Acoustic Correlates of Emphasis in Jordanian Arabic: Preliminary Results

Mohammad Al-Masri and Allard Jongman
University of Kansas

1. Introduction

Most, if not all, dialects of the Arabic language are characterized by features of pharyngealization – traditionally called emphasis. This phenomenon has triggered a great amount of research as early as the eighth century AD. Classical Arab linguists have described emphasis in terms of production with scattered attempts to describe the vocal tract configuration during the production of emphatics. Arabic still retains the full set of emphatics reconstructed from Proto-Semitic at a number of places of articulation, (Versteegh, 2001; Watson, 2002). All dialects of Arabic have minimal or near-minimal pairs with a difference only in terms of emphatic vs. plain consonants. In the early twentieth century, Western linguists have started to study emphasis in detail but the bulk of research that has been conducted since then concentrated on the phonological properties of emphasis. Little attention has been devoted to the acoustics of emphasis. This study provides a first step towards filling the gap by focusing on the acoustic correlates of emphasis in Jordanian Arabic. Some of the previous studies have taken data from different dialects of Arabic, which may have led to inconsistencies in their findings. The fact that emphasis is evident in most dialects of Arabic does not necessarily mean that its correlates are identical.

This paper focuses entirely on the acoustic properties of emphatic vs. plain consonants and vowels in and adjacent to the target syllables. The paper is divided into seven sections. Section 1 lays out the organization of the study. In Section 2, the different definitions of emphasis that have been put forward by classical Arab linguists as well as modern Western linguists are introduced. In this section, the mechanism by which emphasis is produced is also discussed. Section 3 provides an overview of previous work on emphasis. This work, having been mostly phonological in nature, is dealt with in terms of its relatedness to the goal of the present study so as to give a clearer idea of the phonetic qualities of emphasis. Section 4 includes a detailed description of the present acoustic study. The results are presented in Section 5 and discussed in Section 6. The study is brought to a close with a discussion of the implications of the results in Section 7.

2. Emphasis

Among the many definitions of emphasis in the literature, Lehn, (1963) provides a particularly detailed one:

> Emphasis (…) is the cooccurrence of the first and one or more others of the following articulatory features: (1) slight retraction, lateral spreading, and concavity of the tongue and raising of its back (more or less similar to what has been called velarization), (2) faucal and pharyngeal constriction (pharyngealization), (3) slight lip protrusion or rounding (labialization), and (4) increased tension of the entire oral and pharyngeal musculature resulting in the emphatics being noticeably more fortis than the plain segments.
>
> (Lehn, 1963:30-1)

Lehn's definition accounts for more than one type of emphasis at the level of articulation. Thus, we cannot equate emphasis with pharyngealization proper as many linguists have posited. Although most

 Proceedings of the 2003 Texas Linguistics Society Conference, ed. Augustine Agwuele, Willis Warren, and Sang-Hoon Park, 96-106. Somerville, MA: Cascadilla Proceedings Project.

emphatics involve pharyngealization, some emphatics are also labialized, (Watson, 1999). Other definitions of emphasis are more restricted to pharyngealization. Some Arab grammarians refer to emphasis as ʔitbāq (literally, 'covering') and define it as "spreading and raising of the tongue" (Lehn, 1963: 29). Others use the word ʔistiʕlaaʔ (literally, 'elevation') and define it as "elevation of the dorsum," *ibid.* Delattre (1971: 129) describes the production of pharyngeals as one in which "the root of the tongue assumes the shape of a bulge and is drawn back toward the vertical back wall of the pharynx to form a stricture. This radical bulge generally divides the vocal tract into 2 cavities, one below extending from the stricture to the glottis, the other above extending from the stricture to the lip." This provides a detailed description of the mechanism of the production of pharyngeal sounds but is not enough to account for the production of emphatics as it involves another secondary yet crucial articulation. Kahn (1975: 39) defines emphasis as a "secondary pharyngeal articulation of certain consonants, usually stops and fricatives." She adds that the articulation of emphasis involves the organs engaged in the production of a given sound in addition to a secondary pharyngeal articulation. This means that any obstruent in Arabic, more precisely in the Cairene dialect she studied, can be emphatic – a claim that needs more evidence. This definition also excludes other segments from being emphatic and exclusively restricts emphasis to stops and fricatives. Although obstruents are the most common emphatics in Arabic, some studies conducted on Cairene Arabic show that emphasis can be a property of laterals and rhotics as well (e.g., Ferguson, 1956).

According to McCarthy (1994: 38), emphasis in different dialect areas in the Arab world is always characterized by a "constriction in the upper pharynx". He distinguishes between these emphatics and pharyngealized consonants, arguing that while the former ones are purely emphatic, the latter ones should be called uvularized – affected by another set of back segments, i.e., uvulars: /q, χ, ʁ/.

Davis (1995: 465) defines emphasis, which corresponds, as he posits, to pharyngealization, as the phenomenon of producing sounds "with a primary articulation at the dental/alveolar region and with a secondary articulation that involves the constriction of the upper pharynx." He provides an account for bilabial emphasis in Arabic, which adds bilabials to the class of possible emphatics, in addition to dentals and alveolars. Emphasis at the labial region has also been reported by Watson, (1999: 289) for a dialect of Yemeni Arabic. Watson states that "emphasis has two articulatory correlates: pharyngealization and labialization," and reports some examples from Yemeni Arabic although there is a clear lack of minimal pairs of emphatic and plain consonants at the labial place of articulation. The bilabial emphatic mentioned here is /m/. This segment is not intrinsically emphatic. There is a set of minimal pairs reported in the literature where /m/ is emphatic in one case and plain in the other – /mælɛk/ vs. /mˁælɛk/, 'your (masc. 2nd person) money' and 'what's wrong with you (masc. 2nd person)?', respectively. These occurrences are not common in Arabic, and will therefore not be discussed any further.[1]

In summary, all previous definitions of emphasis stress the fact that production of emphatics involves a set of features, more or less detailed as they are, that engage the pharynx in a mechanism much similar to the production of pharyngeals.

3. Previous research on emphasis

As mentioned earlier, emphasis has been mostly studied from a phonological perspective. Many phonological features may very well map onto the acoustics of emphasis. Semaan (1968) reviews the studies that have been conducted on emphasis in the medieval era by Arab linguists. He first cites Sibawayh, one of the most prominent medieval Arab linguists, who described the articulation of emphatic sounds as early as the eighth century AD. Sibawayh uses the term ʔitbāq, literally 'covering,' to refer to emphasis. He states that emphatic sounds are produced by, "the part of the tongue which is the place of their utterance being closely covered in their utterance by what is opposite to it of the palate" (Semaan 1968: 45). He adds that in the production of emphatics "you raise it [the tongue] towards the palate." *ibid.* He also observes that if it was not for emphasis, then /tˁ/ would be /d/, /sˁ/

[1] Another segment that shows similar behavior is /l/ in sentences like /wɛllæhu/ and /wɛlˁlˁæhu/, 'he appointed him' and 'by God,' respectively.

would be /s/, /zˤ/ [2] would be /ð/ and /dˤ/ would disappear from the language, (*ibid*. p. 46). In other words, the emphasis distinction creates minimal pairs differing in the feature [+emphatic] or [-emphatic]. This description pairs /tˤ/ with /d/ rather than /t/, where it should be, keeping in mind that the emphatic-plain minimal pairs agree in place and manner of articulation and differ only in emphasis. This account also draws heavily on a physical description of the speech organs that are brought together in the production of emphatics. The last sound, /dˤ/, that is said to have been lost, had no plain counterpart. It should be noted here that a clear account of the status of these emphatics is still lacking. Although Classical Arabic, Arabic of the early Islamic era, retains the same orthography, it has undergone many changes at the phonetic level. It is due to these and other changes that we now have Modern Standard Arabic (MSA). The same orthographic symbols cannot simply be matched to the same phonetic realizations of MSA.

Another account of the medieval literature on emphatics is sketched by Card (1983). In addition to her account of Sibawayh's study, much similar to what Semaan has presented, she presents Ibn Sina (980 – 1037 AD), known in the western literature as Avicenna. Ibn Sina was a physician and his account of these sounds is much informed by his scientific background. As reported in Card (1983: 9), Ibn Sina describes the production of the sounds /tˤ/, /t/, /d/ as having the same place of articulation: "For /tˤ/ the air is restricted by the larger part of the tongue tip and the two sides of the tongue. A depression is formed in the center of the tongue, which resonates as the air is forcibly driven out. The /t/ has similar articulation but only the tongue tip restricts the air." As for the sound /d/, Ibn Sina states that "there is no covering of the palate", and that "the air is not strongly restricted", presumably hinting at the energy of voicing at the vocal folds.

Modern studies of emphasis have changed their focus from descriptions solely based on impressionistic observation to more detailed and accurate explanations made possible by technological advances. Marcáis (in Card, 1983: 13) investigated the articulation of emphatics in the 1940s using palatograms and radioscopy of the vocal tract. Marcáis found that the articulation of emphasis involves "muscular tension and retraction of the prominent articulating organs." He noticed that the "tongue root approaches the back of the pharynx, with the result that the back of the tongue forms a 'collapsed plateau', dipping away from the palate."

The feature that holds for all descriptions of the production of emphatics so far is that they all involve upper pharyngeal constriction. A distinction has to be made here between pharyngeals and pharyngealized segments. The term pharyngeals refers to the sounds whose primary articulator is the pharynx whereas the term pharyngealized, used to describe emphatics, means that the pharynx is the secondary articulator for sounds articulated primarily with other speech organs. Ghazeli (1977) compared the production of a set of pharyngeals to a set of pharyngealized segments. Using cinefluorography, he showed that for pharyngeals such as /ʕ/ and /ħ/, the greatest constriction was located below the epiglottis, while the greatest constriction for emphatics occurs in the upper pharynx. This suggests that the production of these two types of sounds is unrelated – giving no legitimacy for using the two terms interchangeably, as some linguists do.

Acoustically, emphasis seems most consistently manifested by a lowering of the second formant frequency (F2) of the vowel following the emphatic consonant. Lehn (1963: 31) mentions that features of emphasis do not hold to the same degree for different speakers of different dialects. He also observed that in Cairene Arabic, emphasis is more characteristic of men than women and that effects of emphasis on adjacent segments, i.e. emphasis spread, are also not similar. He does not, however, provide experimental support to validate his observations. Lehn also reports that emphasis never occurs as the only feature of any segment in any environment; "its minimum domain is CV but not VC," and "within monosyllabic utterances there are no contrasts," (p. 32). For this last argument, Lehn cites examples such as /tˤin/ vs. /tin/, 'mud' and 'figs', respectively, and /zˤur/ vs. /zur/, 'perjury' and 'visit' (imperative), respectively. For these pairs, subsequent studies (e.g., Card 1983; Davis 1995; Watson 1999) argue that the long vowels block emphasis spread and are phonologically opaque to emphasis.

Kahn (1975) studied the acoustic correlates of emphasis in Cairene Arabic, specifically comparing males and females. She found that emphatics in Cairene Arabic do not lower F2 frequency values to

[2] Semaan uses this phonetic symbol to refer to the emphatic voiced interdental fricative.

the same degree for male and female speakers. The difference between F2 of a vowel following a plain consonant and F2 of a vowel following its emphatic counterpart was much greater for male as compared to female speakers. This suggests that male speakers 'emphasize' more than female speakers, seemingly an acoustic replication of Lehn's (1968) phonological observation.

Davis (1995) examined a northern and a southern dialect of Palestinian Arabic and couched his account of emphasis spread in the framework of Grounded Phonology. Davis reports that emphasis spread behaves asymmetrically: leftward emphasis is not blocked for the entire word but rightward emphasis is always blocked by [+high, –back] vowels (p. 468). This goes against what Lehn suggested, namely that the vowels /i/ and /u/ always block emphasis spread, and it actually excludes the vowel /u/ from being opaque.

Davis' findings support the assumption that different dialects show asymmetries in the characteristics of emphasis spread, in the so-called opaque segments that block emphasis spread, and in the direction of blocking. In more recent phonological accounts (e.g., Davis, 1995; Watson, 1999), emphasis is realized as the spread of the feature [RTR] (retracted tongue root) to adjacent segments. This maps onto the phonetic parameter of low F2. This mapping, however, might very well be non-linear. In other words, the same distance of spread of the feature [RTR] in the underlying representation might not correspond to a comparable lowering of F2 values of the same segments.

One of the most vivid acoustic accounts of emphasis is provided by Card (1983). Card studied emphasis in Palestinian Arabic and found evidence of the lowering effect of emphasis on F2 frequency for segments in emphatic environments compared to higher frequencies for corresponding segments in plain environments. In addition to this by-then clear characteristic of emphasis, she found that emphasis spreads phonetically rightward and leftward in the whole word. Secondary emphatics, i.e., those that acquire emphasis effects from neighboring segments through spread, did not have F2 frequencies as low as those of segments with primary emphasis or as high as F2 frequencies of plain segments. Card noticed that emphasis spread is blocked in the presence of the vowels /i/ and /u/. There must be some characteristics peculiar to these vowels that enable them to block emphasis spread. The feature [+high] would be a likely candidate.

Zawaydeh (1999) investigated emphasis spread in Ammani Jordanian Arabic using four words. Zawaydeh's F2 measurements of the vowels also indicate the word as the domain of emphasis spread. Both rightward and leftward spread were found but not to the same extent. Leftward spread did not display any gradiency: F2 of the vowel was equally low regardless of its distance from the emphatic consonant. In contrast, rightward spread occurred in a gradient manner: F2 increased for vowels that were further away from the emphatic consonant.

4. Acoustic Study

The present acoustic study was conducted to gain a better understanding of the acoustic correlates of emphasis. Second formant frequency of the vowel as well as vowel and consonant duration were measured. Stimuli were selected such that spread and blocking of emphasis could be evaluated. In addition, data were collected from females and males in order to explore gender-related differences in the degree of emphasis.

4.1 Methods

A list of four sets of minimal wordpairs differing only in terms of the emphatic vs. plain distinction was prepared, see Table 1 below. These words were all embedded in the carrier sentence [ʔɪħki ___ kəmæn məɹɛh], meaning 'say ____ once again.' The target words included the four emphatic consonants /tˤ, dˤ, ðˤ, sˤ/ and their plain counterparts /t, d, ð, s/.

Plain	Gloss	Emphatic	Gloss
/dɛm/	blood	/dˤɛm/	he hugged
/sɛb/	he cursed	/sˤɛb/	he poured
/ðɪl/	humiliation	/ðˤɪl/	shadow
/bɛʕd/	after	/bɛʕdˤ/	some

Table 1a. Monosyllabic stimuli used in the production study.

Plain	Gloss	Emphatic	Gloss
/dɛwə/	medicine	/dˤɛwə/	he lit
/tæbət/	she repented	/tˤæbət/	she recovered
/sɛbəʔ/	queen of ancient Yemen	/sˤɛbəʔ/	he longed for
/bæjət/	food left overnight	/bæjətˤ/	have laid eggs
/mærɪs/	one line that appears after plowing the farm	/mærɪs/	nonword
/mɛlæð/	refuge	/mɛlæðˤ/	nonword

Table 1b. Bisyllabic stimuli used in the production study.

Plain	Gloss	Emphatic	Gloss
/bətæləh/	nonword	/bətˤæləh/	unemployment
/məsæbɪħ/	swimming pools	/məsˤæbɪħ/	lanterns
/məðəlɪh/	humiliation	/məðˤəlɪh/	umbrella

Table 1c. Trisyllabic stimuli used in the production study.

Plain	Gloss	Emphatic	Gloss
/tibəh/	nonword	/tˤibəh/	kindheartedness
/tubəh/	repentance	/tˤubəh/	brick

Table 1d. Stimuli containing vowels reported to block emphasis spread used in the production study.

In order to evaluate the many different observations about emphatics presented in Section 3 above, we have included a variety of minimal pairs. Target words are either monosyllabic, where there is strong evidence for emphasis spread throughout the whole word; bisyllabic, with the emphatic segment occurring word-initially, word-medially, or word-finally to examine emphasis as a function of position of the emphatic segment; or trisyllabic to examine the domain and directionality of emphasis spread. Two bisyllabic minimal pairs with putatively opaque vowels were also included. The wordlist included a few non-words that were phonologically legal.

4.2 Subjects

The subjects of this study were 5 male and 3 female native speakers of the northern dialect of Jordanian Arabic. They were all adults from the Lawrence community without any speaking or hearing impairment. Three of them, two males and one female were graduate students at the University of Kansas.

4.3 Procedure

Each target word was embedded in the carrier sentence provided above. Each speaker read the stimuli five times. Recordings were carried out in an anechoic chamber using a DAT recorder (Fostex D-5) and unidirectional microphone (Electrovoice RE-20). The recordings were digitized using Praat speech analysis software. F2 was measured for every vowel in every stimulus word. The durations of the target vowel and immediately adjacent vowel(s) were also measured, where applicable. Finally,

durations of plain and emphatic consonants were also measured. Data were averaged across all repetitions.

5. Results

This section contains the results on consonant duration, vowel duration, vowel F2 values, opacity, and gender. All measurements were subjected to Analysis of Variance. Results are significant at the $p<.05$ level unless indicated otherwise.

5.1. Consonant Duration

Results on consonant duration show that the emphatic and plain consonants had the same duration (118 ms) when averaged across all stimuli. However, some differences in duration surfaced when position of the target consonant was taken into account. Word-initially, emphatic consonants (120 ms) tend to be longer than their plain counterparts (110 ms) [$p=.063$]. Target consonant durations did not show any significant differences in word-medial or word-final positions. Overall, consonant duration does not seem to be a reliable cue for emphasis.

5.2. Vowel Duration

Results on target vowels – vowels in the same syllable as the target consonants – indicated no effects. That is, there was no significant difference in vowel duration between emphatic (105 ms) and plain (118 ms) environments. In addition, there were no significant differences in duration between vowels in plain and emphatic environments in any position, regardless of the location of the vowel, i.e. in the syllable with the target consonant, or in adjacent syllables to the right or left of the syllable with the target consonant. Thus, similar to consonant duration, vowel duration does not seem a reliable cue for emphasis.

5.3. Vowel F2

As expected, target vowels, i.e., vowels in syllables with the target consonants, show significant differences in F2 values. Target vowels in emphatic environments show a significant lowering of F2 compared to their counterparts in plain environments. As shown in Figure 1, on average, there is a 521 Hz drop in F2 of the vowel in the emphatic environment compared to the same vowel in the plain environment. A similar effect, although smaller in magnitude, is shown for F2 values of vowels in right-adjacent syllables, i.e., vowels one syllable to the right of the target syllable. For these vowels, F2 in emphatic environments is significantly lower, with a 262 Hz drop in F2 of the vowel in the emphatic environment compared to the same vowel in the plain environment. A similar effect is shown for vowels in left-adjacent syllables. F2 values in left-adjacent positions are significantly lower for vowels in emphatic environments, with a 144 Hz drop in F2 of the vowel in the emphatic environment compared to the same vowel in the plain environment. Figure 2 shows F2 measurements in adjacent syllables.

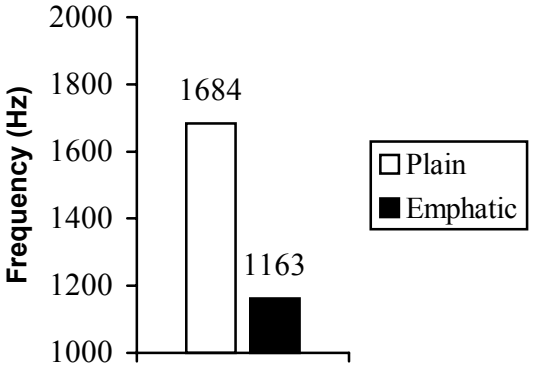

Figure 1. F2 values for vowels in the same syllable as the plain or emphatic target consonants.

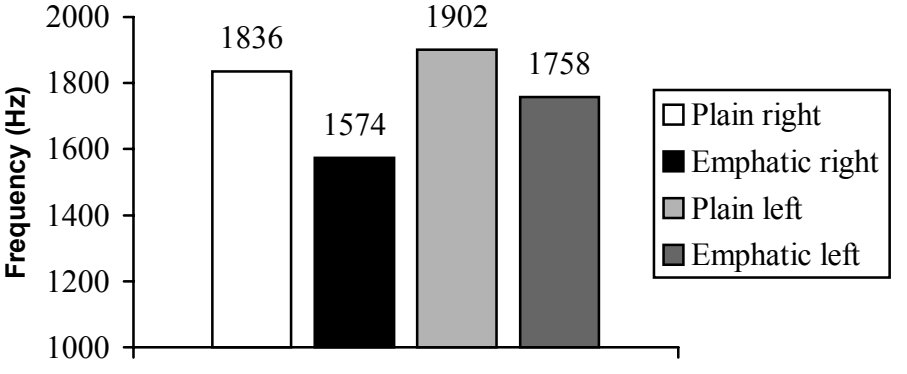

Figure 2. F2 values for vowels in syllables either to the right or left of the target syllable containing the plain or emphatic target consonant.

5.4 Emphasis blocking

The vowels /i/ and /u/ that have been reported to be opaque, i.e., to block emphasis spread, were tested. Opaque vowels in the syllables with the target consonants show the same emphasis effect in terms of vowel F2. Opaque target vowels in emphatic environments have significantly lower F2 values than their plain counterparts. As shown in Figure 3, there is an average 466 Hz drop in F2 of the vowel in the emphatic environment compared to the same vowel in the plain environment. This amount of lowering is quite similar to what we observed for the transparent vowels.

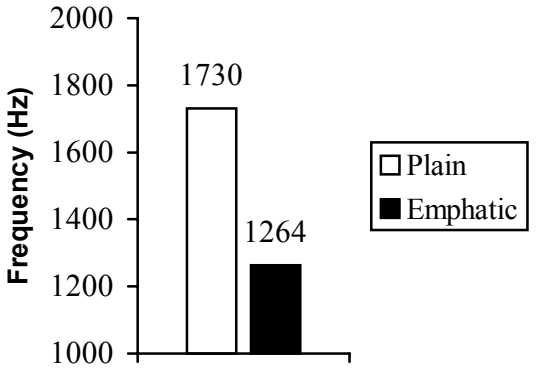

Figure 3. F2 values for opaque vowels (/i, u/) in the same syllable as the plain or emphatic target consonants.

However, emphasis spread is blocked to right-adjacent syllables. As shown in Figure 4, transparent vowels in right-adjacent syllables, the vowel in the target syllable being opaque, do not show significant differences in F2 between plain and emphatic environments.

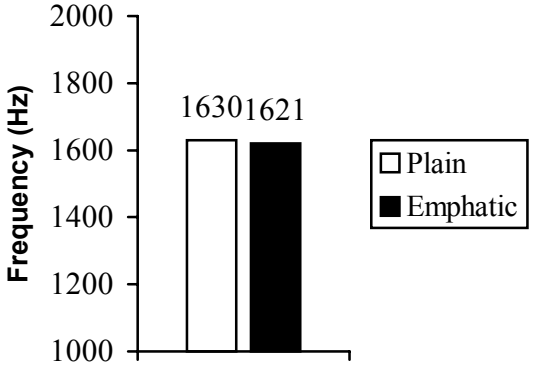

Figure 4. F2 values for vowels in syllables to the right of target syllables containing an opaque vowel and plain or emphatic consonant.

Our choice of stimuli did not allow us to evaluate leftward spread.

5.5 Effects of Gender

The results show a clearer effect of emphasis for females than males. The degree of emphasis, i.e., the extent of lowering of F2 values for the vowels in the target syllables with plain and emphatic consonants, is significantly greater for females than males. As shown in Figure 5, emphasis lowers F2 by 704 Hz for females and by 565 Hz for males.

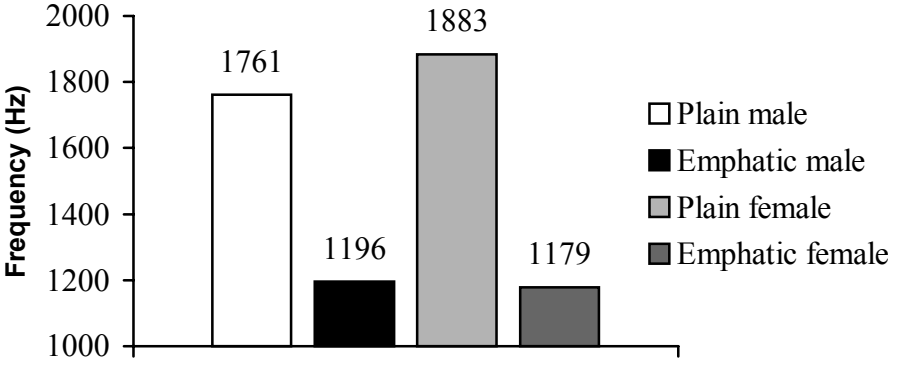

Figure 5. F2 values for vowels in plain or emphatic context as a function of speaker gender.

6. Discussion

The present results support previous findings in that a lowering of F2 in the vowel adjacent to the emphatic consonant is a clear and consistent acoustic correlate of emphasis. In addition, emphasis was shown to spread beyond the target syllable in both leftward and rightward directions. However, the effect of emphasis is less pronounced in adjacent syllables as compared to the target syllable. Our initial results show that the extent of F2 lowering for the vowel in adjacent syllables is less than that for the vowel in the target syllable. This suggests that emphasis spread might be gradient. In other words, the results suggest that degree of emphasis decreases as distance from the target syllable increases. Furthermore, our results suggest an asymmetry in emphasis spread, with a stronger effect for rightward than leftward spread.

The overall spectrum for an emphatic syllable is more compact than its plain counterpart. It seems that the occurrence of the secondary back articulation brings the first two formants closer together by significantly lowering the second formant. Figure 6 shows spectrograms of a minimal pair. The top spectrogram represents the emphatic word and the lower one represents the plain word. The vowel in the syllable with the emphatic target consonant clearly has a more compact spectrum.

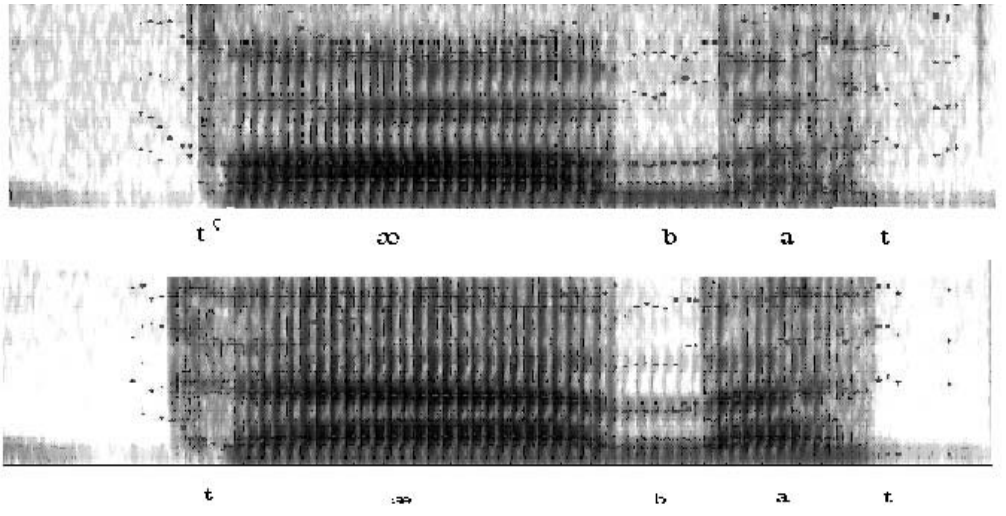

Figure 6. Spectrograms for the emphatic form /tˤæbət/ (upper panel) and plain counterpart /tæbət/ (lower panel).

The opacity of certain vowels – their ability to limit the domain of emphasis to its minimum – is also evident in the results. Contrary to previous reports (e.g., Card, 1983), the opaque target vowels /i,

u/ themselves do not resist F2 lowering. However, they limit the effects of emphasis to the syllable with the target consonant. Thus, vowels in adjacent syllables are not affected by emphasis since its effect is confined to the minimum domain. This effect is not tested for leftward spread since the data did not allow us to test the effect of emphasis spread in this direction.

Another dimension that needed investigation is the role of gender in the production of emphasis. Previous research on Egyptian Arabic (Kahn, 1975) reported that emphasis is more pronounced in males than females. In contrast, the present study shows the opposite effect. The extent of emphasis, measured in terms of F2 frequency of the vowel in the target syllable, is greater for females than males.

Finally, duration does not seem to be a reliable acoustic correlate of emphasis. No effects of emphasis were found for the duration of vowels in the target or adjacent syllables. Across all positions, plain and emphatic consonants did also not differ in terms of duration. However, word-initial emphatic consonants were slightly longer than word-initial plain consonants.

7. Conclusions and future directions

We have seen that a major acoustic correlate of emphasis is a lowering of F2 for the vowel in the same syllable as the emphatic consonant. This lowering averages approximately 500 Hz. In addition, emphasis spreads to the right and left of the target syllable if the word has no opaque vowels. The set of opaque vowels proved to limit emphasis spread to its minimum. A gender effect was observed, indicating that emphasis is more pronounced in female rather than male speakers of Jordanian Arabic. Finally, duration measurements for the target consonants or the vowels in different positions did not reveal any significant differences.

This study should be considered as a preliminary investigation into the acoustic correlates of emphasis. Most previous research has dealt with emphatics from a phonological perspective. Recent studies on the acoustics of emphasis have largely contributed to a better understanding of this phenomenon. However, each of these studies faces a number of limitations that are likely to restrict the generalizability of the findings. Some of these studies deal with a limited number of informants from different dialects. Other studies simply restrict the set of emphatics to one place of articulation. In all of the studies reviewed, there has not been one systematic investigation of emphatics to account for all the acoustic characteristics of emphasis.

In future research, the acoustic characteristics of consonants will be analyzed. While linguists consider consonants as the primary locus of emphasis and speak of emphatic consonants, surprisingly, most acoustic analyses of emphasis have focused on properties of the vowels surrounding the emphatic consonant rather than the consonant itself. Acoustic characteristics of the target consonants as well as consonants in adjacent syllables will therefore be investigated. In addition, domain and direction of emphasis spread need to be explored in more detail. The present data do not allow for a systematic evaluation of the domain of emphasis since the farthest syllable from the one with the target consonant is only one syllable away. That is, counting from the syllable with the target consonant, the farthest syllable is directly adjacent to either the left or the right. We certainly need longer words so that we can establish emphasis spread. Likewise, the results on opaque vowels need to be supported with more observations. The addition of female speakers to create a balanced set of female and male speakers will help clarify the controversial issue of whether gender plays a role in emphasis. Finally, we will explore the behavior of two adjacent emphatics in a consonant cluster.[3] We are not aware of any discussion of this phenomenon in the literature. It is therefore as yet unclear whether this situation may result in stronger effects of emphasis or effects of de-emphasis.

[3] This idea was suggested by an audience member at the TLS conference held at the University of Texas, Austin from March 7th- March 9th 2003.

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Proceedings of the 2003 Texas Linguistics Society Conference: Coarticulation in Speech Production and Perception

edited by Augustine Agwuele, Willis Warren, and Sang-Hoon Park

Cascadilla Proceedings Project Somerville, MA 2004

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