

The Sociophonetics of Emphasis in Jordanian Arabic: Age and Gender الصوتيات الاجتماعية للتفخيم في اللهجة الأردنية: العمر والجنس

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Abstract:

Objectives: This paper investigates the bearings of both age and gender as social variables on the production of the two primary emphatics (i.e. [sʕ] vis-à-vis [tʕ]) in Ajlouni Jordanian Arabic, a variety of Rural Jordanian Arabic.

Methods: This study adopted the variationist approach to interpret the findings within their social context. To investigate the combined effect of these two social factors on the emphatic sounds /sʕ/ and /tʕ/, sounds were analyzed at the initial and final positions of mono- and disyllabic words in different phonetic environments. Twelve native speakers of the Ajloun dialect participated in the study, divided into three age groups (18–35, 36–50, and 50 and above) and two gender-based groups. Several acoustic parameters (CD, VOT, F1, F2, and F3) were utilized to measure the combined effect of age and gender on the production of emphatic sounds as articulated by the study sample.

Results: The study divulged that only VOT is a reliable acoustic correlate of emphasis as far as age and gender are concerned. The present study's findings would broaden researchers' understanding of the conceivable effect(s) a social variable may have in an overall interaction.

Conclusions: The study revealed that the effect of emphasis was prominent only in the syllable containing the emphatic sound. This underscores the importance of studies addressing the scope of emphasis in Jordanian dialects in general, and in the Ajlouni dialect in particular.

Keywords: Ajlouni Jordanian Arabic; vowel quality; primary emphatics; acoustic means.

الملخص:

الأهداف: هدفت هذه الدراسة لايجاد تأثير عمر و جنس المتكلم كعوامل اجتماعية على نطق صوتي التفخيم الصاد والطاء في واحدة من لهجات أهل الريف في الأردن وهي لهجة أهل عجلون.

المنهجية: اتبعت هذه الدراسة المنهج التبايني وذلك لتفسير النتائج وفقاً لسياقها الاجتماعي. ولدراسة التأثير المشترك لهذين العاملين الاجتماعيين على الصاد والطاء، تم تحليل الأصوات في بداية ونهاية الكلمات ذوات المقطع الواحد والمقطعين في بيئات صوتية مختلفة. ولقد شارك في نطق الأصوات اثني عشر متحدثاً أصلياً للهجة أهل عجلون والذين تم تقسيمهم إلى ثلاث مجموعات عمرية وهي (18-35) و(36-50) و(50 فأعلى) ومجموعتين وفقاً للجنس. ولقد تم استخدام عدة معايير أكوستية (acoustic means) وهي (CD, VOT, F1, F2, and F3)، وذلك لقياس التأثير المشترك للعمر والجنس على نطق التفخيم كما نطقته عينة الدراسة.

النتائج: أظهرت النتائج أن ال(VOT) فقط هو معيار أكوستي موثوق عند نطق التفخيم في هذه اللهجة. ومن الجدير بالذكر أن من شأن هذه النتائج تعزيز فهم الباحثين للتأثيرات التي قد تحدثها العوامل الاجتماعية في التفاعلات الشاملة. الخلاصة: أظهرت الدراسة أن تأثير التفخيم كان بارزاً فقط في المقطع الذي يحتوي على الصوت المفخم. وهذا يعزز أهمية الدراسات التي تتناول نطاق التفخيم في اللهجات الأردنية بشكل عام وفي اللهجة العجلونية بشكل خاص.

الكلمات المفتاحية: التفخيم؛ لهجة أهل عجلون؛ بيئات صوتية؛ معايير أكوستية؛ التفاعلات الشاملة.

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1 Introduction

Emphasis is an inherent feature of almost all Semitic languages, such as Arabic, Hebrew, and their varieties, including Jordanian Arabic (Omari & Jaber, 2019), Qatari Arabic (Kulikov, Mohsenzadeh, and Syam, 2020), Iraqi Arabic (Salman, 2020), among others. However, there have been different ascriptions to the articulatory process of producing emphatic sounds. For instance, some argue that the secondary articulation involved in producing emphatic sounds occurs at the velar (Obrecht, 1968; Hetzron, 1998) while others posit that it happens at the uvula (McCarthy, 1994; Zawaydeh, 1999). Despite this unconformity, emphasis is grossly defined as the co-articulation of a primary and a secondary articulation, with the former being articulated in the dental/alveolar region and the latter being articulated in the posterior region of the vocal tract (Lehn, 1963; Ghazeli, 1977; Younes, 1993; Davis, 1995, among others). To avoid inconsistencies, the researcher uses the term emphasis throughout this study.

Emphasis refers to two different categories, namely primary emphatics and secondary emphatics. The former category includes the full set of the four primary emphatic sounds, namely /tˤ/, /dˤ/, /sˤ/, and /ðˤ/, along with their plain counterparts /t/, /d/, /s/, and /ð/. The difference between the so-called primary and secondary emphatics is that the former set has phonemic contrasts whereas the latter does not. (Table 1) below displays the full set of primary emphatic sounds in Modern Standard Arabic (henceforth MSA).

Table 1: Primary emphatic sounds in MSA

Emphatic	Gloss	Plain	Gloss
tˤi:n	‘mud’	ti:n	‘figs’
dˤa:r	‘harmful’	da:r	‘house’
sˤob	‘pour’	sob	‘badmouth’
ðˤal	‘dissipated’	ðal	‘humiliated’

Exhibiting only allophonic contrasts, secondary emphatics are further subdivided into two subcategories, namely allophonic emphasis and free-variational emphasis (cf. Al-Deaibes, Al-Shawashreh, and Jarrah, 2021: p. 2).

1.1 Context of the Study

Jordanian Arabic (henceforth JA) is not a mere dialect but an umbrella term that covers several dialects and varieties. However, some developments have contributed to the dialectal situation in Jordan. The Hashemite Kingdom of Jordan originally had two main dialects, namely Rural Jordanian Arabic (henceforth RJA) and Bedouin Jordanian Arabic (henceforth BJA) (Herin, 2013; Alzoubi, 2017). After the influx of immigrants from neighboring countries like Palestine and Syria, a new dialect, Urban Jordanian Arabic (henceforth UJA), has started to rise (Al-Deaibes, 2016).

Although these two dialects have, to the best of my knowledge, a relatively high degree of mutual intelligibility, each dialect has its own unique phonetic, phonological, and morphological structures. (Table 2) below displays some of these similarities and differences.

Table 2: Phonetic and phonological differences among MSA, RJA, and BJA

	MSA	RJA	BJA	Gloss
a.	/kalb/	[tʃalɪb]	[tʃalb]	‘dog’
b.	/sʕaʕb/	[sʕaʕɒb]/[sʕɒʕɒb]	[sʕaʕb]	‘cooking’

It is worth mentioning that in (a) MSA /k/ is realized as /tʃ/ in both RJA and BJA. Clearly, RJA phonotactics does not allow word-final consonant clustering, as in (a) and (b). Instead, the epenthetic vowels /ɪ/ and /ʊ/ are inserted to break up the consonant clusters. Unlike RJA, MSA and BJA allow word-final consonant clusters, as exemplified in (a) and (b).

Given the abundance of studies on emphasis in different Arabic dialects (Khattab, Al-Tamimi, and Heselwood, 2006; Omari and Jaber, 2019; Omari and Jaber, 2020, for Jordanian Arabic; Lehn, 1963, for Cairene Arabic; Algryani, 2014, for Libyan Arabic; Kulikov, 2022, for Qatari Arabic, among others), the phenomenon of emphasis is not given its due share of investigation in terms of societal, individual, and dialectal dimensions. Concisely, there have been relatively few studies tackling the impact of social variables on emphasis production (e.g. Almomany, 2023a; Almomany, 2023b; Omari and Jaber, 2020; Omari and Jaber, 2019; Rababa, 2017; Abudal Luh, 2011). Moreover, few studies have refined their dialectal scope (Almomany, 2023a; Almomany, 2023b). That is, the majority of researchers used broad terms such as Qatari Arabic, JA, UJA, or RJA (cf. Omari

and Jaber, 2020; Al-Deaibes et al., 2021; Kulikov, 2022). Therefore, the present study analyzes the possible effects of both age and gender, coupled with those of other linguistic variables, on the production of emphasis in a variety of JA, namely Ajlouni Jordanian Arabic (henceforth AJA).

1.2 Research Questions

The present study addresses the following questions:

- What are the possible effect(s) of age and gender as social variables on emphasis production in AJA?
- Does the inclusion or exclusion of some variables alter the direction of the interaction effect?

1.3 Hypotheses

To answer the research questions, the following hypotheses were formulated:

- Age and gender significantly affect emphasis production, where older males are expected to produce emphasis more prominently than females.
- The interplay between different social variables in one pool changes the direction of the interaction effect.

The following section reviews the findings of previous research on emphasis production, shedding light on emphasis production in different Arabic dialects, emphasis production in JA, and, more importantly, emphasis production from a socio-phonetic perspective.

2 Literature Review

Emphasis has been collectively believed to be correlated with some acoustic cues in almost all Arabic dialects. As the realization of emphasis varies from one variety to another (see Section 1. above), the extent to which these acoustic cues hold true varies, too.

2.1 Emphasis in Arabic

Several studies have accounted for the possible acoustic cues of emphasis in Arabic dialects (Card, 1983, for Palestinian Arabic; Wahba, 1993, for Alexandrian Arabic; Abudalbh, 2011, for JA; Kulikov, 2022, for Qatari Arabic).

In her study on emphasis in Palestinian Arabic, Card (1983) examined the acoustic cues of emphasis utilizing the first three formant frequencies. Her sample consisted of four native speakers of Palestinian Arabic, two from a rural background and two from an urban background. Card (1983) found that only F2 lowering of vowels in an emphatic environment is reliable as far as emphasis is concerned.

Wahba (1993) investigated the probable effects of gender on emphasis production in Alexandrian Arabic in mono- and di-syllabic minimal pairs. Corroborating Card's (1983) finding, Wahba (1993) found that where F1 was by no means a reliable acoustic cue of emphasis neither at the vowel onset nor at the midpoint of emphaticized vowels, F2 lowering was unfailing both at the onset and midpoint of emphaticized vowels.

Studying the acoustic correlates of emphasis in Qatari Arabic, Kulikov (2022) utilized several acoustic parameters such as VOT, Spectral Central of Gravity (SCG) of burst, pitch, F1, F2, and F3. The researcher found that relative to the spectral cues, only SCG of bursts was affected by the emphasis in that the SCG of /t/ was significantly lower in the vicinity of an emphatic segment. As for the vocalic cues, Kulikov (2022) asserted that only F1 raising and F2 lowering of emphaticized vowels are reliable acoustic correlates of emphasis.

2.2 Emphasis in JA

Most researchers confirm the salience of the first three vowel formant frequencies in detecting emphasis in JA. That is, raised F1 and F3 and lowered F2 of emphaticized vowels are deemed the most reliable acoustic correlates of emphasis in JA (Jongman, Herd, and Al-Masri, 2007; Al-Masri, 2009; Abudalbh, 2011; Jongman, Herd, Al-Masri, Sereno, and Combest, 2011; Alzoubi, 2017, inter alia).

Jongman et al. (2007) examined the acoustic correlates of emphasis in JA spoken in Irbid. Eight native speakers of Irbidi JA produced the stimuli, which consisted of mono- and bi-syllabic minimal pairs. The investigated acoustic cues include spectral mean and the first three formant frequencies (F1-F3). Overall, the researchers found that the spectral mean was a reliable exponent of emphasis, where the spectral mean of emphatic segments was significantly lower than that of their plain counterparts. In addition, emphasis was more obviously pronounced employing the first three formant frequencies. That is, vowels in an emphatic environment showed raised F1 and F3, and a lowered F2 value compared to those in a plain environment (Jongman et al., 2007).

Al-Masri (2009) investigated the acoustic and perceptual emphasis cues in UJA. Eight native speakers of UJA were recorded reading a list of 80 minimal pairs, each incubated in a carrier phrase. The acoustic correlates that were studied are consonant duration (henceforth CD), vowel duration, and spectral moments, on the one hand, and F1, F2, and F3 at the vowel onset, midpoint, and offset, on the other hand. The researcher concluded that only the vocalic cues showed significance. The only reliable acoustic emphasis cues were raised F1 and F3 and lowered F2 of emphaticized vowels.

Abudalbh (2011) analyzed the effects of gender on emphasis production in JA. 22 native speakers of JA, who produced a list of nine monosyllabic minimal pairs, represented his sample. The researcher examined several acoustic parameters, including VOT, friction duration, spectral mean of fricatives, vowel duration, and the first three formant frequencies (i.e. F1, F2, and F3). Abudalbh (2011) concluded the following: (1) VOT is a reliable acoustic correlate only for voiceless stops, where the VOT of /t^s/ was significantly shorter than that of /t/, (2) emphatic fricatives were shorter than plain ones, (3) there was no significant difference in terms of spectral mean between emphatic fricatives and plain ones, (4) emphatic vowels were longer than plain ones, and (5) emphaticized vowels showed raised F1 and F3, and lowered F2 as compared to their plain counterparts.

Jongman et al. (2011) studied the acoustic and perceptual emphasis cues in UJA. Twelve native speakers from Irbid City were recorded reading a list of 252 minimal pairs, with each token incubated in a carrier sentence. The acoustic parameters utilized include the spectral mean of obstruents and the vowel's first three formant frequencies. Acoustically speaking, the researchers found that only the spectral mean of emphatic stops was lower than that of their plain ones; therefore, emphasis was characterized by a raised F1, lowered F2, and a raised F3.

Alzoubi (2017) examined the acoustic correlates of emphasis in Ammani Jordanian Arabic. 22 native speakers of JA from East and West Amman were recorded reading a stimulus of minimal pairs and commonly used words. The acoustic cues that were investigated include VOT, Center of Gravity (COG) of obstruents, and the vowel first three formant frequencies (F1-F3). Overall, emphasis was characterized by a raised F1, lowered F2, raised F3, shorter VOT, and shorter stop COG.

2.3 Sociophonetics of Emphasis

There are limited studies on the interaction(s) between emphasis as a linguistic variable and other social variables on the acoustic cues. In addition, most studies focused on one-to-one interactions (e.g. Ahmad, 1979; Al-Masri and Jongman, 2004; Abudalbh, 2011; Almomany, 2023a; Almomany, 2023b, inter alia). That is the interaction between emphasis and, for instance, gender or social class, neglecting the possible outcomes of overall interactions. However, few researchers (Alzoubi, 2017; Omari and Jaber, 2019; Omari and Jaber 2020) utilized the overall analysis, which resulted in inconsistent outcomes.

Ahmad (1979) investigated the effects of gender on emphasis production in Cairene Arabic. Four native speakers of Cairene Arabic, with gender being equally satisfied, were recorded reading a list of minimal pairs. In general, Ahmad (1979) observed a salient effect of gender on emphasis production in Cairene Arabic, where male speakers showed a more lowered F2 value in emphatic environment than females.

Al-Masri and Jongman (2004) examined the effect(s) of gender as a social variable on the production of emphasis in the northern dialect of JA. Eight native speakers, five males, and three females, were recorded reading a list of 15 minimal pairs in which each word was out in a carrier sentence. The acoustic cues that were used were CD, vowel duration, and vowel F2. On the whole, gender proved to have a significant effect on emphasis through F2 lowered value, where female speakers maintained a more lowered F2 value in an emphatic environment as compared to their male peers (Al-Masri and Jongman, 2004).

Abudalbh (2011) studied the possible effects of gender on emphasis production in JA. 22 undergraduates, 12 males and ten females, were recorded reading a list of nine minimal pairs. The researcher investigated the VOT of stops, friction duration for fricatives, spectral mean of fricatives, vowel duration, and the vowel's first three formant frequencies. The study revealed the following conclusions as regards the main effect of emphasis: (1) the VOT of voiceless stops is a reliable acoustic cue of emphasis, where emphatic VOTs were significantly lower than plain ones, (2) vowel duration is a reliable acoustic cue of emphasis as vowels in emphatic environment were significantly longer than plain ones, (3) friction duration is a reliable acoustic cue of emphasis as emphatic fricatives showed shorter friction durations as compared to plain ones, (4) spectral mean is not a reliable acoustic cue of emphasis, (5) F1, F2, and F3 are also reliable cues of emphasis, where emphaticized vowels showed raised F1, lowered F2, and raised F3 as compared to plain ones. As for the gender-related effects, only the vowel three formant frequencies at the vowel onset and midpoint were reliable acoustic indicators of

emphasis, where males carried a higher magnitude of change in the direction of emphasis by maintaining more raised F1, lowered F2 and raised F3 in emphatic environment as compared to those of females in the same environment (Abudalbuh, 2011).

Almomany (2023a) investigated the effects of gender on emphasis production in a sub-dialect of JA, namely Ajlouni-Jordanian Arabic (henceforth AJA). 12 native speakers of AJA were recorded reading a stimulus of 48 minimal pairs, mainly contrasting in /t^s/-/t/ and /s^s/-/s/. The acoustic parameters that were used included CD, VOT of voiceless stops, and the vowel's first three formant frequencies. Overall, Almomany (2023a) found that only VOT is a reliable acoustic cue of emphasis, where males' emphatic VOTs were significantly longer than those of females.

Almomany (2023b) probed the effects of age on emphasis production in AJA. 12 native speakers of AJA were recorded reading a stimulus of 48 minimal pairs, mainly contrasting in /t^s/-/t/ and /s^s/-/s/. The environments in which these minimal pairs were investigated included six vowel qualities, namely /ɪ/, /i:/, /a/, /a:/, /o/, and /u:/. The acoustic parameters that were used included CD, VOT of voiceless stops, and the vowel's first three formant frequencies. In general, Almomany (2023b) found that only VOT turned out to be reliable in detecting emphasis, where the emphatic-plain contrast was significantly higher for the third age group (above 50) than it was for the second (36-50) and first (18-35) age groups.

Alzoubi (2017) examined the effects of social class, gender, and origin of the speaker on emphasis production in Amman City. Twenty-two native speakers of JA from East and West Amman were recorded reading a stimulus of minimal pairs and commonly used words. The acoustic cues investigated include VOT, Center of Gravity (COG) of obstruents, and the vowel first three formant frequencies (F1-F3). Overall, Alzoubi (2017) suggests that emphasis was, relative to the gender-related effects, more pronounced in males' speech than in females, where males showed more raised F1, lowered F2, raised F3, and shorter VOT than their female equals. Social class also proved to have a significant effect on emphasis production. While participants from East Amman showed a higher degree of emphaticness using the F3 raised value, participants from West Amman showed a higher degree of emphaticness through their lowered stop COG value. As for the effects of the origin of the speaker or speaker's ORD, to use Alzoubi's terminology, there was a correlation between the speaker's ORD and the proportion of emphaticness they produce. That is, the Rural Palestinian group and the rural Jordanian group respectively showed higher degrees of emphaticness across F2, F3, VOT, and stop COG as compared to the urban Palestinian group (for details, see Alzoubi, 2017, pp. 99-103).

Omari and Jaber (2019) looked into the effects of gender and social class on emphasis production in JA. Forty native speakers of JA who came from two different socio-economic backgrounds (i.e. upper class vis-à-vis lower-middle class), with gender being equally satisfied, were recorded reading a list of 12 monosyllabic minimal pairs. The acoustic correlates that were investigated are VOT for voiceless stops, post-release duration for voiced stops, friction duration, vowel duration, and the vowel first three formant frequencies (F1-F3). In general, gender and/or social class did not significantly affect the VOT of the voiceless stops and the friction duration. However, the post-release duration of voiced stops was affected only by the interaction between emphasis and social class, where the lower middle-class speakers tended to shorten their post-release for the emphatic voiced stops compared to their upper-class peers. While both interactions emphasis*gender and emphasis*gender*social class did not yield any significance on vowel duration, the interaction between emphasis and social class did. That is, lower-middle-class speakers produced longer lags for the emphatic vowels than their counterparts from the upper class did. As for the vocalic cues, only F1 and F2 were reliable acoustic cues regarding emphasis (for details, see Omari and Jaber, 2019, pp. 183-190).

Now, it becomes crystal clear that there was no consensus among researchers regarding what counts as a reliable acoustic cue of emphasis for several reasons. First, researchers had no unified methodology when probing the phenomenon of emphasis. For instance, some (Almomany, 2023a,b; Al-Masri, 2009) resorted to increasing the volume of the data at the expense of the number of respondents, while others (e.g. Omari and Jaber, 2019; Abudalbuh, 2011) did the opposite. Second and last, none of the researchers, except for Alzoubi (2017), controlled for underlying social factors such as the original dialect of the participant and the intermarriage effects¹. Hence, the present study seeks to solve this unconformity among researchers by controlling for both speakers' ORD, using Alzoubi's (2017) terminology and intermarriage effects.

¹ Intermarriage refers to, for instance, the original dialects of participant's parents.

3 Method

3.1 Participants

The present study's participants were 12 native speakers of AJA, six males and six females, whose ages fall into one of the three following categories: 18-35, 36-50, and 51-above. The choice of this categorization was far from being random. Thus, it was motivated by the participants' different affiliations as self-reported and the researcher's observations as a native speaker of AJA. People in their late thirties tend to affiliate with the more mature group, and people in their fifties tend to affiliate with the older age group. All respondents were students at Ajloun Vocational Training Institute, where the researcher taught. Each respondent was verbally asked for their permission to process the data only for academic purposes prior to the recording. As for the selection criteria, there were three main criteria. First, the participant has to be a native speaker of AJA. Second, the participant's parents have to be native speakers of AJA. Third, the participant has to have no speech, visual, or hearing impairment.

3.2 Variables of the Study

The present study included two independent social variables and one independent linguistic variable, as shown in (Table 3) below.

Table (3): Variables of the present study

Linguistic	Social
Emphasis (emphatic-plain)	Age Gender

3.3 Data

The stimuli of the current study consisted of mono- and di-syllabic minimal pairs contrasting in /t^s/-/t/ and /s^s/-/s/. Each of these sounds occurred both word-initially and word-finally in the vicinity of /i:/, /ɪ/, /a:/, /a/, /u:/, and /ʊ/. The stimuli inevitably consisted of both words and non-words, given that the ratio of non-words constitutes almost 33 percent of the overall stimuli.

3.4 Recordings

Each participant of the present study was seated in a comfortable room, mainly the conference room, at Ajloun Vocational Training Institute. The participants were provided with a typed list of the randomized target words, each incubated in the carrier sentence ʔħki ____ ʔħwalad 'Say ____ the boy'. The researcher, using Remax RP1, a voice recorder with built-in noise reduction, performed all of the recordings. Before the recording, the participants were instructed to read each incubated target word at a normal pace and with a normal tone. The recordings were then imported to a TOSHIBA Core i3 laptop and labeled accordingly. The recordings were labeled as M-18-35, F-18-35, M-36-50, F-36-50, M-above 50, and F-above 50, where M. stands for male and F. stands for female. To obtain the measurements for the analysis, the researcher used *PRAAT* (Boersma and Weenink, 2009).

3.5 Acoustic and Statistical Analyses

The investigated acoustic cues included CD, Voice Onset Time (VOT), and the first three formant frequencies (F1-F3). The vocalic cues were only measured at the vowel midpoint both in the target and non-target syllables. As for the statistical test that was used, the researcher opted to use One-Way Analysis of Variance (ANOVA) and Three-Way ANOVA both to identify the main effect of each of the independent variables on the acoustic cues and to identify the overall effect(s) of emphasis, age, and gender on the acoustic cues.

4 Results

This section displays the findings on the acoustic measurements. This section is further divided into two main subsections, each pertaining either to consonant or vowel data. While One-Way ANOVA was used to measure the main effect of each independent variable on the acoustic cues, Three-Way ANOVA was utilized to assess the coupled effects of emphasis, age, and gender on the acoustic means. It is worth mentioning at this juncture that only significant main effect interactions will be reported throughout this section but will not be further considered in the discussion unless emphasis is involved.

4.1 Consonant Duration and Voice Onset Time

A One-Way ANOVA showed no significant main effect of emphasis on CD [$F(1.1150) = 2.123$, $p = .145$]. On the other hand, the ANOVA analysis indicated that there was a significant main effect of age on CD [$F(2.1149) = 20.536$, $p = .000$], where speakers from the first age group (128.28 ms) produced shorter CDs than those from the third (128.42 ms) and second (150.71 ms) age groups, respectively. Similarly, the ANOVA analysis indicated that there was a significant main effect of gender on CD [$F(1.1150) = 5.972$, $p = .015$], where males' CDs (131.73 ms) were significantly shorter than those of females (139.88 ms).

A One-Way ANOVA indicated that there was a significant main effect of emphasis on VOT [$F(1.286) = 282.865$, $p = .001$], where emphatic VOTs (19.92 ms) were significantly shorter than plain VOTs (38.87 ms). The ANOVA test also indicated that there was a significant main effect of age on VOT [$F(2.285) = 4.557$, $p = .011$], where speakers of the first age group (26.80 ms) produced shorter VOTs than those of the second (28.86 ms) and third (32.52 ms) age groups, respectively. Conversely, the ANOVA test showed no significant main effect of gender on VOT [$F(1.286) = .782$, $p = .377$].

As for the emphasis*age*gender interaction, a Three-Way ANOVA showed that there was no significant interaction effect on CD [$F(2.1140) = .649$, $p = .523$] whereas it indicated a significant interaction effect on VOT [$F(2.276) = 3.480$, $p = .032$], where the emphatic-plain contrast was highest for [F. 50-∞ (25.5 ms)] followed by [F. 36-50 (23.04 ms)], [M. 36-50 (22.66 ms)], [F. 18-35 (15.12 ms)], [M. 18-35 (14.33 ms)], and [F. 50-∞ (13 ms)], as shown in Figure 1 below.



Figure 1: Mean values of VOT for different age and gender groups.

4.2 F1, F2, and F3 in the Target Syllable

A One-Way ANOVA indicated that there was a significant main effect of emphasis on F1 [$F(1.1126) = 11.137$, $p = .001$], F2 [$F(1.1126) = 104.196$, $p = .000$], and F3 [$F(1.1126) = 10.704$, $p = .001$], where emphaticized vowels showed higher F1 and F3 values (528.84 Hz, 2754.47 Hz) and lower F2 (1236.48 Hz) value than plain vowels (F1: 502.46; F2: 1526; F3: 2673 Hz).

In addition, a One-Way ANOVA indicated that there was a significant main effect of age on F1 [$F(2.1125) = 21.306$, $p = .000$] and F3 [$F(2.1125) = 8.791$, $p = .000$], but not on F2 [$F(2.1125) = .260$, $p = .771$]. A Bonferroni post hoc analysis revealed that F1 of the first age group (535.89 Hz) was significantly higher than that of the third age group (479.74 Hz). In addition, the analysis showed that F1 of the second age group (531.33 Hz) was significantly higher than that of the third age group (479.74 Hz). However, there were no significant differences in terms of F1 between the second and third age groups. As for F3, the Bonferroni post hoc analysis also revealed that F3 of the third age group (2778.99 Hz) was significantly higher than that of the second age group (2652.17 Hz). Conversely, there were no significant differences in F3 between the first and second age groups nor between the first and third age groups.

A One-Way ANOVA indicated that there was a significant main effect of gender on F1 [$F(1.1126) = 116.168$, $p = .000$], F2 [$F(1.1126) = 38.163$, $p = .000$], and F3 [$F(1.1126) = 92.557$, $p = .000$], where females' F1 (556.41 Hz) and F3 (2829.07 Hz) mean values were significantly higher than those of males (F1: 474.90 Hz; F2: 2598.78 Hz). On the other hand, males' F2 mean value (1291.34 Hz) was significantly lower than that of females (1472.01 Hz).

As for the emphasis*age*gender interaction, a Three-Way ANOVA showed no significance on F1 [$F(2.1116) = .214$, $p = .807$], F2 [$F(2.1116) = .545$, $p = .580$], or F3 [$F(2.1116) = 2.465$, $p = .085$].

4.3 F1, F2, and F3 in the Distant Syllable

A One-Way ANOVA indicated that there was no significant main effect of emphasis on F1 [$F(1.574) = .470$, $p = .493$], F2 [$F(1.574) = 3.408$, $p = .065$], or F3 [$F(1.574) = .159$, $p = .691$]. However, a One-Way ANOVA indicated that there was a significant main effect of age on F1 [$F(2.573) = 11.802$, $p = .000$] and F3 [$F(2.573) = 4.640$, $p = .010$], but not on F2 [$F(2.573) = .326$, $p = .722$]. A Bonferroni post hoc analysis revealed that F1 was significantly higher for the first age group (532.22 Hz) than it was for the second age group (521.82 Hz), which in turn was substantially higher than that of the third age group (468.15 Hz). However, there were no significant differences in terms of F1 between the first and second age groups. The Bonferroni post hoc analysis also revealed that F3 of the third age group (2677.73 Hz) was significantly higher than that of the second age group (2561.86 Hz). On the contrary, there were no significant differences in F3 between the first and second age groups or between the first and third age groups.

Similarly, a One-Way indicated that there was a significant main effect of gender on F1 [$F(1.574) = 55.688$, $p = .000$], F2 [$F(1.574) = 14.779$, $p = .000$], and F3 [$F(1.574) = 57.911$, $p = .000$], where females' F1 (549.37 Hz) and F3 (2751.73 Hz) were significantly higher than those of males (F1: 465.42 Hz; F3: 2511.32 Hz). Conversely, males' F2 (1319.82 Hz) was significantly lower than that of females (1498.85 Hz).

As for the emphasis*age*gender interaction, a Three-Way ANOVA showed no significance on F1 [$F(2.564) = .059$, $p = .942$], F2 [$F(2.564) = .828$, $p = .437$], or F3 [$F(2.564) = .530$, $p = .589$].

4.4 Summary of the Main Findings

Table 4 below summarizes the findings of the main effect of each independent variable on the acoustic cues and the interaction effects between emphasis, age, and gender acoustic correlates. An asterisk (*) denotes a significant interaction, the (Ø) symbol shows an insignificant interaction, the (↑) symbol indicates an increased value, and the (↓) symbol represents a decreased value, and the more (↑)/(↓) symbols there are, the more/less increased values there are.

Table 4: Main findings on CD, VOT, F1, F2, and F3.

Dependent Variable	Independent Variable(s)	Interaction Effect	Groups ²					
CD	Emphasis	Ø	--					
	Age	*	18-35	↓↓↓	36-50	↓	51-∞	↓↓
	Gender	*	M.		↓↓		F.	↓
	Empahsis*Age*Gender	Ø	--					
VOT	Emphasis	*	E.	↓↓	P.	↓		
	Age	*	18-35	↓↓↓	36-50	↓↓	51-∞	↓
	Gender	Ø	--					
	Empahsis*Age*Gender	*	See Section 4.1					
F1 in the Target Syllable	Emphasis	*	E.	↑↑	P.	↑		
	Age	*	18-35	↑↑↑	36-50	↑↑	51-∞	↑
	Gender	*	M.	↑	F.	↑↑		
	Empahsis*Age*Gender	Ø	--					
F2 in the Target Syllable	Emphasis	*	E.	↓↓	P.	↓		
	Age	Ø	--					
	Gender	*	M.	↓↓	F.	↓		
	Empahsis*Age*Gender	Ø	--					
F3 in the Target Syllable	Emphasis	*	E.	↑	P.	↓		
	Age	*	18-35	--	36-50	↑	51-∞	↑↑
	Gender	*	M.	↑	F.	↑↑		
	Empahsis*Age*Gender	Ø	--					
F1 in the Distant Syllable	Emphasis	Ø	--					
	Age	*	18-35	↑↑↑	36-50	↑↑	51-∞	↑
	Gender	*	M.	↑	F.	↑↑		
	Empahsis*Age*Gender	Ø	--					

² E. stands for emphatic, P. for Plain, M. for male, and F. for female.

F2 in the Distant Syllable	Emphasis	Ø			--		
	Age	Ø			--		
	Gender	*	M.		↓↓	F.	↓
	Empahsis*Age*Gender	Ø			--		
F3 in the Distant Syllable	Emphasis	Ø			--		
	Age	*	18-35	--	36-50	↑	51-∞ ↑↑
	Gender	*	M.		↑	F.	↑↑
	Empahsis*Age*Gender	Ø			--		

5 Discussion

The present study has investigated the coupled effects of age and gender on emphasis production in AJA. The present study's findings support some previous research findings while simultaneously refuting others.

The present study shows that, as has been reported in the literature (Al-Masri, 2009; Almomany, 2023a, Almomany, 2023b), neither emphasis had a significant main effect on CD nor emphasis*age*gender interaction had any significance on CD.

However, it now becomes crystal clear that emphasis alone affects the relative values of the VOT voiceless stops and the vowel three formant frequencies (F1-F3) only in the syllable containing the emphatic consonant. As for VOT, this finding goes in tandem with those of Abudaljuh (2010), Alzoubi (2017), Almomany (2023a), and Almomany (2023b), while it refutes those of Omari and Jaber (2019) and Kulikov (2022). More importantly, the emphasis*age*gender interaction indicated a statistically significant effect on VOT, where the emphatic-plain contrast was higher for females from the third, second, and first age groups as compared to that of males from the same age groups (see Figure 1 above).

What this informs is that females produced shorter emphatic VOTs than males. In addition, the correlation between the speaker's age and the proportion of emphasis production is quite evident among females. Older females produced shorter emphatic VOTs than middle-aged and young females, respectively. Unlike females, males showed an anomaly in this direction of change, where middle-aged males showed a higher magnitude of change in the direction of emphasis than as compared to that of the young (18-35) and old (above 50) age groups.

This finding corroborates that of Almomany (2023a), who argued that females' emphatic VOTs were significantly lower than those of males. On the other hand, this finding goes against that of Alzoubi (2017), who claimed that males' emphatic VOTs were significantly shorter than their male peers. Similarly, the present finding on VOT contradicts that of Abudaljuh (2011), who argued that the emphasis*gender interaction did not yield any significance on VOT.

As for the vocalic cues, the present study shows that emphasis had a significant main effect on the relative values of the vowel's first three formant frequencies in the target syllable. Emphaticized vowels are characterized by raised F1 and F3, and a lowered F2. Notwithstanding this statistically significant interaction, emphasis did not significantly affect the relative values of the vowel's first three formant frequencies in the distant syllable. The former interaction lends support to most studies while the latter goes against these studies, viz. Jongman et al. (2007), Al-Masri (2009), Abudaljuh (2011), Jongman et al. (2011), inter alia.

As for the emphasis*age*gender interaction, the analysis yielded no significance on vowels F1, F2, and F3, neither in the target nor the distant syllable. This finding ratifies those of Almomany (2023a, 2023b), where he found that none of the vocalic cues that were suggested to be reliably proved to detect emphasis in pair-wise interactions (i.e. emphasis and gender; emphasis and age). Therefore, this finding probably constitutes a turning point where vowel formant frequencies fail to detect emphasis, which contradicts the majority of studies on the sociophonetics of emphasis (Ahmad, 1979; Jongman et al., 2007; Al-Masri and Jongman, 2004; Abudaljuh, 2011; Alzoubi, 2017; Omari and Jaber, 2019, to mention but a few).

With all that being said, the interaction between emphasis, on the one hand, and age and gender, on the other hand, unravel fundamental issues in researching the sociophonetics of emphasis. By looking at the interaction between the consonant and vowel data, it becomes apparent that the possible effects of emphasis, evident in the primary effect analysis, were ruled out when emphasis comes into play with age and gender (Omari and Jaber, 2019). Yet, VOT survives as a reliable acoustic cue in detecting emphasis in the emphasis*age*gender interaction, where females across the three age groups spearhead their male peers in producing emphasis. In this regard, speakers in this social context likely maintain the emphatic-plain contrast distinguishably as evinced on stop VOT.

6 Conclusions

This study aimed to investigate the overall effects of age and gender for the two primary emphatics, viz. /t^s/ vis-à-vis /t/ and /s^s/ vis-à-vis /s/, in AJA. Phonetically speaking, emphasis was characterized by shorter VOT, on the one hand, and by raised F1 and F3 and lowered F2 only in the target syllable. However, the interplay between the linguistic and social variables yielded a robust finding; only VOT has turned out to be significant in detecting emphasis. This finding probably informs future research that there is no guarantee that a certain acoustic cue preserves its reliability across different social contexts. Following this, speakers from various social backgrounds may utilize different acoustic cues to show emphasis. Furthermore, this study showed that emphasis had a prominent effect on emphasis only in the syllable in which an emphatic segment exists. This fosters the importance of studies that tackle the domain of emphasis in JA in general and in AJA in specific.

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