4	40%	0	0%	0	0%		
	z	1	10%	1	10%	2	20%	6	60%		
kwilt	k	0	0%	1	10%	1	10%	7	70%	1	10%
	w	4	40%	5	50%	1	10%	0	0%	0	0%
	i	5	50%	3	30%	2	20%	0	0%	0	0%
	l	1	10%	1	10%	6	60%	1	10%	1	10%
	t	0	0%	0	0%	0	0%	2	20%	8	80%
smel	s	1	10%	2	20%	0	0%	7	70%	-	-
	m	0	0%	6	60%	4	40%	0	0%	-	-
	e	6	60%	1	10%	1	10%	2	20%	-	-
	l	3	30%	1	10%	5	50%	1	10%	-	-
Total		100	22.72%	103	23.4	100	22.7	97	22%	40	9.90%

Table (2)

Table (2):`Detailed Statistics of Sonority Profiling for Bisyllabic Tokens

The Token	The Segment	Frequency of Value 1	Percentage	Frequency of Value 2	Percentage	Frequency of Value 3	Percentage	Frequency of Value 4	Percentage	Frequency of Value 5	Percentage	Frequency of Value 6	Percentage
b□ndl	b	1	10%	1	10%	1	10%	3	30%	4	40%	-	-
	□	7	70%	2	20%	1	10%	0	0%	0	0%	-	-
	n	1	10%	3	30%	6	60%	0	0%	0	0%	-	-
	d	0	0%	1	10%	1	10%	3	30%	5	50%	-	-
	l	1	10%	3	30%	2	20%	4	40%	0	0%	-	-
mi:nɪŋ	m	2	20%	1	10%	4	40%	2	20%	1	10%	-	-
	i:	8	80%	0	0%	2	20%	0	0%	0	0%	-	-
	n	0	0%	3	30%	2	20%	5	50%	0	0%	-	-
	i	0	0%	4	40%	1	10%	3	30%	2	20%	-	-
	ŋ	0	0%	2	20%	1	10%	0	0%	7	70%	-	-
vænɪʃ	v	0	0%	1	10%	2	20%	4	40%	3	30%	-	-
	æ	7	70%	1	10%	1	10%	1	10%	0	0%	-	-
	n	0	0%	2	20%	5	50%	3	30%	0	0%	-	-
	i	1	10%	6	60%	1	10%	0	0%	2	20%	-	-
	ʃ	2	20%	0	0%	1	10%	2	20%	5	50%	-	-
tɔ:kə	t	0	0%	3	30%	2	20%	5	50%	-	-	-	-
	ɔ:	10	100%	0	0%	0	0%	0	0%	-	-	-	-
	k	0	0%	2	20%	7	70%	1	10%	-	-	-	-
	ə	0	0%	5	50%	1	10%	4	40%	-	-	-	-
sækful	s	1	10%	1	10%	2	20%	1	10%	4	40%	1	10%
	æ	8	80%	1	10%	0	0%	0	0%	0	0%	1	10%
	k	0	0%	1	10%	1	10%	0	0%	4	40%	4	40%
	f	1	10%	0	0%	1	10%	5	50%	1	10%	2	20%
	u	0	0%	7	70%	1	10%	0	0%	1	10%	1	10%
	l	0	0%	0	0%	5	50%	4	40%	0	0%	1	10%
pri:sel	p	0	0%	2	20%	0	0%	3	30%	1	10%	4	40%
	r	0	0%	0	0%	4	40%	4	40%	0	0%	2	20%
	i:	9	90%	0	0%	1	10%	0	0%	0	0%	0	0%
	s	0	0%	1	10%	2	20%	1	10%	4	40%	2	20%
	e	0	0%	6	60%	1	10%	1	10%	1	10%	1	10%
	l	1	10%	1	10%	3	30%	4	40%	1	10%	0	0%
fiʃnet	f	0	0%	1	10%	1	10%	5	50%	2	20%	1	10%
	i	6	60%	2	20%	0	0%	0	0%	1	10%	1	10%
	ʃ	3	30%	1	10%	0	0%	2	20%	3	30%	1	10%
	n	0	0%	0	0%	9	90%	1	10%	0	0%	0	0%
	e	1	10%	5	50%	0	0%	1	10%	2	20%	1	10%
	t	0	0%	1	10%	0	0%	1	10%	2	20%	6	60%
pla:stə	p	0	0%	0	0%	1	10%	1	10%	2	20%	6	60%
	l	0	0%	3	30%	3	30%	3	30%	1	10%	0	0%
	a:	9	90%	0	0%	0	0%	1	10%	0	0%	0	0%
	s	1	10%	2	20%	3	30%	4	40%	0	0%	0	0%
	t	0	0%	1	10%	2	20%	1	10%	5	50%	1	10%
	ə	0	0%	4	40%	2	20%	1	10%	2	20%	1	10%
meəʊd	m	0	0%	3	3%	5	50%	1	10%	1	10%	-	-
	e	7	70%	0	0%	1	10%	2	20%	0	0%	-	-
	ʊ	1	10%	2	20%	3	30%	3	30%	1	10%	-	-
	ə	0	0%	4	40%	1	10%	1	10%	4	40%	-	-
	d	1	10%	1	10%	0	0%	3	30%	5	50%	-	-
me□ə	m	2	20%	3	30%	4	40%	1	10%	-	-	-	-
	e	7	70%	0	0%	3	30%	0	0%	-	-	-	-
	□	1	10%	4	40%	0	0%	5	50%	-	-	-	-
	ə	0	0%	3	30%	3	30%	4	40%	-	-	-	-
Total		99		100		103		104		77	-	37	-