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The Sociophonetics of Emphasis Among Children and Adolescents in Jordanian Arabic: Linguistic and Extra-linguistic Variables

"A Dissertation Submitted in Partial Fulfillment of the Requirements for the Degree of Doctor of Philosophy in Linguistics"

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Program: Theoretical Linguistics

2026

Abstract

This research aims to examine the relative impact of gender, age, and parental education as they interact with emphasis and other linguistic variables in the speech of children and adolescents speaking the Ajlouni dialect of Jordanian Arabic (AJA). The rationale for conducting this study was to determine whether both social and linguistic variables consistently and meaningfully influence the production of emphasis among children and adolescents in this under-researched language variety. To achieve this objective, 40 native speakers were recorded, equally divided by gender (20 males and 20 females), age (20 children and 20 adolescents), and parental education (20 tertiary and 20 below-tertiary). These participants read three lists of CVC minimal pairs, each corresponding to a phonemic contrast (e.g., /tˤ/-/t/), with the stimuli embedded in a carrier sentence and repeated three times, yielding 96 tokens per speaker (96 x 40 = 3840). The acoustic measurements included the friction duration of fricatives (FD), stop closure of voiceless stops (SC), voice onset time of voiceless stops (VOT), vowel duration (VD), and the first three formant frequencies (F1-F3) of the target vowels (i.e., /æ, aː, ʊ, uː, ɪ, iː, oː, eː/). The findings reveal several significant interactions between emphasis and the other variables, both linguistic and extra-linguistic. Specifically, emphasis is more acoustically pronounced in the vicinity of a stop than in that of a fricative, and it is proportional to the position of the emphatic consonant. Additionally, the analysis indicates that emphasis is more prominent in the environment of low vowels compared to front and back vowels, and it is more pronounced on short vowels than on long ones. Crucially, the study identifies several important interactions between emphasis and other social variables, showing that emphasis is more pronounced in the speech of males than in that of females, and more evident in the speech of adolescents than in that of children. The effect of parental education is minimal, observable only in the interaction between gender, age, and parental education, suggesting its dependence on gender and age. Specifically, the interaction demonstrated that only female adolescents are more sensitive to parental education than their male counterparts; females whose parents had a higher educational attainment (i.e., tertiary level) exhibit a lesser degree of emphaticness than those whose parents had a lower educational attainment (i.e., below-tertiary level). Furthermore, the study reports other statistically significant interactions between emphasis and the other linguistic and non-linguistic variables.

Keywords**:** Emphasis, Ajlouni Jordanian Arabic, acoustic phonetics, voice onset time, formant frequencies.

Declaration

I affirm that the academic work contained in this dissertation, titled "The Sociophonetics of Emphasis Among Children and Adolescents in Jordanian Arabic," is entirely derived from my own research efforts and has not been submitted previously, in whole or in part, to earn any degree or diploma at this or any other academic entity. All referenced information sources have been properly cited. Instances where I have included quotations from authors are marked with citations. An extensive bibliography is included. I also declare that the following articles were published in partial fulfillment of the requirements of the Theoretical Linguistics PhD program, of which the last two articles were based on data arising from this dissertation:

1. Almomany, I. E. O. (2023a). Effects of gender on emphasis production in Jordanian Arabic: A socio-phonetic study. *Contemporary Studies in Social Sciences, 2*(2), 169-179. https://doi.org/10.31559/CSSS2023.1.1.5. [published]
2. Almomany, I. E. O. (2023b). Effects of age on emphasis production in Jordanian Arabic: A socio-phonetic study.. *Journal of Studies in Language, Culture, and Society, 6*(1), 10-26. [published]
3. Almomany, I. E. O. (2024). The sociophonetics of emphasis in Jordanian Arabic: Age and gender. *Contemporary Studies in Social Sciences, 1*(1), 59-72. https://doi.org/10.31559/CSSS2024.2.2.5. [published]
4. Almomany, I. E. O. (2025). Acoustic correlates of emphasis among Jordanian Arabic-speaking children. *Bucharest Working Papers in Linguistics, XXVII*(2).
5. Almomany, I. E. O. (to appear). Variation in the production of emphasis among children in Jordanian Arabic: Gender and Education. *Applied Linguistics,* [Accepted].

Dedication

To my cherished parents,

the roots that keep me grounded,

sustaining me with love, sacrifice, and wisdom.

To my brothers and sisters,

the neighbouring branches,

at times bending in different directions,

yet always stretching toward the same sky.

To my beloved wife, Dr. Bayan,

the gentle light that guides my steps

and eases every load simply by being there.

To my son, Hamzah,

the bright flame of the days ahead,

whose laughter fuels my determination

and embodies my promise to the future.

And to my nephews and nieces,

the blossoms and fresh leaves,

reminding me that hope and joy

return with every season,

I dedicate this work.

Acknowledgements

I embark on this acknowledgment by extending my deepest gratitude to my supervisor, Dr. Zsigri Gyula. His unparalleled support, unwavering dedication, and profound academic expertise have been the cornerstone of this humble endeavor, and without his guidance, this work would not have reached fruition. My appreciation further extends to Prof. Németh Enikő and Prof. Ivaskó Lívia, whose amiable consultations and sage advice have been instrumental in deepening my comprehension of the PhD program. A debt of gratitude is also owed to Prof. Szentgyörgyi Szilárd and Prof. Fenyvesi Anna for their astute comments and incisive remarks on the initial draft of this dissertation proposal, which have significantly enriched the quality and depth of this work. My thanks are graciously extended to all esteemed faculty members at the Doctoral School of Linguistics, whose contributions have illuminated my understanding across other core areas of Linguistics. Additionally, I hold in high regard Dr. Mujdey Abudalbuh from Yarmouk University, Jordan, whose voluntary commitment to training me in SPSS and peer-reviewing the acoustic analysis was pivotal to the success of this study. I am equally indebted to the eminent statistician Mr. Ahmed Almomani, whose voluntary peer-review assistance on the statistical analysis was invaluable. Ultimately, I must express my heartfelt gratitude to all the participants who graciously volunteered to partake in this study.

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Abbreviations

MSA	Modern Standard Arabic
JA	Jordanian Arabic
RJA	Rural Jordanian Arabic
BJA	Bedouin Jordanian Arabic
UJA	Urban Jordanian Arabic
AJA	Ajlouni Jordanian Arabic
ORD	Original Regional Dialect
PTC	Position of the Trigger Consonant
VQ	Vowel Quality
VL	Vowel Length
FD	Friction Duration
SC	Stop Closure
VOT	Voice Onset Time
COG	Center of Gravity
VD	Vowel Duration
F1	First Formant Frequency
F2	Second Formant Frequency
F3	Third Formant Frequency
RTR	Retracted Tongue Root
Hz	Hertz
ms.	Milliseconds
SPSS	Statistical Package for the Social Sciences
ANOVA	Analysis of Variance

List of Phonetic Symbols

Consonants

Phonetic Symbol	Arabic Script	Description
tˤ	ط	Voiceless emphatic alveolar stop
t	ت	Voiceless non-emphatic alveolar stop
dˤ	ض	Voiced emphatic alveolar stop
d	د	Voiceless non-emphatic alveolar stop
sˤ	ص	Voiceless emphatic alveolar fricative
s	س	Voiceless emphatic alveolar fricative
ðˤ	ظ	Voiced emphatic interdental fricative
ð	ذ	Voiced non-emphatic interdental fricative
zˤ	–	Voiced alveolar emphatic fricative
z	ز	Voiceless alveolar non-emphatic fricative
ʕ	ع	Voiced pharyngeal fricative
ħ	ح	Voiceless pharyngeal fricative
ɣ	غ	Voiced velar fricative
x	خ	Voiceless velar fricative
ʁ	غ	Voiced uvular fricative
χ	غ	Voiceless uvular fricative
q	ق	Voiceless uvular stop
b	ب	Voiced bilabial stop
m	م	Voiced bilabial nasal
w	و	Voiced bilabial glide
f	ف	Voiced labiodental fricative
θ	ث	Voiceless interdental fricative
n	ن	Voiced alveolar nasal
r	ر	Voiced alveolar trill
l	ل	Voiced alveolar lateral
ʃ	ش	Voiceless post-alveolar fricative
ʧ	–	Voiceless post-alveolar affricate

ʤ	ج	Voiced post-alveolar affricate
k	ك	Voiceless velar stop
g	–	Voiced velar stop
h	ه	Voiceless glottal fricative
j	ي	Voiced palatal glide

Vowels

Phonetic Symbol	Description
aː	Long low front vowel
æ	Short mid-low front vowel
ɐ	Short mid-low front vowel
iː	Long high front vowel
ɪ	Short mid-high front vowel
uː	Long high-back vowel
ʊ	Short mid-high back vowel
eː	Long mid front vowel
e	Short mid front vowel
oː	Long mid back vowel
ɑː	Long low back vowel
ɑ	Short low back vowel

Chapter 1: Introduction

1.1. Articulation of Emphasis

Emphasis (*tafkhīm* in Arabic), a feature of almost all Semitic varieties, is defined as the coarticulation of two features: primary and secondary, with the former being articulated in the dental/alveolar region and the latter being articulated in the back of the vocal tract (Ghazeli, 1977; Bin-Muqbil, 2006; Jongman, Herd, and Al-Masri, 2007; Jongman, Herd, Al-Masri, Sereno, and Combest, 2011, among others). Yet, the essence of this secondary articulation has been disputed among researchers. That is, different terms have been attached to emphasis such as *uvularization, pharyngealization*, *velarization, dorsalization*, and *backing*.

Previous research on Arabic phonetics and phonology discusses the nature of emphatics and gutturals (e.g. Bin-Muqbil, 2006). The former refer to the four emphatic sounds /tˤ/, /dˤ/, /sˤ/, and /ðˤ/ vis-à-vis their plain equals /t/, /d/, /s/, and /ð/ whereas the latter refer to the two pharyngeals /ħ/ and /ʕ/, the two laryngeals /h/ and /ʔ/, and the three uvulars /χ/, /ʁ/, and /q/. Yet, there was no uniformity among researchers whether these two sets of sounds form one natural class or not. For instance, Zawaydeh (1999) refers to emphasis as *uvularization,* and thus she uses 'gutturals' as a cover term for emphatics, pharyngeals, laryngeals, and uvulars. She argues that while pharyngeals, uvulars, and emphatics have the same articulatory denominator (i.e. constriction at the pharynx), laryngeals do not have this articulatory denominator. Thus, they cannot be grouped as one natural class on an articulatory basis. On the other hand, McCarthy (1994) proposed the distinctive feature [pharyngeal] to group gutturals as one natural class. He continued that pharyngeals, laryngeals, and uvulars are articulated in the same region spanning from "the larynx to the oropharynx" (p. 198). Therefore, these guttural sounds, along with emphatic sounds, consistently raise the vowel's first formant frequency, which would give support to grouping these sets of sounds as one natural class.

Problematic as it appears, the articulatory classification of emphatic segments in Arabic has been discussed by other researchers. Bin-Muqbil (2006) adopts, similar to Younes (1982), Laufer and Baer (1988), Herzallah (1990), and Davis (1995), *pharyngealization* to refer to emphatics since the secondary articulation of these sounds entails the retraction of the tongue towards the upper oropharynx. Contrary to this, Algryani (2014) argues that it is not true that all emphatics involve a constriction at the pharynx, hence they cannot be referred to by *pharyngealization*.

In addition, Bin-Muqbil (2006) explains the conflicting accounts that try to depict the essence of the secondary articulation involved in producing the primary emphatics. Bin-Muqbil stresses that, contrary to Obrecht (1968), who refers to emphasis as *velarization*, there are two interpretations behind referring to emphasis as *uvularization*. The former posits that emphatic segments have identical secondary articulation to that in /x/ and /ɣ/, in which the velum is an active articulator. In contrast, the latter suggests that the secondary articulation involves what Davis (1995) and Watson (2002) referred to as retracted tongue root [RTR], in which the dorsum of the tongue gets retracted and pulled towards the uvula.

With all that being said, this leaves little doubt that emphatics phonologically form a natural class since they all share the same distinctive feature [+pharyngeal], [+RTR], or [+emphatic]. Not only this, emphatics also pattern together in emphasis spread, which is a phonological process. For instance, plain vowels like /æ/ get retracted when they are in the vicinity of an emphatic consonant (McCarthy, 1994; Davis, 1995; Watson, 1999; Al-Raba'a & Davis, 2020, among others). Emphatics are also phonetically considered as a natural class. First, all emphatic sounds are characterized by a shared secondary articulation. Second, they all the effect of lowering the second formant frequency (F2) of the vowel and, though to a lesser degree, raising the first (F1) and third formant (F3) frequencies of the vowel (Al-Masri & Jongman, 2007; Al-Masri, 2009; Abudalbuh, 2011; Alzoubi, 2017, inter alia).

Emphatics are conventionally divided into two main categories, namely primary emphatics and secondary emphatics (Card, 1983; Watson, 2002; Algryani, 2014; Rababa, 2017; Jaber, Omari, and Al-Jarrah, 2019; Al-Deaibes, Al-Shawashreh, and Jarrah, 2021, inter alia). The former refer to the four emphatic consonants /tˤ/, /dˤ/, /sˤ/, and /ðˤ/ in contrast to their plain counterparts /t/, /d/, /s/, and /ð/. It is worth noting that the contrast between emphatic vis-à-vis plain is phonemic. Table 1. below displays some examples of primary emphatics in Modern Standard Arabic (MSA).

Table 1. *Primary emphatic sounds in MSA*

Emphatic	**Gloss**	**Plain**	**Gloss**
[tˤɑ:b]	'Recovered'	[ta:b]	'Repented'
[dˤɑm]	'Hugged'	[dæm]	'Blood'
[sˤɑjf]	'Summer'	[sæjf]	'Sword'
[ðˤɑl]	'Dissipated'	[ðæl]	'Humiliated'

Conversely, secondary emphatics are claimed to have no contrasting counterparts; they are mere allophones of the same phoneme (Rababa, 2017; Jaber, Omari, and Al-Jarrah, 2019; Al-Deaibes et al., 2021, among others). Al-Deaibes et al. (2021) argue that secondary emphatics can further be divided into two subcategories: allophonic and free-variational. The researchers maintain that whereas the former is either the product of neighboring emphatic segments (i.e. assimilation) or the product of the environment in which the sound occurs, the latter is the product of dialectal or social (e.g. gender) variations (for details, see Al-Deaibes et al. 2021: 2). Tables 2 and 3[1] below display the examples Al-Deaibes et al. (2021) provided on allophonic and free-variational emphatics, respectively.

Table 2. *Examples of what they call allophonic emphasis in Jordanian Arabic.*

No.	Emphatic	Gloss	Plain	Gloss
1.	[bɑːlˤɑ]	'second-hand store'	[baːlu]	'he mind'
2.	[tˤɑl]	'looked'	[tæl]	'hill'
3.	[fɑrˤ]	'ran away'	[færd]	'individual'
4.	[ʤɑrˤ]	'dragged'	[ʤærd]	'inventory'
5.	[ħɑːrˤ]	'spicy'	[ħaːrɪs]	'guard'

Table 3. *Examples of free-variational emphasis in Jordanian Arabic.*

Emphatic	Plain	Gloss
[bˤɑwˤɑːdɪ]	[bæwaːdɪ]	'deserts'
[ʤˤɑwˤ]	[ʤæw]	'weather'
[wˤɑːdɪ]	[waːdɪ]	'valley'

[1] Tables 2 and 3 were adapted from Al-Deaibes et al. (2021:2) with some slight changes in the format, transcription, and glosses.

However, their classification is inadequate. The researchers claim that allophonic emphasis is either the product of emphasis spread from a primary emphatic sound (i.e., assimilation) as in examples 1-2 in Table 2 or the product of the environment in which the sound occurs (i.e., constrained) as in examples 3-4 in Table 2. If one considers example 1 in Table 2, the researchers' criteria would fail to account for the indicated emphasis since there is no primary emphatic sound. In addition, the conditioning environment in examples 3-5 in Table 2, which the researchers did not clearly state, could be deduced as that [r] is realized as emphatic [rˤ] when it is in syllable- or word-final position following the low vowels /æ/ or /aː/. Yet, I believe that this argumentation fails to account for pairs like those in Table 4 below, where there is a contrast.

Table 4. *Data from Ajlouni Jordanian Arabic that contradict allophonic emphasis patterns.*

Emphatic	Gloss	Plain	Gloss
[mˤɑj]	'water'	[mæj]	'proper name'
[ʤɑːrˤɪ]	'my neighbor'	[ʤaːrɪ]	'ongoing'
[dɑːrˤɪ]	'my home'	[daːrɪ]	'be patient with!'

Given the fact that the distribution of the secondary emphatics was not, to the best of my knowledge, thoroughly examined for the Jordanian varieties of Arabic, an alternative way to account for pairs like these is probably feasible if we consider them as marginal phonemes with low functional loads. That is, speakers store such unpredictable, lexically constrained variants in the lexicon (Watson, 2002; Scobbie & Stuart-Smith, 2008; Hall, 2013, inter alia).

Regarding the second type of secondary emphatics, specifically free-variational emphasis, the examples provided by Al-Deaibes et al. (2021) are not typical of the dialect under the current investigation. More frequently occurring examples would be like [sˤɪʤɪn] 'prison' versus [sɪʤɪn] 'prison' and [zbˤɑːlɪh] 'garbage' versus [zbaːlɪh] 'garbage'. What these examples might suggest is that although /sˤ/ is a primary emphatic sound, it appears in free variation, thus leaving the discussion open as what to dub such probably idiolectal variation.

1.2. Acoustics of Emphasis

Following this, it becomes crystal clear that emphasis has been thoroughly investigated on articulatory basis. Yet, there seems to be little consensus among researchers as regards the articulation involved in producing emphatic sounds in Arabic. Following this, several acoustic studies have been carried out to find common ground for emphatic segments (Obrecht, 1968; Ghazeli, 1977; Card, 1983; Zawaydeh, 1999; Al-Masri and Jongman, 2004, among others).

The bulk of acoustic research on Arabic emphatics argues that emphasis affects the acoustic properties of neighboring speech sounds, mainly the vowel's first three formant frequencies (F1-F3). That is, vowels in an emphatic environment show raised F1 and F3, and a lowered F2 value as compared to those in a plain environment (Ghazeli, 1977; Card, 1983; Laufer and Baer, 1988; Zawaydeh, 1998; Jongman et al., 2011, among others). Similarly, emphasis has less frequently been reported to significantly affect Voice Onset Time (VOT) of voiceless stops. That is, emphatic VOTs were found to be significantly shorter than plain ones (Khattab, Al-Tamimi, and Heselwood, 2006; Abudalbuh, 2011; Almomany, 2024). Moreover, the spectral mean of emphatic stops was reported to be significant in detecting emphasis, viz., the spectral mean of emphatic stops was lower than that of plain stops (Jongman et al., 2007; Jongman et al., 2011).

Although many studies have acoustically accounted for emphasis in different Arabic dialects (Lehn, 1963, for Cairo Arabic; Card, 1983, for Palestinian Arabic; Wahba, 1993, for Egyptian Arabic; Abudalbuh, 2010, for Jordanian Arabic; Kulikov, Mohsenzadeh, and Syam, 2020, for Qatari Arabic), there seems to be only one common denominator among these studies as far as emphasis is concerned, that is F2 lowering of emphaticized vowels.

The majority of studies on emphasis in Arabic dialects reported several reliable acoustic correlates. On the whole, F2 was consistently reported to be lower for vowels in an emphatic environment than for vowels in a plain environment, regardless of the position of the emphatic consonant, whether prevocalic or postvocalic. While F2 lowering was consistently reliable in detecting emphasis, F1 and F3 raising in an emphatic environment was less commonly reported in the previous studies. Similarly, the VOT of voiceless stops was, though to a lesser degree than F2, reported as a reliable acoustic cue of emphasis. However, the least frequently reported reliable acoustic cue is, to the best of my knowledge, the spectral mean of stops.

1.3. Sociophonetics of Emphasis

Sociophonetics is a loose term that represents the intersection of phonetics and sociolinguistics. While the phonetic facets refer to articulatory, acoustic, and auditory analyses, the sociolinguistic ones refer to all types of variation, be it gender-graded, geographical, or age-graded. Still, there is a great deal of debate between phoneticians and sociolinguists, as each group adapt the term differently. In other words, phoneticians consider sociophonetics as a phonetic study that takes into consideration dialectal variation, whereas sociolinguists view it as a sociolinguistic study that draws evidence based on phonetic features, mainly acoustic and/or auditory (Thomas, 2011). For clarity reasons, the researcher adopts the phoneticians' view, where the main focus is phonetic (i.e., acoustic) with a Variationist Sociolinguistic analysis.

Investigating the acoustics of emphasis not only entails studying the physical properties of these sets of sounds but also links these physical properties to a larger set of external factors, namely social factors, for a better understanding of this linguistic phenomenon. People use different language forms, be it phonetic, syntactic, or morphemic, to show their social identity. Social factors such as age, gender, social class, education, et cetera, hold as external entities that we affiliate ourselves with (Holmes, 2013). To this end, several studies have tackled the socio-phonetics of emphasis in different Arabic dialects (Almbark, 2008, for Syrian Arabic; Alfraikh, 2015, for Najdi Arabic; Al Malwi, 2017, for Abha Arabic; Salem and Sebane, 2023, for Oran Arabic; Khattab et al., 2006; Abudalbuh, 2011; Alzoubi, 2017; Omari and Jaber, 2019, for Jordanian Arabic, inter alia).

Previous studies reported several findings regarding the interaction effects between emphasis and other social variables such as gender, social class, and/or regional dialect. To sum up, gender was reported to have a salient effect on emphasis production where females generally produced less degrees of emphaticness than males. Social class was also reported to have a significant effect on emphasis production where people from the lower/lower-middle class tended to project stronger emphatic-plain contrasts than those from the upper class. Similarly, the speaker's original regional dialect or speaker's ORD, to use Alzoubi's (2017) term, was found to have a significant effect on emphasis production. Specifically, speakers of the urban dialect exerted the least emphatic-plain contrast as compared to other dialects (e.g., rural).

Social factors such as age, gender, and/or education seem to be powerful in shaping interaction effects. Only few studies have relatively recently been oriented to studying the interaction effect between emphasis, on the one hand, and other linguistic and nonlinguistic factors, on the other hand (Alzoubi, 2017; Omari and Jaber, 2019; Omari and Jaber, 2020; Al-Deaibes et al., 2021; Almomany, 2023a; Almomany, 2023b; Almomany, 2024). The majority of these studies showed that the effect of a variable (e.g., emphasis) on an acoustic cue might get obliterated when other variables come into play (see Almomany, 2024:176-177; Omari and Jaber, 2020, p. 12). This indicates that one should not take into account only one interaction environment but rather investigate the phenomenon of emphasis in different environments so that generalizations would be suggested on a more solid ground.

1.4. Children and Emphasis

Emergent writing, which is at the heart of phonemic awareness, is defined as the early developmental phase of children's written language production, typically beginning before formal schooling, approximately between three and five years of age. During this period, children manifest nascent writing-related competencies through behaviors such as scribbling and the production of nonconventional or random letter-like forms (Puranik & Lonigan, 2014; Bradford & Wyse, 2020). Despite the presence of these preliminary skills, Pinto, Bigozzi, Gamannossi, and Vezzani (2012) posit that children between five and six years of age commence the systematic acquisition of conventional writing. Accordingly, these authors maintain that children's writing abilities undergo substantial development as they near the end of their sixth year of life.

Since one of the main observations of this dissertation is devoted to children's production of emphatic sounds in Jordanian Arabic, it becomes inevitable that we have to look at some previous research that dealt with the acquisition of emphatic consonants by children. Since emphatic sounds in Arabic involve a double articulation (see Section 1.1.), children have difficulty pronouncing these sounds at an early stage, and thus these emphatic consonants are labeled as 'late' consonants (Al Amayreh, 1994; Mashaqba, Daoud, Zuraiq, and Huneety, 2022).

Few studies have examined children's acquisition of emphatic consonants in Arabic (Mashaqba et al., 2022). Al Amayreh (1994) investigated children's acquisition of Arabic sounds. Comprising the speech of 180 children, whose ages were distributed into nine age groups ranging from 2;0-6;4 (years; months) (for details, see Al Amayreh, 1994, p. 74), the researcher found that, relative to our study, the four primary emphatics were regarded as late consonants, which are acquired at a later age (>6;4). Therefore, the researcher argues that there was no significant correlation between performance and gender. That is, male and female children maintained the same performance across the different age groups.

Amayreh and Dyson (2000) studied the phonetic inventories of Arabic-speaking children aged between 13 and 24 months in Jordan; the researchers found that their respondents' phonetic inventory was confined to [b, t, d, l, j, h, w, m, ʔ, n, ħ], confirming that emphatic sounds are acquired at a later stage. A later study on children's acquisition of Arabic consonants was carried out by Amayreh (2003). The researcher claims that children acquired /dˤ/ at the ages of 6;6-7;4 (viz. years; months) whereas they acquired /tˤ/, /sˤ/ and /ðˤ/ at the ages of 7;8-8;4. Investigating the consonant profile of first-grade children in Amman, Hamdan and Amayreh (2007) found that, relative to our study, children whose mean age was 6;4 acquired /sˤ/ and /tˤ/ but not /dˤ/ and /ðˤ/. The researchers attributed this acquisition failure to the inhomogeneity of the respondents who spoke different dialects of Jordanian Arabic (JA), namely Urban Jordanian Arabic (UJA) and Rural Jordanian Arabic (RJA).

A more recent, yet informative, study on children's acquisition of emphatic consonants was carried out by Mashaqba et al. (2022). The researchers studied the speech of 60 children (30 males and 30 females) in Amman City. The researchers argue, in favor of the acoustic evidence, that children acquire the three emphatic sounds, namely /tˤ/, /dˤ/, and /sˤ/, in an adult-like manner at the age of six for word-initial and word-medial positions and at the age of seven for word-final position. Mashaqba et al. (2022) pinpoint the unreliability of the accuracy judgments (i.e., customary, acquisition, and mastery), as they revealed that emphatics are acquired by the age of four and mastered by the age of five.

To sum up, the bulk of research concentrated on examining children's speech using accuracy tests, except for Mashaqba et al. (2022), who used both an accuracy test and an acoustic test. Yet, there was no uniformity in terms of the age at which children acquire emphatic sounds. Several justifications were proposed but will not be reported here.

1.5. Context of the Study

The labels JA, Syrian Arabic, Lebanese Arabic, or Palestinian Arabic are cover terms for varieties of Arabic spoken within countries whose borders were drawn by French and British colonial authorities in the 1920s (Al-Deaibes, 2016). Though there are political boundaries, the varieties spoken in these countries are mutually intelligible varieties of Levantine Arabic[2] (Al-Hawamdeh, 2016; Alzoubi, 2017; Albdairat, 2021). Dialectal boundaries do not match with political boundaries: some dialects are spoken in more than one country (e.g. the southern part of Syria and the northern part of Jordan) (Al-Deaibes, 2016). Hence, Al-Wer (2007, p.1) advocates studying how these geography-based distinctions were drawn at the beginning of the twentieth century while Alzoubi (2017: 21) distinguishes between a speaker's "original regional dialect (ORD)" and the speaker's "evolving regional dialect (ERD)".

Arabic dialects in general and JA in specific are best classified not only according to their origins or isoglosses[3] (e.g., Hourani) but also according to pronunciation[4], morphology, and syntax. Cleveland (1963) categorized the dialects of what was in the 1950s Transjordan and the West Bank into four dialect groups, namely the [jɪguːl], [bəguːl], [bəkuːl], and [bəʔuːl] dialect groups, relying on how speakers of these dialects produce the simple imperfect verb forms. The first dialect group refers both to the nomads in the eastern and southern deserts of Transjordan and to those settled nomads in Al-Karak and elsewhere. The second dialect group refers to rural people in the south part of Palestine, the Jordan Valley, and the areas to the east of the Jordan Valley. The third dialect group refers to villagers of northward in central Palestine and those around Jerusalem. The fourth group refers to people in Jerusalem, Jenin, Hebron, Nablus, and Palestinian refugees in Transjordan. However, the researcher argues that his classification was to some degree based on the socio-economic hierarchy and geography of the country.

A more recent study on the classification of Arabic dialects in Palestine and Transjordan was provided by Palva (1984). Criticizing Cleveland's dialect grouping, Palva claims that significant isoglosses indeed go across linguistic boundaries as such in the dialects of Jerusalem and, for instance, Hebron, which were grouped together (viz. the [bəʔuːl] dialect). The researcher argues that there are substantial differences not only

[2] Arabic dialects that are primarily spoken in Syria, Lebanon, West Bank, Israel, and Jordan.
[3] An isogloss refers to a geography-bound linguistic feature such as the realization of /k/ as [ʧ] in Rural Jordanian Arabic.
[4] The RJA phoneme /g/ corresponds to /ʔ/ in UJA. Both of which correspond to the voiceless uvular stop /q/.

between dialect groups like Bedouin and Sedentary but also between the dialects within either of these two major dialects. Palva also touched on the effect of what he referred to as "dialect leveling[5]", referring to the main causes for fading linguistic boundaries such as naturally developing forms, influx of immigrants, and extensive dialect contact.

Based on a larger set of distinctive features (for details, see Palva, 1984, p. 6), Palva thoroughly classified the dialects in Palestine and Transjordan. The researcher argues that there are three main dialects: (1) urban Palestinian dialects, (2) rural dialects, and (3) Bedouin dialects. As for (1), it represents the urban dialect in the Levant, which Palva referred to as the [bɪʔuːl] 'he says' dialect. Rural dialects, on the other hand, refer to a set of dialects such as dialects of Galilee, dialects of central Palestine, dialects of southern Palestine, dialects of northern and central Transjordan, and dialects of southern Transjordan. These varieties were referred to as the [bɪquːl], [bɪkuːl], [bɪguːl]- [diːʧ]/[djuːʧ], [bɪguːl]- [diːʧ]/[djuːk], and [bɪguːl]- [diːk]/[djuːk]- [gahwa] dialects[6], respectively.

Furthermore, Bedouin dialects include a set of dialects that are spoken both by Bedouins in Negev and Arabia Petraea and by Syro-Mesopotamian tribes who rely on sheep raising and breeding and by the tribes of Bani Sakhar, Bani Khaled, and Sirhan in Transjordan. [bɪguːl] 'he says', [diːk]/[djuːk] 'a rooster/roosters', and [gahawah] 'coffee' were used to refer to the first dialect (i.e., Bedouins of the Negev), whereas [jɪguːl] was used to refer to the other three dialects.

In the second part of her lecture, Al-Wer (2015)[7] classified JA as a southern Levantive dialect (Albdairat, 2021), as shown in Figure 1. below.

[5] Palva (1984: 359) utilizes the term to refer to the processes by which marked differences between dialects decrease over a span of time.
[6] [bɪquːl], [bɪkuːl], and [bɪguːl] stand for 'he says'; [diːʧ], [djuːʧ], [djuːk] stand for 'a rooster/roosters'; and [gahwa] stands for 'coffee'.
[7] This classification and Figures 1-3 were based on Al-Wer's (2015) lecture entitled "Jordan Heritage", retrieved from إرث اللهجات: محاضرة الدكتورة إنعام الور الجزء الثاني. Besides, it seems that her classification was more of a political nature than linguistic.

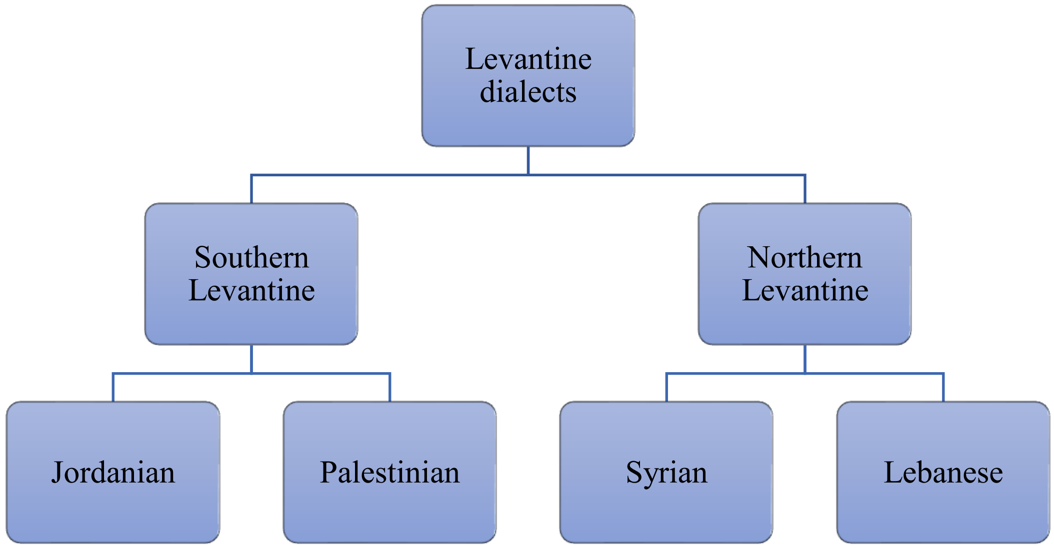

Figure 1. Countries with Levantine Arabic dialects.

Yet, the author believes, as a native speaker of JA, most varieties of Arabic spoken in Jordan belong to the Levantine group, except for Bedouin dialects, which belong to the peninsular dialect group. Levantine Arabic varieties are spoken in the following countries: Jordan, Palestine, Lebanon, and Syria.

Linguistically speaking, Al-Wer (2015) contends that there is no difference between a language and a dialect since both are linguistically constrained, and thus she adds that JA is conventionally divided into three main categories, namely Balqawi[8], Hourani,[9] and Moabi[10], as represented in Figure 2 below.

[8] Balqawi is a dialect chain that includes the dialect of Salt and its surroundings.
[9] Horani is a dialect chain that includes, but not limited to, two sub-variety groups: southern variety that is spoken in Balqa, Salt included, and its neighborhoods, and northern that is spoken in Ramtha, Irbid, and Ajloun.
[10] Moabi is a dialect chain that includes, but not limited to, dialects spoken in Tafila, Karak, and Shoubak.

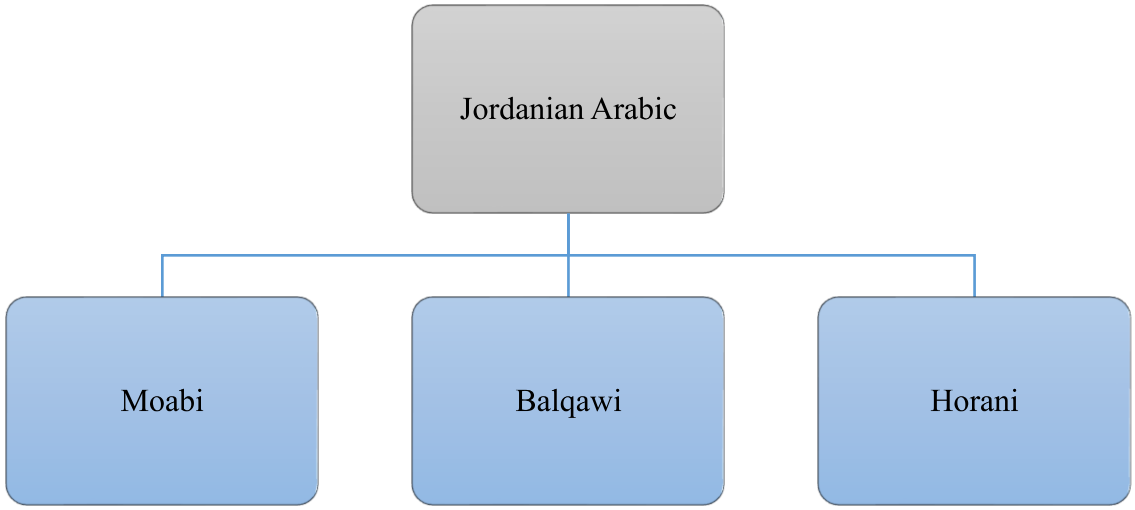

Figure 2. Categorization of JA dialects.

Challenging the conventional belief that Jordanians almost speak the same as Palestinians, Herin (2013) examined the dissimilarities between Salti JA, Hourani, and the dialect of Jalbun, a Palestinian village located in the north of the West Bank. Counting on a set of phonological and morphological features, Herin concluded that Salti JA is better fitted under Horani; thus, verifying the reformed version of the categorization of JA that was proposed by Al-Wer (2015), as shown in Figure 3 below.

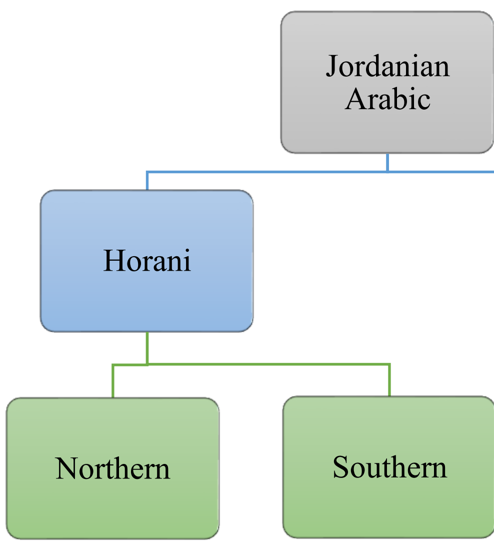

Figure 3. Reformed categorization of JA dialects.

Referring to Herin's (2013) thorough investigation of Salti JA, Al-Wer (2015) verified that Salti JA should not be classified as a sole entity but rather as a variety of Hourani. Al-Wer (2015) continues that Northern Hourani JA dialects are mainly spoken in the north of

Jordan, primarily in Irbid Governorate, Al-Ramtha District is included, Ajloun[11], and their surroundings. Southern Hourani JA, on the other hand, is spoken in central Jordan, mainly in Al-Balqa Governorate, Salt is included, and its surroundings. However, Moabi JA dialects are spoken in the south of Jordan, chiefly in Al-Karak Governorate, Al-Tafila Governorate, Shoubak, and their surroundings.

It becomes now clear that Jordan originally had two dialects, namely RJA[12] and Bedouin Jordanian Arabic (BJA)[13] (Cleveland, 1963; Palva, 1984; Al-Wer, 2007; Herin, 2013; Al-Deaibes, 2016; Alzoubi, 2017).

Tracing it back to its origins, the so-called UJA[14] appeared after the influx of immigrants from neighboring countries like Syria and Palestine due to the political instabilities in these countries (Ibrahim, 1986; Al-Wer, 2007; Herin, 2013; Al-Deaibes, 2016, inter alia). Following this, JA has become a cover term for the three varieties spoken in Jordan, namely RJA, BJA, and UJA (Al-Hawamdeh, 2016; Al-Deaibes, 2016; Albdairat, 2021). Despite the similarities that hold between these three varieties, each variety has its distinct morphological, syntactic, phonological, phonetic, and sociolinguistic features (Abdel-Jawad, 1981; Al-Deaibes, 2016; Al-Hawamdeh, 2016).

1.5.1. RJA

Earlier studies of JA dialects propose that although there are similarities between these dialects, many linguistic contrasts still exist between them (Cleveland, 1963; Palva, 1984; Abdel-Jawad, 1981; Al-Deaibes, 2016; Al-Hawamdeh, 2016).

Varieties of Arabic differ in their phoneme inventories. Al-Deaibes (2016)[15] highlights some phonological and morphological characteristics of RJA. Phonologically speaking, Al-Deaibes (2016) distinguishes eight vowel phonemes, as shown in Table 5 below. The data are presented in broad transcription throughout this proposal except where allophonic variants are explicitly mentioned.

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[11] Al-Wer (2007: 2) argues that Ajlouni JA is a good representative of Horani JA.
[12] Al-Deaibes (2016: 21) contends that RJA is primarily spoken in the villages of Ajloun, Jerash, and Irbid.
[13] Al-Deaibes (2016: 22) argues that BJA is largely spoken in the desert areas of Mafraq, Karak, Tafilah, and Ma'an.
[14] Al-Deaibes (2016: 22) claims that UJA is chiefly spoken in the urban areas of the cities of Amman, Zarqa, and Irbid.
[15] The researcher adopts Al-Deaibes's (2016) categorization of the phonemic inventory of JA dialects because he has, being a native speaker of JA, the intuition that Al-Deaibes's classification best illustrates the phonemic similarities and dissimilarities.

Table 5. *Vowel inventory in RJA*

Long Vowel	Example	Gloss	Short Vowel	Example	Gloss
/i:/	[ti:n]	'figs'	/ɪ/	[sɪn]	'a tooth'
/u:/	[tu:t]	'berries'	/ʊ/	[sˤʊb]	'pour!'
/a:/	[ma:t]	'died'	/æ/	[sˤɑb]	'he poured'
/e:/	[be:ðˤ]	'eggs'			
/o:/	[ħo:l]	'a twelve-month period'			

What is worth noting from Table 2 is that RJA has three vowels that are not shared with MSA. These vowels are, to use Al-Deaibes's (2016) terminology, the mid-front long vowel /e:/, the mid-front short vowel /e/, and the mid-back long vowel /o:/ (p. 29). Al-Deaibes (2016) attributes the emergence of the two new vowels, namely /e:/ and /o:/, in RJA to what he calls "vowel shift", in which these two vowels were diphthongs (i.e., /aj/ and /aw/)[16] over a specific span of time and were then monophthongized to become long vowels instead. The vowel phonemes show allophonic variation in the environment of emphatic vs. plain consonants: emphaticized vowels are retracted and lowered compared to their plain counterparts. For instance, /aː/ is realized as [aː] or [æː] in the environment of plain consonants and [ɑː] in the environment of emphatic consonants (Hetzron, 1998). In addition to the plain/ emphaticized allophones, Al-Deaibes (2016: 32) also mentions a special allophone of /a/ realized as [e], which only appears in a single-vowel morpheme, the word-final feminine marker, as in [xʊbzeh] 'a piece of bread'.

However, it could be argued that if the feminine ending is immediately preceded by an emphatic or guttural sound, as in [bɑtˤtˤɑh] 'a duck' and [mɑtˤbɑʕɑh], it is realized as [ɑh]. Otherwise, it is raised to [eh] as in [mædiːneh]. Table 6 below displays some examples.

[16] Al-Deaibes (2016:41) argues that RJA shares these two diphthongs with MSA in certain contexts, as in comparative adjectives [ajsar] 'simpler', passive voice forms [mawsˤu:l] 'connected', and broken plural forms [ajja:m] 'days'.

Table 6. *Examples of feminine ending realizations in MSA and RJA.*

MSA [ah]	RJA [eh]	RJA [ɑh]	Gloss
[fɑːtˤɪmæh]	[fɑːtˤmeh]		‘proper name’
[tˤɑːwɪlæh]	[tˤɑːwleh]		‘table’
[mædræsæh]	[mɪdræseh]		‘school’
[mɑtˤbɑʕɑh]		[mɪtˤbɑʕɑh]	‘printing press’
[mæzræʕæh]		[mɪzræʕɑh]	‘farm’
[kæbiːræh]	[kæbiːreh]		‘old’
[ʤæmiːlæh]	[ʤæmiːleh]		‘beautiful’
[mædiːnæh]	[mædiːneh]		‘city’

RJA also exhibits, in comparison to MSA, a distinct consonantal inventory in that it has 29 consonants, as shown in Tables 8 and 9 below (Al-Deaibes, 2016). Please note that right-aligned consonants are voiced, whereas left-aligned ones are voiceless.

Table 7. *Consonantal inventory in RJA.*

	Bilabial	Labiodental	Interdental	Alveolar	Post-alveolar	Palatal	Velar	Pharyngeal	Glottal
Plosive	b			t tˤ d			k g		ʔ
Nasal	m			n					
Trill				r					
Fricative		f	θ ð ðˤ	s sˤ z	ʃ		x ɣ	ħ ʕ	h
Affricate					ʧ ʤ				
Lateral				l					
Glide	w					j			

Adapted from Al-Deaibes (2016: 42)

Table 8. *Consonantal inventory in MSA.*

	Bilabial	Labiodental	Interdental	Alveolar	Post-alveolar	Palatal	Velar	Uvular	Pharyngeal	Glottal
Plosive	b			t tˤ d dˤ			k	q		ʔ
Nasal	m			n						
Trill				r						
Fricative		f	θ ð ðˤ	s sˤ z	ʃ		x ɣ		ħ ʕ	h
Affricate					ʤ					
Lateral				l						
Glide	w					j				

Adapted from Al-Deaibes (2016: 42)

By looking at the tables above, it can be deduced that some consonants are not present in MSA, and some others are found in MSA but not in RJA. The former set includes the voiceless post-alveolar affricate /ʧ/ and the voiced velar stop /g/, and the latter one includes the voiced alveolar emphatic stop /dˤ/ and the voiceless uvular stop /q/ (Al-Deaibes, 2016).

Not only does RJA exhibit its characteristic consonantal and vowel inventories, but it also has its characteristic functioning in certain phonological processes such as vowel epenthesis (Al-Deiabes, 2016). Vowel insertion in RJA is exclusive for the two short vowels, namely /ʊ/ and /ɪ/, at the syllable level, where speakers of this dialect do not allow consonant clusters of two or more segments neither at the beginning nor at the end of the syllable (Al-Deaibes, 2016). To illustrate, MSA /mɪlħ/ 'salt' becomes /mɪlɪħ/ in RJA, which entails that RJA speakers split up consonant clusters by inserting /ʊ/ or /ɪ/. In support of this is when RJA speakers borrow English words that end with consonant clusters, as in English /sɪks/ 'six' vs. RJA /sɪkɪs/ (Al-Deaibes, 2016).

1.5.2. BJA

Cleveland (1963) examined the dialects of what is now Jordan[17] based on data collected in the second half of the 1950s. He proposed a four-group classification referring to them as the 'yigu:l', 'bagu:l', 'baku:l', and 'baʔu:l' groups. Cleveland argues that BJA falls within the first group, the 'yigu:l' group, and therefore he contends that this dialect is linguistically more similar to the dialects spoken in central Saudi Arabia, namely Najd, than to Levantine Arabic.

Albdairat (2021) depicts BJA[18] as an umbrella sheltering various dialects that are spoken in different areas in Jordan like those spoken in Al-Mafraq and Al-Karak. However, he argues that BJA is characterized, like RJA, by the frequent use of /ʧ/ and /g/ whereas MSA has /k/ and /q/, respectively. Therefore, BJA dialects can be, following Sakarna (1999, as cited in Albdairat, 2021), classified according to the tribe they are spoken in. Hence, there are a variety of Bedouin JA dialects including Bani Hasan, Al-Huweitat, Bani Sakher, Al-Abbadi, and Al-Ajarmah.

Despite the fact that BJA pertains to JA, it also shows distinctiveness in its linguistic structure. Phonologically speaking, BJA has its distinct consonantal inventory in that, like RJA, it has consonants that are not found in MSA (Cleveland, 1963; Al-Deaibes, 2016). The most distinctive consonants in BJA are: the realization of /q/ as [g], /k/ as [ʧ], and /dˤ/ as [ðˤ], and the occurrence of the voiced alveolar emphatic fricative /zˤ/, as in /jɪgu:l/ 'He says', /ʧalb/ 'dog', and /ðˤɪmi:r/ 'conscience' (Al-Deaibes, 2016). It is worthy of mentioning that vowel epenthesis in BJA behaves differently from that in RJA, as BJA speakers use [a], [ɪ], and [ʊ] when breaking a word-final consonant cluster, as in MSA /baħr/ 'sea' vs. BJA /baħar/ 'sea' (Al-Deaibes, 2016).

1.5.3. UJA

UJA[19] is a relatively new variety that has emerged as a result of language contact between Jordanians, on the one hand, and other immigrants from neighboring countries like Syria and Palestine, on the other hand (Abdel-Jawad, 1981; Al-Deaibes, 2016). While Abdel-Jawad

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[17] Jordan included both the West Bank and the East Bank from 1950-1988.

[18] Al-Deaibes (2016) argues that BJA is spoken in the north, south, and east of Jordan, and thus it would a good example of the different Bedouin dialects spoken in Syria, Iraq, and Saudi Arabia (p. 24).

[19] Abdel-El-Jawad (1987) contends that educated upper (middle) class Palestinians who moved to live in big Jordanian cities like Amman and Irbid primarily speak UJA.

(1981) argues that /ʔ/ is the most distinctive variant in UJA, Al-Deaibes (2016) highlights other distinctive variants, as shown in Table 9 below.

Table 9. *Distinctive variants of UJA.*

MSA	UJA	Gloss
/k/	/k/ [kæf]	'slap'
/q/	/ʔ/ [ʔaːl]	'he said'
/θ/	/t/ [tʊlt]	'one-third'
/dˤ/	/dˤ/ [dˤæw]	'light'
/ð/	/z/ [ɪzæ]	'if'
/ʤ/	/ʒ/ [ʒæw]	'weather'

Slightly adapted from Al-Deaibes (2016)

The table above shows that UJA is less similar to the other two varieties of JA based on its consonantal inventory (Jarbou and Al-Share, 2012, as cited in Al-Deaibes et al., 2021). Despite these apparent differences, UJA shares some degree of similarity with BJA in terms of the phonotactic rules. That is, both BJA and UJA allow consonant clustering at the end of the syllable, as in UJA [tʊlt] and BJA [θɪlθ] vs. RJA [θɪlɪθ] 'one-third'. Therefore, vowel epenthesis shows a different behavior as compared to that in RJA in that BJA speakers utilize the vowels [ɪ], [ʊ], and [a] to split a word-final consonant cluster, as in MSA [baħr] vs. UJA [baħar] (Al-Deaibes, 2016).

Having considered some of the linguistic differences between JA dialect groups, now we move to consider the socio-cultural dimensions of these dialect groups as spoken in the Hashemite Kingdom of Jordan.

1.6. Theoretical Framework

The present study adopts Labov's (1966) theory of Variationist Sociolinguistics. The theory posits that language variation is intrinsic, as it is governed by both linguistic and extralinguistic variables. A good manifestation of this intrinsic variability is, Meyerhoff (2006) reckons, intraspeaker variation[20], where speakers often opt for shifts from spontaneous speech to more careful speech. Holmes (2013: 254) pointed to an excellent example of differentiating between intraspeaker and interspeaker variation. The instance she

[20] Meyerhoff (2006) contends that intraspeaker, often referred to as stylistic variation, refers to variation at the speaker's level.

drew on is based on Trudgill's investigation of the use of vernacular [in] as correlated with different social classes and speech styles. The investigation revealed that, relative to intraspeaker variation, speakers shifted from vernacular [n] to more careful (i.e., formal [iŋ]) as the speech style changed from casual to formal. Holmes (2013) argues that intraspeaker variation mirrors interspeaker variation. To clarify, when speakers from the lower class attend a formal conference, they would shift their speech, adapting that of some other social group (e.g. upper class).

To understand linguistic variation in general and phonological/phonetic variation in specific, it is inevitable to look into the social context in which different forms surface. Labov (2001) formulates the principles of linguistic change. He argues that women all over the world consistently use standard/prestigious forms more than men do, and thus he refers to this as "Principle 2: the linguistics conformity of women"[21] (p. 266). Interacting with social class, gender shows significant correlations in that lower-middle-class women[22] show the greatest tendency to use prestigious forms and to avoid stigmatized forms while those from the lower class and upper-middle class show a lower tendency. Labov (2001) refers to the third principle "In linguistic change from above[23], women adopt prestige forms at a higher rate." to account for this kind of interaction (p. 274). In support of this, Labov (2001) draws on Haeri's (1996) study of palatalization of /t/ and /d/ in Cairo Arabic, where he found that women are the leaders of change. It was therefore evident from this instance, along with other examples (e.g. Vancouver and Toronto), that as age correlated with gender, it was clear that younger speakers, especially women, showed a greater tendency in the direction of change (for details, see Labov, 2001: 281-284).

Since several arguments, including verbal superiority of women and biologically-based explanations, failed to account for the inconsistencies of sound changes, Labov (2001) has suggested accounting for gender differentiation apart from psychological/ phonetic differences in light of an independent principle (i.e. Principle 4)[24]. Moving to the interaction

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[21] Labov (2001: 271) argues that only women who are exposed to sociolinguistic norms will abide by Principle 2.
[22] Labov (2001: 275) contends that the interaction of gender*social class is more characteristic of *changes from above.*
[23] Meyerhoff (2006: 171) uses *change from above* to refer to changes of which speakers are consciously aware, and which may come from higher social groups in a descending manner.
[24] Labov (2001: 292) refers to Principle 4 as "In linguistic change from below, women use higher frequencies of innovative forms than men do." However, he therefore suggested a gender paradox to adjoin principles 2, 3,

between gender and social class, Labov (2001) pinpoints the correlation between social awareness[25] and the interplay of gender and social class. He argues that the more the social awareness of a change in progress is, the stronger and thus clearer the correlation between gender and social class will become.

Hazen (2017) sheds light on sociophonetics, the study of variation in sound patterns. Hazen argues that sociophonetic[26] research seeks quantitative data of a given set of sounds, which get digitized and acoustically examined through measuring vowel formants and other acoustic properties using speech analysis software to later acoustically compare these sounds, linking them to their social context. Hazen continues that the term sociophonetics is relatively recent; however, the utilization of acoustic research in sociolinguistic studies dates back to the 1960s, referring to Labov's (1963) pioneering investigation of the vowels of Martha Vineyard.

1.6.1. Prestige

The notion of prestige vis-à-vis stigma in Sociolinguistics is not recent, for it dates back to the 1960s. Pioneered by Labov (1966), the term prestige refers to two main categories, viz. overt and covert. The former indicates the affinities some linguistic forms enjoy as they echo, for instance, the speaker's educational background, social standing, et cetera. The latter entails, on the other hand, favored language forms that speakers of a given speech community adopt without being aware of. A good example of covert prestige is self-opposition when a speaker is asked about using a certain form and their actual use of another form (Labov, 1966; Trudgill, 1972; Meyerhoff, 2006; Holmes, 2013).

Inspired by Labov's (1966) investigation of gender differences, Trudgill (1972) examined whether women generally use more of the standard/prestigious forms than men do in Britain. Trudgill found that it was true that women use more of the standard forms than men do, referring such phenomenon to two contributing factors. The former posits that women are more aware of status, so they adapt forms that are socially favored more than men (for details, see Trudgill, 1972: 182-183). The latter presupposes that speakers from the

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and 4 in that: "Women conform more closely than men to sociolinguistic norms that are overtly prescribed, but conform less than men when they are not." (p. 293).

[25] Labov (2001) contends that gender and social class each shows independence in terms of their effects where social awareness is minimal.

[26] Hazen (2017: 531) uses the term "sociophonetic approach".

working class are thought to use forms that are judged on a continuum of masculinity as more masculine and which are associated with strength, thus allowing for women to use more refined speech forms that are, on the other hand, associated with femininity.

To account for the different patterns of language variation/change in men's vis-à-vis women's speech, Labov (1990) formulated two principles: (1) "In stable sociolinguistic stratification, men use a higher frequency of nonstandard forms than women." (p. 205); (2) "In the majority of linguistic changes, women use a higher frequency of the incoming forms than men." (p. 206). All that being said, it becomes now clear that women contribute more to the propagation of language change.

Al-Wer and Horesh (2019) argue that sociolinguistic studies on Arabic started in the 1970s, when researchers directed their investigations toward the interrelationship between variation and social factors in Arabic-speaking communities. With social stratification being brought to life, the expansion of such studies on spoken varieties of Arabic was achieved in the 1980s, with the fact that many Arab universities have programs that tackle Sociolinguistics. However, the development of studies on dialectal Arabic remained impeded by the negative attitudes[27] associated with spoken Arabic at that time. More importantly, the rapid advances in technology, namely the sudden exposure to the internet, including social media, in 2000-2020 impeccably contributed to the growth of spoken Arabic varieties or vernacularization, to use Al-Wer and Horesh's (2019) term.

A robust sociolinguistic study on spoken Arabic that has reconstructed the model[28] of analysis adopted in studies on Western speech communities, where standard and prestigious match, is Ibrahim's (1986) article on the failure of such a model to account for varieties in the Arabic context. Ibrahim argues that this methodological failure would be ascribed to two reasons. The first lies in the fact that inquiries in Arabic sociolinguistics were tackled in the same manner as that of other non-diglossic, to use Ibrahim's (1986) term, languages (e.g.

[27] Spoken varieties of Arabic, Al-Wer and Horesh (2019) contend, were, unlike standard Arabic, stigmatized and thus were not viewed as aspects worthy of investigation. The researchers trace this to what they referred to as "reactionary politics and its by-products, namely social fundamentalism and conservatism" (p. 2).
[28] The model that was adopted in researching vernaculars in Western societies views, for instance, standard English as prestigious while simultaneously it views vernaculars as less prestigious/stigmatized deviations from the norm.

English). The second reason rests in Ferguson's (1959) characterizing features of diglossia[29] in which he equates prestige with standard (see Ferguson, 1959: 329-330).

Given the common sociolinguistic phenomenon that women use more socially accepted variants than men, Ibrahim (1986) argues that previous sociolinguistic studies on Arabic came up with one conclusion: women in the Arab world show fewer affinities with standard Arabic than men. Erroneous as it appears, this conclusion was grounded on the invalid belief that standard and prestigious refer to the same variety. Alternatively, Ibrahim (1986) tries to figure out the reasons behind this false interpretation; he pinpoints that since standard Arabic, unlike standard English[30], does not play a role in social stratification, and since it is only acquired through academic education[31], it cannot be interpreted in the same place as standard English. Instead, one should perceive the analogy to be between English, on the one hand, and the Arabic locally prestigious variety, which has stigmatized features corresponding to the same features in the H variety, namely standard Arabic.

Crucial to the understanding of gender differences in Arabic-speaking communities is the consideration of the locally standardized variety[32] (L) as a more socially prestigious variety compared to standard Arabic, the H variety. Having its distinct features, the prestigious L variety par excellence spearheads the H variety in language variation since its social implications (e.g. urban versus Bedouin affinities) are nothing but substantial in shaping the speech community (Ibrahim, 1986).

As far as our study is concerned, some researchers (Abd-El-Jawad, 1987; Al-Deiabes, 2016) argue that UJA is the only nonstandard prestigious variety that people from other social groups[33] converge their speech to as to acquire some social effect (e.g., avoiding stigma). Complex as it looks, the linguistic situation in Jordan can be best viewed if we follow

[29] Originally introduced by Ferguson (1959), the concept of diglossia denotes a sociolinguistic situation in which two varieties of the same language coexist, with one variety (the standard) being evaluated as high (H) and the other (the colloquial) as low (L). Notably, the high variety does not typically function as anyone's native or home language.

[30] Ibrahim (1986) argues that those who did not have the chance to learn the H variety, the only standard/prestigious variety, through formal education will not be accounted for in the social stratification.

[31] Ibrahim (1986) contends that social stratification of those who have never had the chance to learn the only standard/prestigious variety through formal schooling will be left out.

[32] Ibrahim (1986, p. 120) refers to this variety, in analogous terms to super-posed/ supra-dialectal H, as supra-dialectal/ inter-regional standard L.

[33] Abd-El-Jawad (1987) argues that UJA has gained its prestige from the status of the people who are using this dialect.

Ibrahim's (1986) suggestion supplemented by Abd-El-Jawad's (1987) study that there exists, unlike Western societies, more than one prestigious form of language (i.e., UJA), which competes with and outweighs, for instance, MSA in informal contexts in Jordan. In addition, such locally prestigious forms (i.e., UJA) seem to act as locally spoken standards that compete with MSA in the Jordanian context. In simple terms, Jordan exhibits a diglossic[34] situation in which MSA is the official language used in formal domains such as Friday sermons, newspapers, literary works, and radio broadcasts, while the other local varieties, namely RJA, BJA, and UJA, are used in casual daily interactions. Moreover, speakers of JA may alternate between local varieties to accrue overt or covert prestige and/or to mitigate social stigma. For example, a speaker of RJA may switch to UJA in specific interactional settings, such as routine communicative exchanges with UJA speakers, thereby providing empirical evidence of bidialectal competence.

In a nutshell, since extra-linguistic variables such as gender, social class, etc. are integral parts of language variation (Labov, 2001; Al-Wer, 2007), the current study mainly seeks to investigate the possible bearings of such social factors on emphasis production as produced by children and adolescents in an understudied variety of RJA, namely Ajlouni-Jordanian Arabic (henceforth AJA)., a member of the Hourani dialect group.

1.7. Thesis Statement

Given the fact that emphasis is a characterizing feature of almost all Semitic language varieties, including JA, the researcher has found, to the best of his knowledge, that very few studies have accounted for emphasis as produced by children, viz., no study has accounted for the phonetic variation of emphasis production in the speech of children and adolescents. Instead, the majority of studies have been devoted to the phonological and/or phonetic variation in emphasis production as produced by adult speakers (Abd-El-Jawad, 1981; Davis, 1995; Algryani, 2014; Al-Masri, 2009; Abudalbuh, 2010, to mention a few). Hence, the current study is by and large an attempt to unravel the possible effects of some social variables, such as age (children vs. adolescents), gender (male vs. female), and parental education (educated vs. non-educated), on emphasis as produced by native speakers of AJA.

1.8. Questions of the Study

The present study seeks to answer the following research questions:

1. Which of the acoustic cues are reliable in detecting emphasis among children and adolescents in AJA?
2. Does emphasis significantly interact with other linguistic variables?
3. Does age affect emphasis as produced by children and adolescents?
4. Does gender affect emphasis as produced by children and adolescents in AJA?
5. Does parental education affect emphasis as produced by children and adolescents in AJA?
6. Which of the social variables (i.e., age, gender, and parental education) is/are the most powerful in detecting emphasis in AJA?

1.9. Hypotheses

In answer to the research questions, the following hypotheses were formulated for testing:

1. Emphasis is mainly characterized by a shorter VOT, higher F1, lower F2, and higher F3.
2. Emphasis significantly interacts only with the position of the trigger consonant (PTC), vowel quality (VQ), and vowel length (VL).
3. Emphasis is more pronounced in males' speech than in that of females.
4. Emphasis is more evident in adolescents' speech than in children's.
5. Emphasis is more salient in the speech of participants whose parents are less educated.
6. Gender is the strongest controlling variable among the other social variables.

1.10. Motivation for the Study

The trigger of the current study can be summed up in the following points:

(a) Several studies have probed the acoustics of emphasis in Arabic dialects. Yet, there was no conformity in terms of either the findings or the methodology among these studies for several reasons, which are, the researcher contends, methodological. That is, the mass of studies decreased the number of respondents at the expense of the data while others did the reverse, as briefly summarized in Table 10 below.

Table 10. *A brief review of the sample and stimuli size of previous studies on emphasis.*

Study	No. of respondents	No. of data per token	Dialect
Card (1983)	4	82	Palestinian Arabic
Al-Masri & Jongman (2004)	8	30	Northern JA
Abudalbuh (2010)	22	18	JA
Jongman et al. (2011)	12	504	UJA
Omari & Jaber (2019)	40	24	JA

It now becomes clear from the table above that there was no consistency among researchers of emphasis in Arabic in general and in JA in specific in terms of the sample and stimuli size.

(b) The related literature contains several studies that examined emphasis with the least effort in controlling for the social factors. That is, there was no precision in terms of the dialect[35], age, and gender of the speakers whose speech was being investigated. Table 11 below provides a summary.

Table 11. *A brief review of social and demographic factors in previous studies.*

Study	Dialect	Age	Gender
Card (1983)	Palestinian Arabic (2 rural & 2 urban)	n.m.	Males
Al-Masri & Jongman (2004)	Northern JA	n.m.	5 males & 3 females
Abudalbuh (2010)	JA	19-23	12 males & 10 females
Jongman et al. (2011)	Irbidi JA	n.m.	6 males & 6 females
Omari & Jaber (2019)	JA	17-20	20 males & 20 females

Please note that (n.m.) stands for 'not mentioned'.

[35] There was, to the best of my knowledge, only one study (Alzoubi, 2017) that considered controlling for the dialect of the speakers.

By looking at Table 11, it becomes crystal clear that some researchers (e.g. Al-Masri and Jongman, 2004) did not pay much attention to the dialect that was investigated. That is, they did not thoroughly characterize the dialect, be it rural, urban, or Bedouin, since Northern JA shelters a variety of dialects.

(c) Very few studies concentrated on age as a social variable, which was only represented in the speech of adult speakers, leaving out the speech of children and adolescents, as briefly summarized in Table 7 above.

All of the previously mentioned factors, the researcher argues, along with others, significantly contributed to the dissimilarities in terms of the acoustic findings, especially durational ones, on emphasis in general and on the sociophonetics of emphasis in specific that were found in previous research. Table 12 below displays some of these dissimilarities. Please note that the (Ø) symbol denotes an insignificant interaction effect, the shaded area denotes an unmeasured effect, the (↑) symbol indicates increased value, and the (↓) symbol denotes decreased value.

Table 12. *A brief summary of the main effect of emphasis.*

	CD	FD	VOT	VD	F1	F2	F3
Al-Masri & Jongman (2004)	Ø			Ø		↓	
Abudalbuh (2010)	Ø	↓	↓	↑	↑	↓	↑
Jongman et al. (2011)					↑	↓	↑
Omari and Jaber (2019)		Ø	↓	Ø	↑	↓	↑
Almomany (2024)	Ø		↓		↑	↓	↑

Although the dissimilarities between the findings related to the main effect of emphasis in previous studies were confined to durational cues such as CD, FD, and VD, there is still much more dispute over the other cues, be it vocalic or consonantal, when probing the sociophonetics of emphasis (for a review, see Section 2.4.). With all this in mind, the present study probes emphasis utilizing a more solid methodological ground in which the sample and stimuli sizes are quite large and the social variables are deliberately controlled for.

1.11. Significance of the Study

The present study has generally been an investigation into the acoustic correlates of emphasis as produced by children and adolescents, correlated with gender and parental education, in AJA. This would bridge several research gaps. First, there was only one study, namely Mashaqba et al. (2022)[36], on the acoustics of emphasis in children's speech. Second, there was no study on the acoustics of emphasis in adolescents' speech. Third, no study has tackled the overall effects of the interaction between emphasis, age, gender, and parental education on the considered acoustic cues nor has any study examined the potential interaction(s) between these social variables, on the one hand, and linguistic variables apart from emphasis, on the other hand. Fourth, very few studies (e.g. Almomany, 2023a; Almomany, 2023b; Almomany, 2024) have tackled the acoustics of emphasis in AJA.

Moreover, this study would help speech therapists who deal with children suffering from speech disorders. Similarly, this study is hoped-for to help us grasp a better understanding of the acoustic correlates of emphasis not only cross-linguistically, but also among children and adolescent speakers of the same speech community. Needless to say, this study would foster more sustained research on this understudied research scope.

1.12. Outline of the Study

This dissertation is structured as follows: Chapter 2 provides a detailed précis of previous studies on the articulation of emphasis, acoustics of emphasis, perception of emphasis, and sociophonetics of emphasis. Chapter 3 presents a comprehensive account of the different methods and procedures utilized in the implementation of the present study, including the variables of the study, sample of the study, stimulus materials, data collection, segmentation and acoustic measurements, vowel formants normalization, and statistical analysis. Chapter 4 displays the findings of the present study, including both consonantal and vocalic data. Chapter 5 displays the integration of the findings of the present study with those of previous research. Chapter 6, summarizes the conclusions, shortcomings, and pointers for future research.

[36] The focus of this study was on the acquisition of emphasis in Ammani JA rather than the variation in children's production as compared to that of other age groups.

Chapter 2: Literature Review

This chapter provides a detailed review of the previous literature on emphasis production in dialectal Arabic in general and in JA in specific. The chapter follows a neat outline: Section 2.1. reviews studies on the articulation of emphasis; Section 2.2. explores studies on the acoustics of emphasis; Section 2.3. reviews perception studies on emphasis; Section 2.4. sheds light on the sociophonetics of emphasis.

2.1. Articulation of Emphasis

The study of the configuration of emphatic sounds is not recent, for it dates back to the 8th century. In the fourth volume of his book Al-Kitab (the book), the early Arab grammarian Sibawayh (1982, p. 436) described the articulation of emphatic sounds as [mʊtˤbɑqɑh] 'covered', in which the body of the tongue is elevated towards the palate. Sibawayh also stressed that the presence/absence of the [ɪtˤbɑːq] 'covering' gesture is the distinguishing factor between emphatic vis-à-vis plain. Consequently, it seems that later accounts such as Obrecht (1968) adopted Sibawayh's term *velarization* to refer to emphatics. However, several modern studies have accounted for the articulation of emphatic segments in Arabic (Ali and Daniloff, 1972; Ghazeli, 1977; Laufer and Baer, 1988; Zawaydeh, 1999; Hassan and Esling, 2007; Al-Tamimi, Alzoubi, and Tarawnah's, 2009; Israel, Proctor, Goldstein, Iskarous, and Narayanan, 2012; Altairi, Brown, Watson, and Gick, 2016; Al-Solami, 2017; Alfaifi, Cavar, and Lulich, 2021). Yet, these studies did not agree as how to dub the secondary articulation that is inherent in the production of emphatic sounds.

Ali and Daniloff (1972) investigated the articulatory gestures involved in the production of the primary emphatic /tˤ/, /sˤ/, secondary emphatic /bˤ/, and the emphatic allophone of /k/. Using cinefluorographic films, the researchers argued that emphatics are produced by retraction of the tongue dorsum towards the pharynx, causing a constriction in the oropharynx. However, the hyoid bone or any other articulator had no active role in the production of emphatic sounds (Ali and Daniloff, 1972).

Ghazeli (1977) examined the articulatory features of uvular, pharyngeal, and emphatic consonants. Utilizing cinefluorography, Ghazeli meticulously scrutinized the target articulations through 76 single words and two phrases produced by a native speaker of Tunisian Arabic, who is the researcher himself. Relative to emphatics, the researcher concluded that these sounds entail a double articulation, namely anterior and posterior. The former entails an articulation in the dental/alveolar region and the latter, which is generally disputed, involves both the movement of the tongue backward towards the pharyngeal wall while simultaneously retracting the tongue root. This results in the vocal tract with the oral cavity being widened and the pharyngeal cavity being narrowed. Ghazeli (1977) argued that the degree to which the tongue gets retracted is variable and thus dependent on the vowel environment in which the emphatic segment occurs. Therefore, tongue retraction is highest for the voiceless emphatic stop /tˤ/ and lowest for the voiceless emphatic fricative /sˤ/.

In a quest to unravel the conventional idea that emphatics and pharyngeals share a lot in their articulation using a fiberscope, Laufer and Baer (1988) studied tokens of nonsense utterances, words, sentences, and connected speech as produced by nine native speakers[37] of Arabic and Hebrew. Overall, the researchers found that primary emphatics and pharyngeals share a very similar articulation, mainly a narrowing at the pharynx. Laufer and Baer (1988) continue that although both emphatics and pharyngeals are produced with a pharyngeal narrowing, the amount of this narrowing varies greatly from the former set to the latter set. The researchers contend that this variation is because emphatic sounds involve this pharyngeal constriction as a secondary articulation whereas pharyngeals have this constriction as primary articulation. More importantly, Laufer and Baer (1988) argue that the degree of pharyngeal constriction is, though less sharp, more variant among emphatics, and therefore it is reliant on the manner of articulation and vowel environment (i.e. constriction is greater for /tˤ/ than for /sˤ/ and greater in the environment of /a/ than in that of /i/).

Similar to Laufer and Baer (1988), Zawaydeh (1999) used a fiberscope to identify the job of the pharynx in the articulation of gutturals[38]. The endoscopic experiment included only one participant, the author herself, a native speaker of the dialect of Amman. The participant repeated ten nonsense words five times. Statistically analyzing the normalized pharyngeal width values, the researcher concluded that while emphatics, uvulars, and pharyngeals showed constriction in the pharynx, laryngeals did not. This led the researcher to verify this

[37] It is worth mentioning that some of Laufer's and Baer's respondents served as native speakers of both Arabic and Hebrew simultaneously (for details, see Laufer and Baer, 1988, p. 189).

[38] Zawaydeh (1999, p. 23) used the term *gutturals* as a cover term for emphatics, uvulars, pharyngeals, and laryngeals.

finding by conducting an acoustic analysis[39] since laryngeals cannot be sheltered under the term gutturals on an articulatory basis.

Seeking to explore the nature of the dorsal articulation inherent in emphatic sounds, Hassan and Esling (2007) used laryngoscopy. Their data consisted of eight minimal pairs, mainly contrasting in the presence/absence of their emphatic feature, produced by two native speakers of Iraqi Arabic. The researchers found that emphatics are articulated by "aryepiglottic fold constriction, tongue retraction, and larynx raising", which points to pharyngealization (Hassan and Esling, 2007, p. 1756).

A more recent, yet advanced, study of the physiological articulation of emphatic segments in JA is Al-Tamimi et al.'s (2009) study. The researchers recruited 4 participants[40] (2 males and 2 females) to read a list of 48 real words. Utilizing videofluoroscopic images, the researchers could plot whether emphatics are articulated with pharyngealization and the articulatory gestures accompanying the production of emphatics. Al-Tamimi et al. (2009) resolved that emphatics are articulated, unlike pharyngeals, in the upper part of the pharynx (oropharynx) and thus they are realized as pharyngealized consonants in JA in the speech of both males and females[41], with tongue root retraction[42] [TRT], raising of the hyoid, and elevation of the larynx as accompanying gestures. However, the researchers pinpointed that the uvula and the soft palate were passive articulators in producing emphatic segments in JA (Al-Tamimi et al., 2009).

With a more sophisticated technology, Israel et al. (2012) analyzed the articulation of emphatic sounds in Lebanese Arabic. Their data were 26 words containing the emphatic and plain cognates of /tˤ/, /sˤ/, and /d/ produced by a female native speaker of Lebanese Arabic five times. The researcher used real-time Magnetic Resonance Imaging (MRI) to visualize tongue configurations during the production of emphatic segments. The researchers concluded that emphatics are produced with the retraction of the tongue body causing a narrowing in the upper pharynx.

[39] The acoustic experiment will be presented in the following section devoted to acoustic studies on emphasis for the sake of consistency.
[40] It becomes apparent that the researchers did not control for what Alzoubi (2017) referred to as the speaker's original regional dialect (ORD) (for details, see Al-Tamimi et al., 2009, p. 248).
[41] Male/female differences will be tackled later for the sake of clarity and consistency.
[42] The researchers contend that the raising of the larynx, which is the result of the elevation of the hyoid bone is nothing but the product of tongue root retraction.

Through ultrasound recordings, Altairi, Brown, Watson, and Gick (2016) probed the articulation of both emphatics and pharyngeals. Their data consisted of 24 words uttered by a total of 8 native speakers of different Arabic dialects[43]. The researchers concluded that emphatics are uvularized and thus they are articulatorily different from pharyngeals since the former is articulated in the upper vocal tract (i.e. oral cavity) and the latter group is articulated in the lower vocal tract.

Contrary to Altairi et al. (2016), Al-Solami (2017) investigated the articulatory configuration of uvulars, pharyngeals, laryngeals, and emphatics. His stimuli production consisted of 15 nonwords mouthed by three native speakers of Saudi Arabic, Egyptian Arabic, and Palestinian Arabic. Al-Solami pinpointed that emphatics, in contrast to their plain equals, are produced with more elevation and retraction of the body of the tongue as well as more retraction of the tongue blade in the coronal constriction. As for the comparison between gutturals, mainly uvulars, and emphatics, the researcher argued that while the body of the tongue moves upright to the uvula in the production of uvulars, it moves horizontally in the direction of the upper pharynx in the production of emphatics. In addition, emphatic production entails, unlike uvular production, retraction of the tongue blade in the primary stricture.

Alfaifi et al. (2021) examined the different tongue configurations involved in the production of the two primary emphatics, namely /tˁ/ and /sˁ/, in relation to their plain counterparts and to the voiceless uvular stop /q/. Their production stimuli consisted of 32 nonsense words produced by 2 male native speakers of Hijazi Arabic. Utilizing 3D ultrasound images, the researchers found that the voiceless emphatic sounds are articulated by raising the tongue root and depressing the body of the tongue, which is a result of the primary stricture. Therefore, there was no difference between emphatic and plain emphatics in terms of their primary constriction. More importantly, it was found that the voiceless emphatic stop /tˁ/ and the voiceless uvular stop /q/ share a great deal of similarity in that both of them are articulated at the uvula, needless to say, the former entails a secondary constriction and the latter a primary one (Alfaifi et al., 2021).

[43] Altairi et al.'s sample consisted of 1 Palestinian, 3 Yemenis, 2 Egyptians, and 2 Saudis.

2.1.1. Summary

The bulk of previous research on the articulation of emphatic sounds concurs that emphatic sounds include a double articulation, viz., coronal and dorsal. Notwithstanding this accord, there exists a great deal of debate not only over the nature of the dorsal stricture but also over the coronal one. Table 13 below summarizes the major findings of the previous studies.

Table 13. *Summary of the major findings of articulatory studies on emphasis.*

Study	Secondary Articulation	Dialect(s)
Ali and Daniloff (1972)	Pharyngealization	nm.
Sibawayh (1982)	Velarization	Classical Arabic
Ghazeli (1977)	Pharyngealization	Tunisian Arabic
Laufer and Baer (1988)	Pharyngealization	Hebrew & Arabic[44]
Zawaydeh (1999)	Pharyngealization	Ammani JA
Hassan and Esling (2007)	Pharyngealization	Iraqi Arabic
Al-Tamimi et al. (2009)	Pharyngealization	JA
Israel et al. (2012)	Pharyngealization	Lebanese Arabic
Altairi et al. (2016)	Uvularization	Palestinian, Yemeni, Egyptian, and Saudi Arabic
Al-Solami (2017)	Pharyngealization	Saudi, Egyptian, and Palestinian Arabic
Alfaifi et al. (2021)	Uvularization	Hijazi Arabic

It now becomes apparent that the vast majority of these studies consider the secondary articulation inherent in emphatic segments as pharyngealization. Yet, there is a great deal of disagreement among some of these studies. To clarify, Ali and Daniloff (1972) argued that neither the hyoid bone nor any other articulator, excluding the tongue dorsum, had any active role in the production of emphatics in Arabic. Contrary to this are Hassan and Esling (2007) and Al-Tamimi et al. (2009), who found that other articulators such as the larynx (i.e. being raised) participate in the production of emphatics. As for the coronal constriction, Al-Solami (2017) claimed that emphatics exhibit depression of the tongue blade, which goes against

[44] Laufer and Baer (1988, p. 189) provide information about their sample. Hebrew speakers spoke the dialects of Yemen, Nablus, Beer Zeit, Iraq, and general Hebrew. Arabic speakers, on the other hand, spoke the dialects of Nablus, Iraq, Beirut, Beer Zeit, Baghdad, and general Arabic.

Alfaifi et al. (2021), who argued that there is no difference in terms of the tongue shape in the primary articulation.

2.2. Acoustics of Emphasis

This section offers a comprehensive review of acoustic research concerning Modern Standard Arabic (MSA), dialectal Arabic, and a primary focus on JA.

2.2.1. Acoustics of Emphasis in Varieties of Arabic

The investigation into the acoustics of emphatic sounds in Arabic has recently garnered significant scholarly interest. Previously, the predominant focus of existing research was on the articulatory and phonological aspects of emphasis (Abudalbuh, 2010). Several acoustic studies were conducted on a wide variety of Arabic dialects (Card, 1983; Embarki, Yeou, Guilleminot, and Al Maqtari, 2007; Alarifi, 2010; Kalaldeh and Al-Shdaifat, 2019; Alahmari, 2020; Kulikov et al., 2020; Alsuhaibani, 2022; Al-Ansari and Kulikov, 2022-2023; Al Omary, 2024, to mention a few).

Card (1983) explored the acoustic indicators of emphasis in Palestinian Arabic. Her research was based on 41 minimal pairs, which included nonwords, articulated by four native Palestinian Arabic speakers from two different dialectal backgrounds: rural Palestinian Arabic and urban Palestinian Arabic. Card (1983) analyzed the first three formant frequencies (F1-F3) of vowels preceding and following the emphatic consonants and found that emphaticized vowels consistently exhibited lower second formant (F2) frequencies than plain vowels. Additionally, she argued that emphasis was more acoustically apparent in the context of low and back vowels. Moreover, Card (1983) proposed that the word is the domain where emphasis takes place, spreading in both directions—rightward and leftward—unless blocked by an opaque segment.

In their 2007 study, Embarki et al. analyzed the acoustic features associated with four primary pairs of emphatic and plain consonantal contrasts, specifically /$t^ʕ$/-/t/, /$d^ʕ$/-/d/, /$s^ʕ$/-/s/, and /$ð^ʕ$/-/ð/, in three vowel environments (i.e., /i/, /a/, and /u/). The study's stimuli comprised 48 $C^ʕ$VC and CV$C^ʕ$ real words, evenly sourced from Modern Standard Arabic (MSA) and various dialectal forms, each deployed within a carrier sentence. The participant group included 16 native speakers, with a balanced representation across four Arabic dialects—Yemeni, Kuwaiti, Jordanian, and Moroccan—all of whom also demonstrated proficiency in MSA. The participants' ages ranged from 20 to 40 years. Each of the participants produced each of the target words three times, yielding a total of 1152 tokens for acoustic analysis, which included the second formant frequency (F2) at the onset and midpoint of the vowel (i.e., locus equations). On the whole, the researchers found that all the emphatic sounds in MSA, except for /sˤ/, have lower slope values as compared to their plain peers.

In summary, the investigation revealed that: (i) the slope values of identical consonants are significantly associated with the respective language variety in which they manifest, (ii) the directional impact on emphatic and plain consonants differs according to the language variety, and (iii) the variations in locus equations are more pronounced in MSA compared to other dialects. Subsequent to these findings, the researchers posited that speakers of different language varieties exhibit distinct articulations of emphatic and plain consonants. Moreover, individuals speaking dialectal Arabic demonstrated reduced coarticulatory effects across all consonants, with the exception of /tˤ/. This pattern is encapsulated in the following formula: Cˤ (Dialectal Arabic) < Cˤ (MSA) < C (Dialectal Arabic) < C (MSA).

Based on regional distinctions, Embarki et al. (2007) asserted that in their Modern Standard Arabic (MSA) and colloquial pronunciations, speakers from the Eastern region, comprising Yemen, Kuwait, and Jordan, exhibited a pattern distinct from that of speakers from the Western region, specifically Morocco. In particular, the locus slopes for emphatic consonants demonstrated a flatter profile for speakers from the Eastern region, with the exception of /sˤ/ in their MSA pronunciations, in contrast to the steeper slopes observed among speakers from the Western region. This, they claim, highlights the efficacy of locus equations in identifying emphatic consonants from plain consonants, identifying two language varieties, viz. MSA and dialectal Arabic, and categorizing Arabic varieties on regional grounds.

In his twofold investigation of Urban Najdi Arabic, Alarifi (2010) studied the acoustic correlates of the emphatic-plain contrasts: /tˤ/-/t/, /sˤ/-/s/, and /ðˤ/-/ð/, as well as the domain and directionality of emphasis spread. For his first experiment, the stimuli production consisted of a list of 20 CˤVC minimal pairs, which inevitably included some nonwords. The target consonants were investigated word-initially in the environments of /aː, uː, iː, oː, eː, æ, ə/, as produced by three male native speakers of Urban Najdi Arabic aged between 19 and 27. The researcher used several acoustic cues, including VOT of voiceless stops, friction duration, and the vowel's first three formant frequencies (F1-F3) at the onset, midpoint, and offset of the vowel.

Relative to the temporal cues, He found that emphatic VOTs were significantly shorter than their plain counterparts. However, emphasis did not have any salient effects on friction duration. As for the temporal cues, the researcher found that F1 was significantly higher in an emphatic environment as compared to that in a plain environment throughout the vowel. F2 was also significantly lowered in an emphatic environment as compared to that in a plain environment throughout the vowel. Furthermore, F3 was significantly higher in an emphatic environment as compared to that in a plain environment only at the onset and midpoint of the vowel.

Alarifi (2010) contended that when VQ is taken into consideration, new patterns of change emerge. For F1, the high and mid vowels, viz. /iː/, /uː/, /eː/, and /oː/ showed higher F1 values at the onset than at the midpoint and offset positions. Similarly, the low vowels /æ/ and /aː/ exhibited the same pattern of change, with the former showing significance throughout the vowel and the latter showing significance only at the onset and offset positions. Centralized /ə/, on the other hand, showed a distinct pattern, where F1 was significantly higher only at the midpoint and offset positions. Besides, F2 was found to be insignificantly different at the vowel offset for the front vowels /iː/ and /eː/, whereas it was significantly lowered for the central vowels /æ, aː, ə/ throughout the vowel (Alarifi, 2010, p. 35). However, for back vowels (i.e., /uː/ and /oː/), F2 was significantly lowered only at the onset and midpoint. In addition, F3 was insignificantly different for the non-back long vowels /iː/, /eː/, and /aː/. Conversely, F3 of emphaticized centralized /ə/ was significantly higher throughout the vowel while that of /æ/ was significantly higher only at the midpoint and offset positions. For back vowels, /uː/ was significantly higher at the onset and midpoint positions, and /oː/ was significantly higher only at the onset position. Alarifi (2010) further probed locus equations, where he found that, similar to Embarki et al. (2007), emphatic consonants had lower slope values, suggesting that they are more repellent to the coarticulatory effects of the following vowels than their plain cognates, with /sˤ/ having the lowest slope value, followed by /ðˤ/ and /tˤ/, respectively.

Moving to his second experiment, Alarifi (2010) explored different aspects of emphasis spread in Urban Najdi Arabic. His data consisted of two lists: one including the CVCVC structure, where the C slot was occupied by an emphatic consonant (i.e., word-initially, word-medially, and word-finally), the V slot occupied by a low vowel (i.e., /æ, aː/), and the other C slots were occupied by other plain consonants other than the so-called opaque segments. The other list included CVC constructions, where emphatic /t/ occurred at both edges of the word: tˤVC and CVtˤ, the V slot being filled with any of the seven vowels, and the C slot being filled with any of the three plain consonants /t, s, ð/. It is noteworthy that the former list was devised to identify the degree and directionality of emphasis spread in Urban Najdi Arabic, and the latter one was devised to find out whether plain consonants following/preceding emphatic consonants become emphaticized. The participants of this experiment were the same as those in his first experiment, each yielding a total of 156 tokens.

Relative to the CVCVC investigation, the researcher analyzed only F2 at the onset, midpoint, and offset of the vowel. He found that emphasis spread is gradient and thus bi-directional. Testing the potential of /iː, uː/ in blocking rightward emphasis spread in /tæfðˤiːlaːt/ and /tˤuːlæk/, as evinced on F2 of the low vowels in the right-adjacent syllable, Alarifi (2010) found that the high segments did not completely block emphasis spread but rather they minimized its effects. As for the tˤVC and CVtˤ constructions, F2 was only measured at the onset and offset of the vowel. The researcher found that leftward, but not rightward, emphasis spread showed significant effects only on the sibilant fricative /s/, where F2 mean value was significantly lowered at the onset of the vowel.

Kalaldeh and Al-Shdaifat (2019) analyzed the effects of the voiced emphatic stop /dˤ/, along with its plain counterpart, on adjacent vowels[45] in MSA. Their data consisted of a list of 24 real words, in which both /dˤ/ and /d/ were investigated before and after /ɐ, ʊ, ɪ, aː, uː, iː/. The stimulus materials were embedded in a carrier sentence and were thus randomized for the participants to read twice. The participants were ten male university students from Madaba, whose average age was 23. The acoustic cues that were examined included the vowel's F1 and F2 only at the midpoint of the vowel. Overall, Kalaldeh and Al-Shdaifat (2019) found that VQ significantly correlated with emphasis. That is, emphasis was more acoustically pronounced for /ɐ, a:/, which showed a slight raising of F1 and a striking lowering of F2, than /ɪ, i:/ and /ʊ, u:/, of which the latter showed only F2 lowering when

[45] The researchers investigated the potential effects of /dˤ/ and /d/ concerning three factors: VQ, VL, and directionality of emphasis.

followed by emphatic /dˤ/. Similarly, VL was found to significantly correlate with emphasis. To clarify, emphaticized short vowels generally showed a higher proportion of F2 lowering as compared to that of their plain counterparts, except for /ʊ/ and /u:/. At a greater level of detail, /ɪ/ and /i:/ showed the greatest amount of F2 difference as compared to that of /ɐ/ and /a:/.

As for the potential effects of PTC on the degree of emphasis spread, Kalaldeh and Al-Shdaifat (2019) revealed that both rightward and leftward emphasis spread had almost identical effects of lowering the second formant frequency (F2) of /ɐ, aː, ɪ, iː/, except for the high front vowel /iː/, which showed a higher degree of F2 lowering in the vicinity of a preceding /dˤ/ than in that of a following /dˤ/ (for details, see Kalaldeh and Al-Shdaifat, p. 56). Yet, the high and mid-high back vowels /ʊ, uː/ showed a different tendency, where the amount of F2 lowering was significantly higher in the vicinity of a following /dˤ/ than in that of a preceding /dˤ/. This was attributed to the closer proximity of the articulation space of /dˤ/, being velarized, to a back vowel than to a front vowel, thus resulting in their more back realization.

Alahmari (2020) tackled the effects of the voiced emphatic stop /dˤ/ on the adjacent vowels in two varieties of Arabic, namely Palestinian Arabic and Saudi Arabic. Their stimulus materials were comprised of six words, with the target vowel /æ/ occurring word-initially, word-medially, and word-finally (i.e., following the target consonants). The participants were four native speakers of Arabic (two Palestinians and two Saudis), who produced the target words in isolation three times. Several acoustic measurements were executed by the researcher, such as the vowel's F1 and F2 at two temporal points: the first and second thirds of the vowel, and VL. To summarize, he found that emphaticized vowels in Saudi Arabic showed a higher degree of F1 raising as compared to those in Palestinian Arabic, not to mention that the latter exerted its utmost effect in the second third of the vowel as opposed to the former, which showed consistency in terms of its effect in the first and second thirds of the vowel. Additionally, he found that while emphaticized vowels in both dialects showed the greatest amount of F2 lowering in the first third of the vowel, emphaticized vowels in Palestinian Arabic showed a higher degree of F2 lowering as compared to those in Saudi Arabic. Moreover, he found that emphaticized vowels in

Palestinian Arabic were longer in duration than those in Saudi Arabic, irrespective of their position in the word.

Kulikov et al. (2020) studied the effects of emphasis spread on the VOT of coronal stops in Qatari Arabic. Their data consisted of monosyllabic nonwords contrasting in the presence/absence of the emphatic feature in the environment of the low vowels /æ/ and /aː/. These nonwords were formulated in four syllable frames: (i) /taC/, where C represents /t/, /s/, or /ð/; (ii) /ta**C**/, where bolded C represents the emphatic cognate of /t/, /s/, or /ð/; (iii) /tˤaC/, where C represent /t/, /s/, or /ð/; (iiii) /tˤa**C**/, where bolded C represents the emphatic cognate of /t/, /s/, or /ð/. The participants were 16 female native speakers of Qatari Arabic aged between 20 and 25. Several acoustic parameters were utilized, including VOT, spectral center of gravity (SCG) of stop burst, the vowel's first three formant frequencies (F1-F3) at the beginning, middle, and end of the vowel, and the F1-F2 difference.

The researchers found that emphasis spreads in both directions: rightward and leftward in Qatari Arabic, as indicated by the raised values of F1 and F3 and the lowered value of F2 for emphaticized vowels. Besides, they argued that emphasis is more acoustically pronounced on /æ/ than on /aː/, suggesting that this is a direct result of the more back articulation of /aː/ as compared to that of /æ/, which would result in a lesser degree of tongue retraction. Kulikov et al. (2020) found that SCG of plain /t/ was significantly lowered in an emphatic environment, arguing for a more robust propagation of leftward emphasis spread. In addition, they found that the VOT of plain /t/ in emphatic environments did not show any significant differences, pointing out that there is no relationship between the magnitude of emphaticness and VOT as far as emphasis spreads from an underlying emphatic consonant in the same environment. Rather, the researchers pinpointed that emphatic and plain /t/ pertain to two different categories, namely short-lag and long-lag, as attested in emphatic and plain environments. Kulikov et al. (2020) concluded that emphasis is rather phonetic in Qatari Arabic, provided that it does not entail "complete transformation of the stop category" (p. 27). That is, the difference between an underlyingly emphatic consonant and an underlyingly plain consonant that receives emphasis via emphasis spread is not completely lost because the underlyingly plain consonant still preserves its longer VOT which keeps it distinct from an underlyingly emphatic consonant.

Alsuhaibani (2022) investigated the domain and directionality of emphasis spread in Najdi Arabic, a variety of Arabic spoken in central Saudi Arabia. His data consisted of lists of monosyllabic monomorphemic (CVC), bi-syllabic monomorphemic (CV.CVC), trisyllabic monomorphemic (CV.CV.CV; CV.CV.CVC), and polymorphemic minimal, near-minimal, and non-words, with the three primary emphatics /tˤ/, /sˤ/, and /ðˤ/, along with their plain counterparts /t/, /s/, and /ð/, falling at both edges of the words (for details, see Alsuhaibani, 2022: 69-71). He also devised a list to assess the potentially opaque segments, namely /j/, /ʃ/, and /ʤ/, in blocking emphasis spread. The experimental stimuli were articulated by a single native speaker of Najdi Arabic within a carrier sentence framework, three times[46]. The sole acoustic parameter employed by the researcher was the second formant[47] (F2) of the vowel, which was systematically measured for every vowel present in each syllable.

Within monosyllabic monomorphemic words, the researcher's investigation revealed that the emphasis extends consistently in both directions, regardless of the emphatic consonant's position. In contrast, within disyllabic monomorphemic words, the emphasis was observed to propagate bi-directionally, whereby a proximal relationship between the vowel and the emphatic consonant correlates with a reduction in the vowel's F2 value, thereby indicating its gradient nature. Similar findings were obtained for trisyllabic monomorphemic words, where emphasis was found to spread in both directions, with the fact that F2 lowering was highest for vowels in the target syllable (i.e., the syllable containing the emphatic consonant), followed by vowels in the second and third adjacent syllables, thus showing that it is the phonological word that holds as the domain of emphasis in Najdi Arabic.

On the other hand, polymorphemic words[48] showed that emphasis spreads in both directions: rightward and leftward, with prefixes and suffixes being transparent to emphasis spread. Yet, the degree of this spread was observed in a gradient manner, where the proximity of the vowel to the emphatic consonant inversely correlated with F2 value. As for the potentially opaque segments, the researcher found that while leftward emphasis freely propagates into the word, rightward emphasis is blocked in the vicinity of an opaque

[46] The mean values were then averaged across all the repetitions for comparison.
[47] The measurement point of F2 was not mentioned by the researcher (Alsuhaibani, 2022, p. 71).
[48] These words were mainly comprised of the stem and other inflectional and derivational affixes.

segment. Therefore, the researcher stressed the fact that emphasis in Najdi Arabic did not spread beyond the word boundary, be it rightward or leftward (Alsuhaibani, 2022).

Al-Ansari and Kulikov[49] (2022-2023) investigated the acoustic cues of the three uvulars /χ, ʁ, q/ and the four primary emphatics /tˤ, sˤ, dˤ, ðˤ/, along with plain cognates in Qatari Arabic. These obstuents were each tackled before the long low /aː/. The stimulus materials included 72 real words (i.e., 24 uvulars, 24 emphatics, and 24 plain), articulated in a carrier sentence by ten native speakers of Qatari Arabic (five males and five females) twice. Several acoustic parameters were used by the researchers, such as VOT of stops, spectral mean of stops and fricatives, friction duration of fricatives, vowel's spectral slope, and vowel's F1, F2, and F3. The consonantal cues revealed many similarities between emphatics and uvulars. First, both emphatic and uvular stops showed the same VOT category (i.e., short-lag) whereas plain stops pertained to the long-lag category. Second, both emphatics and uvulars showed lower spectral means in relation to plain consonants, with the fact that stops, along with voiced fricatives, carried the highest degree of lowering. However, voiceless emphatic /sˤ/ showed the least amount of lowering.

In addition, the spectral slope was found to form a similar pattern for emphatics and uvulars only at the onset of the vowel, where the voice quality was tenser for emphatics and uvulars than for plain stops. Al-Ansari and Kulikov (2022-2023) ascribed this tendency to the fact that gutturals have a narrower range and a minimized impact on voice quality. More importantly, robust resemblance was found between emphatics and uvulars in terms of their effects on the vowel's F1, F2, and F3. F1 showed almost equal raising at the beginning of the vowel, with a fading effect from plain consonants at the middle of the vowel. F2 only at the onset and midpoint of the vowel showed significantly lowered values in the environments of both emphatics and uvulars, pointing to the involvement of the tongue retraction gesture. Yet, emphatics showed a wider range than uvulars did. F3 was raised throughout the vowel in the vicinity of both emphatics and uvulars, with a higher degree of raising for emphatics than for uvulars only at the beginning and middle of the vowel. Overall, the researchers proposed that emphatics would be erroneously termed as pharyngealized in Qatari Arabic since they both share striking similarities (Al-Ansari and Kulikov, 2022-2023).

[49] Al-Ansari and Kulikov (2022-2023, p. 44) contended that speakers of Qatari Arabic pronounce /q/ as [g] and /dˤ/ as [ðˤ].

Al Omary (2024) sought to unravel the similarities and differences in the production and perception of emphasis between "Arabic heritage speakers[50]," to use Al Omary's (2024, p. 22) terminology, and American English-speaking learners of Arabic. Her data[51] consisted of 24 CVC minimal pairs, contrasting in the presence/absence of the emphatic feature in the /tˤ/-/t/, /sˤ/-/s/, /dˤ/-/d/, and /ðˤ/-/ð/ contrasts. The target consonants were investigated word-initially and word-finally preceding and following /æ/, /ʊ/, and /ɪ/. The participants, equally distributed in terms of gender, comprised 18 heritage speakers (including 10 Palestinians, 5 Jordanians, and 3 Syrians) along with 18 American English speakers studying Arabic as a second language, all of whom were undergraduate students of MSA. As for the former experiment, several acoustic cues were deployed, including the vowel's first two formant frequencies (F1 & F2), VOT of stops, and spectral center of gravity (COG) of fricatives.

As for the production experiment, the researcher found that while F1 did not show any significant differences in emphatic vs. plain environments, F2 proved to be a reliable acoustic cue of emphasis for both Arabic heritage speakers and learners of Arabic as a second language, with the greatest amount of F2 lowering for /æ/ than for either /ɪ/ or /ʊ/. The emphasis by VQ interaction revealed that the emphatic-plain contrast was significant both between /ɪ/ and /æ/ and between /ʊ/ and /æ/. Although both groups showed lower F2 in the emphatic vis-à-vis plain environment, Arabic heritage speakers showed a greater amount of F2 lowering as compared to that of their L2 peers. However, neither VOT nor COG was found to be a reliable cue of emphasis for both groups.

2.2.2. Acoustics of Emphasis in JA

Several studies analyzed the acoustic properties of segmental emphasis in JA (Zawaydeh, 1998; Al-Masri and Jongman, 2004; Khattab, Al-Tamimi, and Heselwood, 2006; Jongman et al., 2007; Al-Masri, 2009; Abudalbuh, 2011; Jongman et al., 2011; Jaber, Omari, and Al-Jarrah, 2019; Saed, Jaradat, Yassin, and Al-Smadi, 2022, inter alia).

Zawaydeh (1998) assessed the degree and directionality of emphasis or 'uvularization' spread, to use her terminology, from /tˤ, dˤ, sˤ, zˤ/ vis-à-vis /q/ in the urban dialect of JA

[50] The researcher used this term to refer to speakers who acquired both Arabic and English, with Arabic being the heritage vernacular variety and English the majority language of society (for details, see Al Omary, pp. 21-25).

[51] In the perception experiment, the researcher utilized the 24 filler minimal pair words that were used to distract the participants' attention from the purpose of the study, thus yielding a total of 96 words.

spoken in Amman, the largest metropolitan city in Jordan. Therefore, she analyzed uvularization spread from /χ, ʁ/ vis-à-vis /q/. Her analysis of the former set of emphatics was based on 80 words, of which only 50 contained emphatic consonants, framed in four controlling environments: CVBV, CVBV, CVC, and CVCV, where C represents a plain consonant, C represents an emphatic consonant, V represents a vowel, and B represents an opaque segment (i.e. [i, u, ʃ, ʒ, w, j]). All of the tokens were produced by the researcher herself, a native speaker of UJA. To do so, the researcher utilized Soundscope to elicit spectrograms for the digitized tokens and then resorted to both Soundscope's built-in analyzer and direct visual examination of the spectrograms to obtain F1 and F2 readings. Zawaydeh (1998) found that emphasis spread is not blocked by any of the opaque segments, as demonstrated by a higher F1 and a lower F2 of the low vowel /æ/ in an emphatic environment as compared to those in a plain environment. Moreover, she contended that the articulation of the low vowel /æ/ in an emphatic environment results in its quality being more back [ɑ], given that the spreading of emphasis into neighboring suffixes,[52] such as the feminine singular suffix and the second-person singular masculine suffix, was not possible.

In her analysis of /χ/ and /ʁ/, she examined the vowels' F1 and F2 in five repetitions of the words /χaːlɪ/ 'my maternal uncle' and /ʁaːlɪ/ 'expensive', using the same procedure and assets she utilized in her previous experiment of /tˤ, dˤ, sˤ, zˤ/. In relation to F2 mean values of the low vowel in /qælæb/ 'turned upside down', Zawaydeh (1998) found that F2 of vowels in the vicinity of either /χ/ or /ʁ/ was around 250 Hz higher than that of vowels in the vicinity of /q/, thus claiming that /χ/ and /ʁ/ are velar rather than uvular. In addition, she investigated whether uvularization spread from /q/ is blocked by any of the opaque segments, viz. [ɪ, uː, ʃ, w, j]. Her investigation was based on seven words[53] framed in three conditioning environments[54], namely qVBV, qVq, and qVCV, where q refers to the voiceless uvular stop, V to the short/long low vowel /æ, aː/, B to an opaque segment, and C to the plain lateral /l/. Following the same procedures and assets in her first experiment, Zawaydeh (1998) found that uvularization spread from the uvular /q/ was not as robust as it was from primary

[52] Zawaydeh (1998) argued that emphasis spread into the plural suffix is perhaps optional.
[53] These words were repeated five times, yielding a total of 35 repetitions for analysis.
[54] The first conditioning environment was designed to validate whether the vowel in the adjacent syllable, which is preceded by an opaque segment, shows front/back quality. The second conditioning environment was formulated to assess the vowel falling between the two uvulars, whereas the third conditioning environment was designed to measure vowels in both syllables.

emphatic sounds. Therefore, she argued that uvularization spread is by no means categorical but rather gradient, and thus it is less strong from the uvular /q/ as compared to that from emphatic sounds. As for potentially blocking segments, it was found that only /ɪ/, /j/, and /uː/ block uvularization spread from the uvular /q/.

Al-Masri and Jongman (2004) studied the acoustic cues of emphasis in the dialect spoken in the north of Jordan. Their investigation was based on reading lists, which included 15 minimal pairs, mainly contrasting the presence/absence of the emphatic feature in the /tˤ/-/t/, /dˤ/-/d/, /sˤ/-/s/, and /ðˤ/-/ð/ contrasts[55]. To this end, eight native speakers of northern JA (5 males and 3 females) were recruited to read the stimulus materials, with each token embedded in a carrier sentence, five times. Averaged across the five repetitions, the researchers measured CD, VD, and the vowel's F2 in emphatic and plain environments. The researchers found that while CD and VD were not reliable exponents of emphasis, F2 turned out to be a reliable exponent of emphasis, where F2 showed a significantly higher degree of F2 lowering in an emphatic environment as compared to that in a plain environment within the target syllable, with weaker effects on syllable falling to the right and left of the target syllable (i.e. the syllable including the emphatic consonant).

Furthermore, the researchers probed the capability of the so-called opaque segments, namely /i/ and /u/, in blocking emphasis spread. They found that opaque segments falling within the target syllable showed similar degrees of F2 lowering to non-opaque segments. Yet, vowels falling to the right of the target syllable containing an opaque segment did not show any significant lowering of F2 but rather comparable means in emphatic and plain environments.

Seeking to explore the emphatic-plain contrast between /tˤ/ and /t/ in prevocalic position, Khattab et al. (2006) conducted two experiments: acoustic and auditory[56]. Their data consisted of four minimal pairs, produced by 10 native speakers of JA (5 males and 5 females), whose origins and socioeconomic backgrounds were different. That is, all of the male participants and two of the female participants were from Irbid whereas the other three female participants were from Amman. Acoustically, the researchers utilized VOT and the

[55] Unlike Zawaydeh (1998), Al-Masri & Jongman (2004: 100) did not have clear-cut conditioning environments.

[56] Auditory investigations are displayed in Section 2.4.

vowel's F1 and F2 only at the onset position as acoustic means; therefore, they plotted F1 against F2 to pinpoint the relative approximation between the two formants in different environments, viz. emphatic vs. plain; open vowel vs. close vowel. Relative to VOT, the researchers found that emphatic VOTs were significantly shorter than their plain counterparts.

As for F1 and F2, Khattab et al. (2006) found that F1 was, on the one hand, significantly raised in an emphatic environment as compared to that in a plain environment, and F2 was, on the other hand, lowered in an emphatic environment as compared to that in a plain environment. At a greater level of detail, they found that while F2 value was consistently lowered for both /iː/ and /æ/, the magnitude of change was greater in the vicinity of the latter than in that of the former. In addition, the approximation between F1 and F2 was greater for emphaticized vowels than for plain vowels.

Jongman et al. (2007) studied the acoustic indicators of the /tˤ/-/t/, /sˤ/-/s/, /dˤ/-/d/, and /ðˤ/-/ð/ contrasts in a variety of JA that is spoken in the north of Jordan, mainly in Jerash, Ajloun, Irbid, and their neighboring villages, namely the Irbid dialect of JA. Their corpus included notecards on which the target monosyllabic and disyllabic words and nonwords were embedded in a carrier sentence, with the target consonants occurring word-initially, word-medially, and word-finally. The target consonants were investigated in a variety of vowel environments[57], including /æ, aː, ʊ, uː, ɪ, iː/. To this end, eight native speakers of JA, equally divided in terms of gender, were recruited to read the designated notecards five times. Several acoustic parameters were utilized, including the vowel's first, second, and third formant frequencies (F1-F3) and the spectral mean of emphatic obstruents.

For monosyllables, they found that emphaticized vowels consistently showed higher F1, lower F2, and higher F3, with more salient effects on vowel portions closer to the emphatic consonant. Besides, they found that the emphasis by VQ interaction significantly affected the degree of F2 lowering. That is, while emphaticized /æ/ showed the greatest amount of F2 lowering, emphaticized /ʊ/ showed the least amount of F2 lowering. Though less obvious, the spectral mean was found to be significantly lower for both word-initial and word-final emphatic consonants. A similar pattern of change was elicited for disyllables, with

[57] Although the researchers did not plainly specify the conditioning environments, but it can be deduced that the target consonants were investigated in pre- and post-vocalic position.

the exception that emphasis from a word-medial emphatic consonant was found to propagate throughout the whole word. This finding was based on F2 mean values at the onset, midpoint, and offset of the vowel. Spectral mean, on the other hand, was also found to be lower for the target emphatic consonants, but not for consonants at both edges of the word. In other words, the effect of emphasis spread was confined to vowels in the target and adjacent syllables and did not proceed to consonants at both edges of the word.

Al-Masri (2009) examined the acoustic and perceptual indicators of emphasis in UJA. From an acoustic perspective, he identified two primary observations: the monosyllabic and disyllabic. Regarding the former, his dataset comprised a list of 48 minimal pairs, contrasting in /tˤ/-/t/, /dˤ/-/d/, /sˤ/-/s/, and /ðˤ/-/ð/. These contrasts were analyzed within the context of three sets of VLs, specifically /iː/, /ɪ/, /aː/, /æ/, /uː/, and /ʊ/. The target consonants appeared at both the initial and final positions[58]. The participants in his monosyllabic observation comprised eight native speakers of UJA, evenly divided between genders with four male and four female subjects, all within the age range of 20 to 39 years. Each of the participants produced each of the target words in a carrier sentence three times. Besides, several acoustic cues[59] were utilized such as consonant duration (henceforth CD), spectral moments for stops and fricatives (i.e., center of gravity, standard deviation, skewness, and kurtosis), locus equations, VD, and the vowel's first three formant frequencies (F1-F3) at the beginning, middle, and end of the vowel.

Overall, Al-Masri (2009) found that emphasis was mainly characterized by longer CD, higher F1 and F3, and lower F2. More importantly, a subgroup analysis (word-initial vs. word-final) revealed that only word-final emphatic consonants showed longer CDs. In addition, while emphaticized vowels showed significantly higher F1 onsets in the vicinity of both word-initial and word-final emphatic consonants, they showed this effect for F1 offsets in the vicinity of a word-final emphatic consonant. Unlike F1, F2 consistently showed lower mean values in the environments of both word-initial and word-final emphatic consonants throughout the vowel. As for F3, emphaticized vowels showed higher mean values of F3 at the onset and midpoint only in the vicinity of a word-initial emphatic segment. However, F3

[58] The target words were framed in CVC syllables, with the other vacant C slot being filled with the bilabial stop /b/: CVb vs. bVC.
[59] The researcher further investigated the duration of the syllable-initial/final filler /b/ and its spectral moments.

offset of emphaticized vowels was also significantly higher only in the vicinity of a word-final emphatic consonant.

Exploring the potential effects of other segmental features[60] on emphasis, Al-Masri (2009) figured out that the emphasis by PTC interaction determined that only word-final emphatic consonants yielded longer CDs. The emphasis by manner interaction identified that emphatic stops, but not emphatic fricatives, showed longer CDs. As for the vocalic cues, the emphasis by PTC interaction also showed effects on F2 only at the onset and offset positions, where in the former F2 was significantly lowered in the environment of a word-initial emphatic consonant and where in the latter F2 was significantly lowered in the environment of a word-final emphatic consonant.

Similarly, the emphasis by VQ interaction showed significant effects on F2 throughout the vowel and F3 only at the midpoint position. To clarify, the proportion of F2 lowering was significantly higher for /iː/-/ɪ/ and /aː/-/æ/ than for /uː/-/ʊ/ at the onset, significantly higher for /aː/-/æ/ than for /iː/-/ɪ/ and /uː/-/ʊ/, respectively, at the midpoint, and significantly higher for /iː/-/ɪ/ than for /aː/-/æ/ and /uː/-/ʊ/, respectively, at the offset. However, F3 showed a higher mean value for emphaticized /aː/-/æ/ only at the midpoint position. Besides, the emphasis by VL interaction yielded significant effects only on F2 at the midpoint, where only emphaticized short vowels showed lower F2 mean values.

Moving to the spectral moments of consonants, the emphasis by manner interaction showed that while word-final emphatic stops showed significantly higher mean values as compared to those of their plain counterparts, word-final emphatic fricatives showed significantly lowered mean values as compared to those of their plain counterparts. Al-Masri (2009)[61] concluded that there were no other statistically significant interactions for his first primary observation: the monosyllabic. As for the emphasis by word-type interaction, there was a significant interaction effect on the duration of filler-/b/, where its mean value in real words containing an emphatic consonant was significantly longer than that of nonwords. The interaction also revealed a significant effect on F3 only at the onset, where F3 mean value in real words containing an emphatic consonant was significantly higher than that of nonwords.

[60] These segmental features included six independent linguistic factors: PTC, manner of articulation, voicing, word type, VQ, and VL.
[61] Al-Masri (2009) identified the potential effects of word type (word vs. nonword), and he found that i

Moving to Al-Masri's (2009) second main observation, the disyllabic, his data consisted of a list of 80 minimal pairs, contrasting in /tˤ/-/t/, /dˤ/-/d/, /sˤ/-/s/, and /ðˤ/-/ð/. These contrasts were analyzed within the context of three sets of VLs, specifically /iː/, /ɪ/, /aː/, /æ/, /uː/, and /ʊ/. The target consonants were investigated word-initially, word-medially, and word-finally in different syllable frames (for details, see Al-Masri, 2009, p. 70). His participants were eight native speakers of UJA (4 males and 4 females), whose age range was between 16 and 26 years old. Each participant repeated the target words, each incubated in a carrier sentence, thrice, of which only the best token was analyzed. In addition, several acoustic means were used such as CD, vowel duration, word duration, and the vowel's first three formant frequencies at the onset, middle, and end of the vowel.

Overall, Al-Masri (2009) found that while temporal cues did not yield consistent findings, spectral cues did. In target syllables (i.e., syllables containing the emphatic consonant), vowels showed higher F1 throughout the vowel when the target consonant occurred word-initially, higher F1 only at the onset and midpoint positions when the target consonant occurred word-medially, and higher F1 only at the onset and offset positions when the target consonant occurred word-finally. F2 of vowels in target syllables was significantly lowered throughout the vowel when the target consonant occurred word-medially and word-finally, but it was significantly lowered only at the onset position when the target consonant occurred word-initially. Similarly, F3 of vowels in target syllables was significantly raised throughout the vowel when the target consonant occurred word-initially and word-finally, yet it was significantly raised only at the onset and offset positions when the target consonant occurred word-medially. Moreover, Al-Masri (2009) identified significant interactions between emphasis and VQ on the spectral cues of the target vowels. In word-medial position, the amount of F2 lowering in an emphatic environment was significantly higher for /a/ than for /i/. However, the amount of F2 lowering in the vicinity of a word-initial emphatic consonant was significantly higher for /i/ than for /a/ and /u/, respectively.

Regarding vowels in adjacent syllables, Al-Masri (2009) found that in the environment of a word-initial emphatic consonant, vowels in right-adjacent syllables showed significantly higher F1 only at the onset, lower F2, and higher F3 throughout the vowel. In left-adjacent syllables where the emphatic consonant occurred word-medially, emphaticized vowels showed significantly higher F1 and lower F2 throughout the vowel, on the one hand, and higher F3 only at the offset position. In left-adjacent syllables where the emphatic consonant occurred word-finally, emphaticized vowels showed significantly higher F1 and lower F2 values throughout the vowel, on the one hand, and higher F3 only at the midpoint and offset positions, on the other hand. Furthermore, the researcher pinpointed the significant interaction effects between emphasis and VQ, where he found that when the emphatic consonant occurred word-medially, the degree of F1 raising throughout the vowel was significantly higher for /a/ than for /i/. This significant trend was replicated for F2 only at the onset, where /a/ showed a higher degree of F2 lowering than /i/.

Jongman et al. (2011) investigated the acoustic and auditory correlates of segmental emphasis in the urban dialect of JA spoken in major metropolitan cities, such as Amman, Irbid, and Zarqa. Their acoustic analysis was based on a list of 504 minimal pairs, which inevitably included real and nonsense words. These words and nonwords contrasted in /tˤ/-/t/, /dˤ/-/d/, /sˤ/-/s/, and /ðˤ/-/ð/ in monosyllables, with the target consonants occurring at both edges of the word before and after different vowels (i.e., /ɪ/, /iː/, /æ/, /aː/, /ʊ/, and /uː/). The study involved 12 native speakers of UJA, evenly divided by gender, with each speaker producing a total of (504*3 repetitions) 1512 tokens. The acoustic analysis encompassed the measurement of the first three formant frequencies (F1-F3) of the vowels at three distinct temporal intervals: the onset, the midpoint, and the offset. Additionally, it involved the measurement of the spectral mean of emphatic obstruents.

For word-initial emphatic consonants, the researchers found that emphasis was characterized by a higher F1 at the onset and midpoint, lower F2, and higher F3 throughout the vowel. The emphasis by VQ interaction revealed significant effects on F1 only at the midpoint, F2, and F3 throughout the vowel. While F1 was significantly higher in the environment of emphaticized /a/ than in that of emphaticized /i/ and /u/, F2[62] was substantially lower for emphaticized /a/ and /i/ than for emphaticized /u/. In addition, F3 was significantly higher for emphaticized /a/ and /u/, but not for /i/. Similarly, the emphasis by VL interaction yielded significant effects on F2 and F3. That is, emphaticized short vowels showed lower F2 and higher F3 throughout the vowel, except for F2 at the onset position, as compared to their long cognates. The researchers suggested that this could be attributed to

[62] Jongman et al. (2011) stressed that the effect of emphasis on F2 was consistent for /a/ throughout the vowel, with diminishing effect for /i/ and /u/.

the uneven interval between the emphatic consonant and the measurement point for short and long vowels, which is valid only for midpoints and offsets. Besides, the emphasis by manner interaction showed significance on F2 throughout the vowel, where vowels in the context of an emphatic stop showed significantly lower F2 mean values than those in the context of an emphatic fricative (Jongman et al., 2011). As for consonantal cues, the study revealed that emphatic consonants had a lower spectral mean as compared to their plain peers. The emphasis by manner interaction indicated a significant effect on spectral mean, where only emphatic stops, but not emphatic fricatives, exhibited a lower spectral mean as compared to their plain cognates.

For word-final emphatic consonants, they found that emphasis was marked by a higher F1, lower F2, and higher F3 throughout the vowel. Similar to word-initial emphatics, the emphasis by VQ interaction indicated a significant effect on F1, F2, and F3 throughout the vowel[63]. To clarify, emphasis was more acoustically pronounced in the environment of /a/ than in that of /i/ and /u/. What is worth noting about this interaction is that emphaticized /a/ consistently showed lowered F2 throughout the vowel while emphaticized /i/ showed a decreasing effect, with /u/ showing indifference. Furthermore, the emphasis by VL interaction indicated a significant effect both on F1 and F3 only at the beginning of the vowel and on F1, F2, and F3 at the midpoint, where emphaticized short vowels showed higher F1, lower F2, and higher F3 as compared to their long cognates. Yet, Jongman et al. (2011) argued that although this interaction was statistically significant, it does not necessarily mean that it is true, given that the only valid measurement point for short and long vowels at this juncture is the offset, which did not show any significance. Additionally, the emphasis by manner interaction indicated a significant effect on F2 throughout the vowel, where vowels in the context of an emphatic stop showed significantly lower F2 mean values than those in the context of an emphatic fricative. As for temporal cues, the study revealed that, similar to word-initial emphatics, emphatic consonants had a lower spectral mean as compared to their plain peers. The emphasis by manner interaction indicated a significant effect on spectral mean, where only emphatic stops, but not emphatic fricatives, exhibited a lower spectral mean as compared to their plain cognates.

[63] At the offset position, F2 was lowest for /i/ and F3 was highest for /u/ (Jongman et al., 2011).

Jongman et al. (2011) further examined the degree of emphasis spread from a word-initial emphatic obstruent to a plain word-final obstruent and from word-final emphatic obstruent to a plain word-initial obstruent. While the former analysis showed no significance on the spectral mean of plain word-final obstruents, the latter analysis revealed that there was a main effect of emphasis on the spectral mean of word-initial plain obstruents. That is, word-initial plain obstruents in the vicinity of a word-final emphatic obstruent showed a lower spectral mean than those in the vicinity of a word-final plain consonant. However, no other statistically significant interactions were found in any combination.

Jaber et al. (2019) investigated the domain of emphasis spread in UJA. Their data, unlike those of previous studies, consisted of four lists: two containing polysyllabic monomorphemic words and two containing polysyllabic polymorphemic. These minimal pairs, which inevitably included some nonsense words, contrasted in the presence/absence of the [±emphatic] feature in the /tˤ/-/t/ contrast, with the target consonants occurring in the first and last syllables (for details, see Jaber et al., 2019: 22-23). The participants were ten native speakers of UJA, equally divided in terms of gender, who read the stimuli in a carrier sentence, yielding a total of 56 tokens per speaker (28 emphatic and 28 plain). The acoustic cues that were measured included the vowel's first, second, and third formant frequencies (F1-F3) of vowels to the right and left of the emphatic stop at the steady state of the vowel (i.e., midpoint).

On the whole, the researchers found that F2 of all vowels within polysyllabic monomorphemic words was consistently lowered in an emphatic environment as compared to that in a plain environment across the different syllables, suggesting that the domain of emphasis in UJA is the morpheme. Supporting this claim is their finding in polysyllabic polymorphemic words, where the F2 of vowels falling in right or left-adjacent morphemes to the morpheme containing the emphatic stop was not lowered. Therefore, in polysyllabic polymorphemic words, there was no significant difference in terms of F2 of vowels in adjacent morphemes in the environments of those that contained /tˤ/ and /t/. In addition, the study revealed that leftward emphasis spread[64] is stronger than rightward emphasis spread, as evinced on F2 in an emphatic environment. Trying to explain this asymmetry vis-à-vis

[64]This claim was supported by the finding on F1 in polysyllabic monomorphemic words (for details, see Jaber et al., p. 15).

previous antagonistic findings (for details, see Jaber et al., p. 18), they linked it to the morphological structure of complex words in Arabic, which are dominated by suffixes rather than prefixes or infixes. In simple terms, while progressive spreading is impeded by suffixes, regressive spreading is blocked by prefixes, which contradicts their earlier statement that leftward spread is stronger than rightward spread[65]. Moreover, Jaber et al. (2019) found that the difference in terms of F1 and F3 for polysyllabic monomorphemic versus polysyllabic polymorphemic was statistically significant, calling for further sustained research. This finding runs counter to Alsuhaibani (2022), who found that prefixes were transparent to emphasis spreading in Najdi Arabic. Saed et al. (2022) examined the domain of emphasis in the /tˤ/-/t/ and /sˤ/-/s/ contrasts in a variety of JA spoken in Irbid, namely RJA. Their stimulus materials were comprised of a list of 60 trisyllabic dimorphemic minimal pairs[66], which inevitably included nonsense words. All of these minimal pairs were examined exclusively in the environment of the short low vowel /æ/, as each was produced in isolation by 14 native speakers of the dialect under scrutiny, evenly divided in terms of gender. The acoustic parameters that were utilized included the vowel's first three formant frequencies[67] (F1-F3), which were measured at the steady state of the target vowel, namely the vowel in the functional morpheme.

For suffixes, the study revealed that F2 of vowels in the target suffix was significantly lowered when attached to an emphatic stem, be stem-initial or stem-final, as compared to its value when attached to a plain stem. Vowels within clitics (their term for enclitics), on the other hand, showed that F2 was significantly lowered only when the trigger was a stem-final emphatic consonant. As for vowels within proclitics, they showed a similar pattern to that of vowels within suffixes. In other words, F2 of vowels within proclitics was significantly

[65] One might ask why, if regressive spreading is blocked by prefixes, the researchers nonetheless maintain that regressive spreading is more robust than progressive spreading. This apparent paradox is resolved by considering the relative frequency of affix types in morphologically complex words: prefixes occur less frequently than suffixes. Consequently, when emphasis spreads rightward, it is regularly interrupted by intervening suffixes. By contrast, when emphasis spreads leftward, it typically encounters no such morphological barriers but rather syllable barriers, and thus proceeds largely unimpeded, except in those cases where a prefix intervenes (for further discussion, see Jaber et al., 2019: 18).

[66] Saed et al. (2022) divided their stimuli according to both the morphosyntactic structure of the word (i.e, stem+suffix, stem+clitic, or proclitic+stem) and the position of the target emphatic consonant in that word (i.e., stem-initial or stem-final).

[67]The vowel formants were normalized to minimize any potential physiological differences between males and females.

lowered in the vicinity of either stem-initial or stem-final emphatic consonants. What these findings might indicate is that, the researchers argued, F2 is the only reliable exponent of emphasis as far as RJA is concerned. Therefore, the researchers elucidated that emphasis freely propagates in both directions onto all morphemes, except for vowels in clitics, where the emphatic trigger was far from the vowel (for details, see Saed et al., p. 182). The researchers thus attributed emphasis spread onto close clitics to articulatory and temporal restrictions in the following lines:

> The narrowing of the pharynx caused by the pharyngeal consonant (Watson 1999) continues while producing the nucleus of the adjacent clitic since there is no enough time to change the status of the pharynx when the pharyngeal consonant is immediately adjacent to a clitic (Saed et al., 2022, p. 183).

Attempting to account for emphasis spread in terms of prosodic features in RJA, they proposed three categorizations: (i) suffixes and proclitics, integrated into the same prosodic word (ω) as the stem, form a flat prosodic structure, which in turn permits the spreading onto their vowels, (ii) since clitics in RJA attach freely to stems, they result in a recursive prosodic word structure (ω), which results in a minimal ω embedded within a maximal ω, and (iii) when the emphatic segment is sufficiently approximate to the free clitic, the emphatic feature may spread across the maximal ω due to the relative articulatory and temporal restrictions.

2.3. Perception of Emphasis

As mentioned earlier, the phenomenon of emphasis has rigorously been studied from phonetic and phonological perspectives (Khattab et al., 2006; Almomany, 2018). Yet, very few studies probed the perceptual correlates of emphasis in dialectal Arabic (Khattab et al., 2006; Almbark, 2008; Al-Masri, 2009; Jongman et al., 2011; Al Omary, 2024).

In their study of the /tˤ/-/t/ contrast among males and females in JA, Khattab et al. (2006) conducted a perception experiment. The stimulus materials were, as in their acoustic experiment, a list of four minimal pairs, with the target consonant occurring only word-initially. The words were articulated by ten native speakers of JA[68], whose ages ranged from 18 to 33 years. Subsequently, these tokens underwent randomization and were presented to

[68] Khattab et al. (2006) noted that although they controlled for speakers' gender (5 males and 5 females), they did not control for the participants' socio-cultural background (i.e., all males and two females were from Irbid, and three females were from Amman).

two native speakers of Arabic, both of whom contributed as co-authors to the study, for perceptual evaluation based on a tripartite scale of emphaticness: fully emphatic, half emphatic, and plain. The findings of the study indicated that all instances of /tˤ/ were assessed as fully emphatic, except for those produced by the three female speakers from Amman, which exhibited greater variability. In contrast, all instances of /t/ were consistently evaluated as plain. Differential analysis by subgroup indicated that the variability in the female data from Amman mainly came from the speech of a female who, the researchers observed, showed affiliation with the high class in Amman. Therefore, it could be argued that males' productions were on average more emphatic than those of females only if we take the speech of the three female speakers from Amman, especially that affiliated with the high class, into consideration (for details, see Khattab et al., 2006, pp. 154-155).

Al-Masri (2009) also analyzed the perceptual cues of emphasis in UJA. His data consisted of a set of four minimal pairs[69], primarily contrasting in /tˤ/-/t/ and /sˤ/-/s/ in the vicinity of /æ/ and /ʊ/. Utilizing cross-spliced speech, he identified the source that contributes most to the perception of emphasis (emphatic consonant vs. emphaticized vowel) and the potential interactions between the perception of emphasis, on the one hand, and either manner of articulation or VQ. To do so, he formulated three conditions: (i) original tokens that were segmented and reassembled, (ii) cross-spliced target consonants in which the target consonants were spliced and swapped, and (iii) the cross-spliced target vowels in which the target vowels were spliced and swapped (for details, see Al-Masri, 2009, pp. 119-123). The cross-spliced tokens, 240 in total, were perceptually rated by 20 native speakers of UJA residing in the USA at the time of the study. As for the analysis, it included perceptual ratings, reaction time, and confidence ratings.

For original tokens, participants were almost always (99%-100%) able to identify emphatic and plain words, suggesting that splicing did not impair emphatic-plain detection. VQ, on the other hand, did not have any significant effects on accuracy rates. That is, participants showed indifference in their perceptual ratings in the environments of /æ/ and /ʊ/. Besides, reaction time (i.e., how fast participants responded) yielded significant, yet complex, differences. While participants responded faster to plain stops /t/ than to emphatic

[69] Al-Masri (2009) noted that all of the minimal pairs were extracted from the speech of one of the participants in his acoustic experiment.

stops /tˤ/ in the environment of the low vowel /æ/, they responded slower to plain fricatives /s/ as compared to their response to emphatic fricatives /sˤ/ in the same vowel environment. Al-Masri (2009) impressionistically argued that this inconsistency was due to the higher frequency of /t/ and /sˤ/ than /tˤ/ and /s/. Conversely, participants showed quite high confidence rates ranging from 4.7 to 4.9 on a five-point scale.

In the context of cross-spliced target consonants, the perception study revealed that a significant majority of participants (94.5%) discerned emphatic stops spliced into plain words as plain. Conversely, a smaller proportion (66%) identified plain stops integrated into emphatic words as emphatic. The same patterns of change were true for fricatives, suggesting that it was, irrespective of manner, the low vowel /æ/, but not the emphatic stop or fricative, which contributed most to the perception of emphasis. Nonetheless, VQ appeared to significantly affect participants' evaluations of whether a sound was perceived as emphatic or plain. Specifically, participants encountered difficulties in distinguishing between emphatic and plain /t/ when the consonants /tˤ/ and /t/ were swapped between /tˤʊb/ and /tʊb/. Furthermore, while 65.5% were able to accurately identify /t/ as plain when it was introduced into an emphatic context, a mere 29.5% perceived it as emphatic. When emphatic /sˤ/ was inserted into a plain word in the environment of /ʊ/, a great majority of the participants (76%) identified it as emphatic. These findings suggest that high back vowels, such as/ʊ/, differ from low vowels in weakening the perceptual correlates of emphasis, particularly for stops. This is because Al-Masri (2009) pinpointed that emphasis lowers the second formant frequency (F2), which is less in magnitude for high back vowels compared to low vowels. Moreover, response times to both emphatic and plain stops and fricatives were significantly, yet contradictorily, significant only in the environment of the front low vowel /æ/. Although participants demonstrated a swifter identification of plain stops relative to their emphatic equivalents, they exhibited a more rapid recognition of emphatic fricatives in comparison to their plain counterparts. Nevertheless, participants exhibited a substantial level of confidence, as evidenced by an average rating of 4.7 on a five-point scale. The findings imply, as Al-Masri (2009) contended, that the vowel, rather than the consonant, plays a significant role in the perceptual identification of emphasis in UJA.

Regarding the cross-spliced target vowels, the findings affirm the prominence of vowels in the identification of emphasis within UJA. When a non-emphatic vowel was introduced into a word containing an emphatic consonant, participants predominantly perceived the target consonant as plain. Conversely, when an emphaticized vowel was introduced into a non-emphatic word, participants predominantly perceived the target consonant as emphatic. Analogous patterns of change were observed for fricatives. Furthermore, the quality of the vowel appeared to be of considerable significance, as participants distinctly identified emphatic-plain contrasts exclusively in the context of the front low vowel /æ/. In contrast, within the context of the high back vowel /ʊ/, participant responses were nearly at the level of random guessing, indicating uncertainty. Al-Masri (2009) highlighted an asymmetry in vowel manipulation, where the insertion of an emphaticized vowel into a plain word led to ambiguous detection of the emphatic-plain contrast, whereas inserting a plain vowel into an emphatic word resulted in the overriding of the emphatic consonant (see Al-Masri, 2009, pp. 136-137 for further details). Nevertheless, reaction time did not reveal any significant effects concerning vowel manipulation. Notwithstanding, participants exhibited a high confidence rate in identifying emphatic-plain contrasts, with an average rating of 4.7 on a five-point scale.

Similar to Al-Masri (2009), Jongman et al. (2011) utilized natural cross-spliced speech in their perception study to assess the extent to which the acoustic patterns in their first experiment contribute to the perception of emphasis in UJA. Their corpus included nine monosyllabic minimal pairs (five included word-initial emphatic consonants and four included word-final emphatic consonants), contrasting word-initially in /sˤ/-/s/ and /tˤ/-/t/, and word-finally in /sˤ/-/s/, /tˤ/-/t/, and /dˤ/-/d/ in the environments of /a, i, u/. These minimal pairs, all real words, were elicited from the speech of two speakers, a male and a female, whose productions were judged as well-articulated and thus verified to match the overall acoustic patterns. The participants were 30 native speakers (11 males and 19 females) of UJA, who judged four repetitions for each stimulus, yielding a total of 72 trials per speaker (for details, see Jongman et al., 2011, p. 92).

For word-initial trials, the perception analysis revealed that originally emphatic words elicited a higher rate of emphatic responses (90%) vis-à-vis their non-emphatic counterparts which were rated (97%) as plain. More importantly, when an emphaticized VC vowel portion was inserted into a plain word, a vast majority of the participants (69%) realized it as emphatic. However, when an emphatic consonant was inserted into a plain VC portion, only few rated it as emphatic (15%). Confirming these findings is their Two-Way ANOVA, which revealed a main effect of both emphasis (emphatic vs. plain) and VC portion on perception. The former indicated that when the word started with an emphatic consonant, 53% of the responses were rated as emphatic compared to 36% of plain responses when the word started with a non-emphatic consonant. The latter indicated emphaticized VC portions contributed with a significantly high rate of emphatic responses (80%), as contrasted with that of plain VC portions (9%). Therefore, the emphasis by VC portion interaction yielded significant differences. That is, while inserting an emphaticized VC portion to both an emphatic word and a plain word resulted in a high rate of emphatic responses, the former (75%) showed a higher magnitude of change than the latter (62%). Similarly, the emphasis by manner interaction indicated a statistically significant effect on perception. To clarify, while participants showed a higher rate of emphatic responses to words with initial emphatic stops (60%) as compared to that of words with initial non-emphatic stops (28%), they showed less precision in terms of words with initial emphatic fricatives (48%) as compared to that in terms of non-emphatic fricatives (41%).

In the context of word-final trials, similar findings were obtained. Original words with word-final emphatic consonants received a higher rate of emphatic responses (96%) than that of word-final words with non-emphatic consonants. Likewise, the emphaticized CV portion was found to contribute much more to the perception of emphasis when added to a plain consonant (94%) as compared to the word-final emphatic consonant when added to a plain CV portion (25%). Besides, the emphasis by CV portion interaction yielded significant results. Inserting an emphaticized CV portion into a plain word resulted in a higher rate of emphatic responses (84%) as compared to inserting an emphaticized CV portion into an emphatic word (70%). This inverted pattern of change was due, Jongman et al. (2011) contended, to the fact that the emphaticized CV portion originated from a CV**C** structure, where C is a plain consonant, V a vowel, and bolded C an emphatic consonant, thus pointing to a more pronounced effect of emphasis from a word-final emphatic consonat. As for the emphasis by manner interaction, the analysis confirmed that while participants showed a higher rate of emphatic responses to word-final emphatic stops (71%) as compared to theirs to word-final plain stops (55%), they showed uncertainty in their responses to word-final emphatic (50%) and plain (49%) fricatives.

A more recent, yet more diversified, account of the perceptual correlates of emphasis among heritage speakers of Levantine Arabic and American English-speaking learners of Arabic was laid by Al Omary (2024). Her data were, as in the acoustic experiment, 24 monosyllabic minimal pairs[70], contrasting in /tˤ/-/t/, /sˤ/-/s/, /dˤ/-/d/, and /ðˤ/-/ð/. These consonants occurred both word-initially and word-finally in the environments of /æ, ɪ, ʊ/. As per her main observation, participants were divided into two groups: 18 native speakers of Levantine Arabic (10 Palestinians, 5 Jordanians, and 3 Syrians) and 18 Arabic L2 learners from an American English background, with each group being equally divided in terms of gender. The same participants participated in the perception study, where each of them had to identify the designated trials as emphatic/plain. The data were analyzed in terms of accuracy rate and reaction time, and thus in relation to emphasis, VQ, and PTC.

The study indicated that Arabic heritage speakers demonstrated greater accuracy in distinguishing phonemic contrasts than their L2 peers, which was ascribed to their early exposure to Arabic. While both speaker groups showed, though marginally significant ($p= 0.055$), higher accuracy rates in identifying plain consonants than in identifying emphatic consonants, pointing out the difficulty both speaker groups experience in identifying emphatic consonants. Similarly, PTC indicated a significant effect, where Arabic heritage speakers maintained almost the same accuracy rate in identifying emphatic-plain contrasts in word-initial and word-final position, L2 speakers showed a higher accuracy rate in identifying emphatic-plain contrasts in word-initial than in word-final position. Al Omary (2024) interpreted this latter effect utilizing the markedness theory, where emphatic-plain contrasts in word-initial position are less marked (less difficult and more frequent) than those in word-final position, which are more marked (more difficult, less frequent).

Moreover, there was a significant correlation between the accuracy rate in identifying emphatic-plain contrasts and VQ. In the environment of the back vowel /ʊ/, all speakers showed higher accuracy rates in identifying emphatic consonants, whereas in the environment of /æ/, those speakers showed higher accuracy rates in identifying plain consonants. That being said, it turned out, Al Omary (2024) contended, that the back vowel

[70] Al Omary (2024) pinpointed that all of the stimulus materials were sourced from textbooks designated for beginner learners of Arabic.

/ʊ/ enhances the perceptual correlate of emphasis, ascribing it to the closer articulatory proximity of /ʊ/ to the emphatic consonant in the vocal tract.

Besides, reaction time showed a significant difference between Arabic heritage speakers and L2 speakers. In simple terms, while L2 speakers showed a faster pace in responding to emphatic consonants as compared to plain consonants, Arabic heritage speakers maintained almost the same pace in responding to both emphatic and plain consonants. The vowel context was found to significantly influence reaction time, whereby Arabic heritage speakers maintained virtually the same reaction times to emphatic-plain contrasts across the different vowel environments /æ, ɪ, ʊ/, L2 speakers demonstrated a larger difference in their reaction time when identifying emphatic-plain contrasts in the environment of /æ/ versus a smaller difference in the environments of /ʊ/ and /ɪ/. Al Omary (2024) affirmed that the findings indicate that Arabic heritage speakers, in contrast to L2 speakers, demonstrated a superior capability in discerning emphatic-plain contrasts across various vowel environments, a consequence attributed to their early exposure to Arabic.

2.4. Sociophonetics of Emphasis

The sociophonetics of emphasis in dialectal Arabic in general and in JA in specific has recently gained momentum. Several studies have accounted for the social, as well as linguistic, effects on the production of emphasis in a wide array of Arabic dialects (Almbark, 2008, for Syrian Arabic; Alfraikh, 2015, for Najdi Arabic; Al Malwi, 2017; Al Malwi, 2024, for Abha Arabic; Salem and Sebane, 2023, for Oran Arabic; Abudalbuh, 2010; Alzoubi, 2017; Omari and Jaber, 2019; Omari and Jaber, 2020; Almomany, 2023a; Almomany, 2023b; Almomany, 2024, for JA). Accordingly, this section is divided into two subsections: Section 2.4.1 and section 2.4.2, with the former shedding light on the sociophonetics in Arabic varieties and the latter being dedicated to JA varieties.

2.4.1. Sociophonetics of Emphasis in Dialectal Arabic

Almbark (2008) investigated regional and gender-based variations in the /tˤ/-/t/, /dˤ/-/d/, /sˤ/-/s/, and /zˤ/-/z/ contrasts. Since the study sought to explore two main observations: acoustic cues of emphasis and emphasis spread, her stimulus materials were devised in two lists accordingly. The first list comprised 18 minimal pairs, all real words except for one [zˤiːne], with the target consonants occurring only word-initially (i.e, prevocalic) in the context of /aː/, /æ/, /iː/, /ɪ/, and [eː]. The second list consisted of 17 minimal pairs[71], in which the target consonants occurred word-medially in the context of /iː/, /ɪ/, /uː/, /aː/, and /æ/. The target words were written using Arabic orthography, reflecting their vernacular forms within Syrian Arabic, and were integrated into carrier sentences. The study sample consisted of eight native Syrian Arabic speakers[72], equally representing two regional dialects (four from Damascus and four from Aleppo), with an equal distribution across gender. Several acoustic parameters were utilized, including consonant duration, VOT of stops, vowel duration, center of gravity (for fricatives), and the vowel's first three formant frequencies at the beginning of the vowel. It is noteworthy that the first and second formant frequencies were normalized against sex differences among males and females.

The investigation demonstrated that emphasis exerted a pronounced effect on the Voice Onset Time (VOT) of voiceless stops, with emphatic VOTs being markedly shorter than their plain counterparts. Likewise, gender, but not region, produced a significant impact on the VOT of voiceless stops exclusively preceding the high front vowel /iː/, where females exhibited a more substantial emphatic-plain contrast than males. Almbark (2008) ascribed this effect to phonological factors, specifically consonant type (emphatic versus plain). Although the VOT of voiced stops was found to be insignificantly influenced by either gender or region, Aleppians demonstrated significantly longer leads than Damascenes for voiced stops. Additionally, emphasis did not exert any significant effects on the duration of friction, nor did gender and region. Similarly, neither emphasis nor gender exerted any prominent effects on the Center of Gravity (COG) of emphatic-plain fricative contrasts. Nevertheless, region displayed a marginal effect on COG, with Damascenes presenting a lower COG compared to Aleppians.

The duration of vowels exhibited nearly identical values in both emphatic and plain contexts, indicating that emphasis did not exert noticeable effects. Similarly, neither gender nor regional differences had significant impacts on vowel duration. Nonetheless, a notable interaction between emphasis and VQ on vowel duration was identified exclusively in the vicinity of fricatives, wherein vowel duration was appreciably extended solely in the

[71] The second list of stimuli included four nonsense words. Therefore, both lists included distractor words and were thus randomized.

[72] Almbark (2008, p. 13) emphasized that additional social determinants with the potential to affect speakers' choices, namely education and social class, were intentionally controlled for.

emphaticized /iː/ context compared to the plain /iː/ context. Almbark (2008) proposed that this phenomenon can be attributed to the coarticulatory influence of the secondary articulation [RTR] associated with emphatic production. In proximity to a stop, variations in F1 between emphatic and plain contexts were contingent solely upon VQ. While F1 exhibited no notable differences for /ɪ/ and /aː/ between emphatic and plain contexts, it was markedly different for /æ/ and /iː/. Contrarily, F2 was appreciably lower in emphatic contexts compared to plain contexts across diverse vowel environments. Furthermore, the interaction between emphasis and gender was statistically significant on F2 across various vowel contexts, with the exception of /iː/. Specifically, the magnitude of F2 lowering was more pronounced for females than for males. This observation was further supported by the greater approximation of F1-F2 in females in emphatic contexts compared to males in the same contexts. In terms of regional influences, there was no significant effect on F2, except in the context of /iː/, where Aleppians demonstrated a more pronounced degree of F2 lowering in emphatic contexts compared to Damascenes. The researcher attributed this regional variation to Aleppian females more substantial F2 lowering. When assessing F1-F2 approximation in relation to region, Aleppians exhibited higher approximation for high vowels /ɪ/-/iː/, whereas their Damascene counterparts exhibited higher approximation for low vowels /æ/-/aː/. Lastly, F3 was considerably higher for emphaticized /æ/ and /ɪ/, but not for their lengthened equivalents.

In the context of vowels adjacent to fricatives, disparities in F1 between emphatic and plain environments were, akin to those observed in stops, entirely dependent on VQ. Specifically, F1 was markedly elevated solely in the presence of emphaticized /iː/ and [eː]. Irrespective of the vowel context, F2 was consistently reduced in the emphatic environment as compared to the plain environment. Furthermore, the interaction between emphasis and region was statistically significant for F2 exclusively in the [eː] context, with Aleppians displaying a greater degree of F2 reduction compared to their Damascene counterparts. Supporting this finding, Aleppians demonstrated a higher F1-F2 approximation only in the context of /iː/ and [eː] relative to Damascenes. Despite the absence of a significant gender-related impact on F2 between emphatic and plain settings, noteworthy F-patterns emerged. Notably, males exhibited a greater F1-F2 approximation and consequently a lower F2 in emphatic conditions than females, who presented greater overall discrepancies in emphatic-plain contrasts, indicating a more acoustically prominent impact of emphasis in their speech. Regionally, Aleppians consistently showed more pronounced formant differences compared to Damascenes. The normalized F1 and F2 values reflected parallel trends, wherein males generally exhibited more suppressed F2 values in emphatic conditions compared to females, with exceptions for /ɪ/ and /a:/, where females' F2 values were more subdued than those of males. Males also exhibited a stronger F1-F2 approximation than females, except in the case of /æ/. Notwithstanding, there was considerable overlap in formant frequencies between emphatic and plain environments, with female speech leading that of males, suggesting females are more inclined towards a less distinct articulation of emphatic fricatives (Almbark, 2008).

Relative to Almbark's (2008) second main observation, emphasis spread, the study revealed that for vowels preceding the target consonants, F2 of /æ/ and /ɪ/ was consistently lowered when preceded by an emphatic stop throughout the vowel. The same pattern was obtained for /æ/ when preceded by an emphatic fricative. Similar to /ɪ/ before emphatic fricatives, /i:/ showed a higher F2 lowering before an emphatic stop only at the offset position. As for vowels following the target consonants, while F2 was lowered for both /a:/ and /i:/ in the vicinity of emphatic stops and fricatives, the former effect was consistent throughout the vowel. In contrast, the latter was only observed at the midpoint position. Similar to /i:/, F2 was lowered after emphatic fricatives, but not emphatic stops, only at the midpoint position. Besides, F2 for /æ/ was lowered only for emphatic stops at the onset position. What these findings indicate is that, Almbark (2008) contended, is that emphasis spreads in both directions: rightward and leftward throughout the phonological word. Therefore, high segments /ɪ, i:, u:/ were found to impede or block emphasis spread. Specifically, leftward emphasis did not surpass /i:/, which in turn showed a fading effect of emphasis in rightward spread. The long high back vowel /u:/ showed inconsistency for both stops and fricatives, where the only noticeable effect was after emphatic fricatives exclusively at the midpoint.

In summary, regarding stops, F2 emerged as the exclusive reliable indicator of emphasis and the sole indicator of differences based on gender and region. The VOT of voiceless stops was notably influenced by emphasis, whereas it exhibited only a marginal impact concerning gender and no influence concerning region. Conversely, negative VOT was not at all impacted by emphasis, gender, or region. Furthermore, gender demonstrated a remarkable effect on F2, with female productions displaying a higher tendency for F2 lowering compared to those of males. Concerning fricatives, the results align with those observed in stops. Primarily, neither the duration of friction nor the center of gravity (COG) appeared to be affected by variations in emphasis, gender, or regional differences. In contrast to the vowels adjacent to stops, gender did not exert any prominent influence on the second formant frequency (F2). Moreover, the propagation of emphasis is bidirectional, with high vowel segments, namely /iː, uː/, serving to diminish or hinder the spread of emphasis.

Alfraikh (2015) conducted a study on the phenomenon of emphasis spread in the speech of male and female speakers of Najdi Arabic, a variety of Arabic prevalent in central Saudi Arabia. The study employed elicitation stimuli consisting of three lists of monosyllabic and disyllabic minimal pairs, contrasting the emphatic/plain consonantal pairs /tˤ/-/t/, /sˤ/-/s/, and /ðˤ/-/ð/. These contrasts were restricted to pre- and post-vocalic positions within the environment of the short low vowel /æ/, yielding a total of 50 minimal pairs. The study's participants included four native speakers (2 males and 2 females), whose ages ranged from 14 to 50, each of whom articulated the target words twice, thereby generating a substantial total of 200 tokens per individual. The scope of the acoustic measurements was limited to the first and second formant frequencies. Although Alfraikh (2015) did not explicitly tackle gender-related differences, the author was able to infer the following differences between males and females.

In monosyllables, it was observed that the second formant frequency (F2) of the emphaticized /æ/ was consistently reduced in the emphatic context compared to the plain context for both male and female speakers. However, the male participants demonstrated a more consistent reduction in F2 than the female participants, suggesting a more pronounced effect of emphasis in male speech. In contrast, female participants exhibited greater overlap in their F2 values between emphatic and plain contexts. Although gender differences were less consistently observed, it was noted that the first formant frequency (F1) for female speakers was occasionally higher in the emphatic context than in the plain context, whereas for male speakers, the F1 values were sometimes lower in the emphatic context compared to the plain context. A similar trend was observed among both male and female participants in regards to rightward and leftward emphasis spread. Males exhibited a more pronounced effect, primarily through the lowering of the second formant frequency (F2), for both rightward and leftward emphasis spread compared to females, who demonstrated greater overlap.

In disyllabic words, although both males and females exhibited a lower F2 for vowels preceding and following the emphatic consonants, there were some salient differences between them. In rightward spread, males consistently showed a higher proportion of F2 lowering than females. In leftward spread, males similarly showed a consistent F2 lowering before an emphatic consonant, whereas females showed an inconsistent pattern in the same environment, where they exhibited an overlap in terms of F2 in emphatic and plain environments. As for F1, males consistently tended to lower their F1, be it rightward or leftward, in an emphatic environment as compared to that of females, which was more variable (i.e., the same or higher).

In disyllabic words containing potentially blocking segments, the high/mid-high front vowels /ɪ, iː/, in contrast to /æ/, demonstrated resistance to emphasis spread. Specifically, the second formant (F2) of the emphaticized /ɪ/ exhibited a reduction in the emphatic environment, although it frequently remained above 2000 Hz. Similarly, F2 of /iː/ was reduced in emphatic contexts, sometimes approximating 2000 Hz, which implies a lower resistance to emphasis spread compared to its shorter variant. The first formant (F1) of /ɪ, iː/, conversely, showed no variation between emphatic and non-emphatic contexts. With respect to gender-specific effects, males exhibited a more pronounced rightward emphasis spread impact, as indicated by changes in F1 and F2, particularly F2, for /ɪ, iː/. In females, however, there was less F2 reduction for emphaticized /ɪ, iː/, suggesting that /ɪ/ may act as a partially or completely blocking segment. The comprehensive analysis indicated that palatal segments generally seem to obstruct emphasis spread. While the F2 value of the second vowel (/æ/) in CˤV.CVC was similar to that in CV.CVC, it experienced slight lowering in [tˤɑʃɑr] and [tˤɑjɑr]. Evaluations of male and female productions indicated that females consistently exhibited greater resistance to emphasis spread, particularly in palatal environments, whereas male productions occasionally displayed F2 lowering, suggestive of emphatic leakage, especially within /ʃ/ or /ʤ/ contexts. Consequently, emphasis spread occurs bidirectionally across the phonological word. Nevertheless, it encounters obstruction by both the long high front vowel /iː/ and the trio of palatal segments /ʤ, ʃ, j/.

Al Malwi (2017) investigated the effects of age and gender on VOT production in Abha Arabic, a variety of Arabic primarily spoken in southwest Saudi Arabia. His corpus was comprised of 30 words, with each starting with /tˤ, t, b, d, g, k/ across four vowel contexts the /i, a, u/, and, though less often, /e/. The participants were 38 native speakers of Abha Arabic (19 males and 19 females), who were further divided into four age groups: 4-6, 7-9, and 10-12 (children) versus 20-40 (adults). All participants were introduced to a picture-naming task, where each of them had to name the 30 pictures, which were randomized, three times, yielding a total of 90 tokens per speaker. Different types of VOT corresponding to voiceless plain stops /k, t/ (long-lag), voiceless emphatic stop /tˤ/ (short-lag), and voiced stops /b, d, g/ (negative VOT/ voicing lead), were analyzed.

In summary, the effect of gender on VOT manifested a statistically significant distinction solely concerning the voiced stops and the voiceless emphatic stop. Males demonstrated prolonged lags for /tˤ/, whereas females exhibited longer negative VOTs for the voiced stops. Furthermore, the research identified a statistically significant impact of age on VOT, wherein children's VOTs substantially differed from those of their adult counterparts. Specifically, although children produced VOTs for /tˤ, t, k/ that were comparable, albeit not identical, to adults, the VOTs for the voiced stops diverged significantly from those of adults. This suggests that children did not achieve alignment with adult VOTs until reaching the age of ten, indicating developmental progression in children's VOTs. The gender-related findings were attributed, according to Al Malwi (2017), to stylistic variation. Nonetheless, these significant disparities, the lack of examination of emphasis as an independent factor, potentially impeded a more comprehensive, insightful analysis.

Salem and Sebane[73] (2023) explored the effects of gender on the production of the voiceless emphatic stop /tˤ/ in Oran Arabic, a prevalent variety of Arabic in Algeria. Their stimuli were comprised of four disyllabic minimal pairs, all real words, in which the target consonants (/tˤ/-/t/) occurred word-initially and word-finally. The target words were investigated in pre- and post-vocalic positions in different vowel environments, with /iː, uː, aː/ occupying the nucleus of the first syllable as in "/tˤiːrɪ/ 'Go away (second feminine

[73] The researchers also studied the effects of the emphatic feature of /tˤ/ on the French voiceless stop in codeswitching. However, aspects concerning this experiment were not reviewed since they fall outside the scope of this study.

singular pronoun)'" (p. 322). The participants were ten native speakers of Oran Arabic, with an equal representation of genders, aged between 19 and 22 years, who produced the target words, each embedded in a carrier sentence, two times. Several acoustic parameters were utilized, including VOT, vowel duration, and the vowel's first three formant frequencies (F1-F3) at the steady state of the vowel (i.e., midpoint).

Overall, the study showed that emphasis was mainly characterized by shorter VOT, higher F1, and lower F2. However, neither vowel duration nor F3 was significantly different between emphatic and plain environments. Besides, emphasis was found to significantly interact with gender in terms of VOT, where both males and females, Salem and Sebane (2023) argued, maintained shorter VOTs for /tˤ/ as compared to that of /t/. Yet, the emphatic-plain contrast between males and females in terms of VOT was notably different. To clarify, females (42 ms) exhibited a higher emphatic-plain contrast in terms of VOT as compared to that of males (26), a finding that Salem and Sebane (2023) overlooked. In terms of normalized F1 and F2 values, there was no significant interaction between emphasis and gender. In other words, males and females showed comparable F1 and F2 values.

2.4.2. Sociophonetics of Emphasis in JA

Abudalbuh (2010) investigated the effects of gender as a social variable on the production of emphasis in JA[74]. His dataset comprised a set of nine monosyllabic minimal pairs contrasting the emphatic/plain consonantal oppositions /tˤ/–/t/, /dˤ/–/d/, and /sˤ/–/s/ in prevocalic position, each realized in three vowel environments: /iː/, /aː/, and /uː/. The stimuli were produced by 22 native speakers of JA (10 males and 12 females), all undergraduate students between 19 and 23 years old. Different acoustic means, both consonantal and vocalic, were deployed, such as the VOT of voiceless stops, friction duration, spectral mean of fricatives, vowel duration, and the vowel's first three formant frequencies at the beginning, middle, and end of the vowel.

In short, the analysis indicated that although emphatic VOT was significantly shorter than plain VOT, the emphasis by gender interaction was not statistically significant in terms of VOT, suggesting that males' and females' VOTs in emphatic versus plain environments were similar. In addition, emphaticized vowels were significantly longer than their plain

[74] Abudalbuh (2010) used JA as a cover term, which would be less representative of JA varieties (for details, see the Introduction: Section 1.5).

cognates. Yet, the emphasis by gender interaction did not yield any significant differences between males and females in terms of vowel duration. However, the emphasis by voice (voiced vs. voiceless) by gender interaction revealed a significant difference in terms of vowel duration only for males, where they exhibited a longer duration for vowels next to a voiceless emphatic stop than that of vowels next to a voiceless plain stop. Verifying these findings, Abudalbuh (2010) analyzed the VOT-to-vowel duration ratio, where he found that only emphasis, but not emphasis as it interacts with gender, had a salient main effect (i.e., lower emphatic ratio as compared to plain ratio). Similarly, friction duration was found to be significantly shorter for emphatic fricatives as compared to that of plain fricatives; nevertheless, males and females exhibited comparable friction durations in emphatic and plain environments. As for the spectral mean of fricatives, neither emphasis nor emphasis by gender interaction had any significant effects. That is, males and females maintained similar spectral means in emphatic and plain environments.

Moreover, emphasis had a statistically significant effect on the (unnormalized) vowel formants. That is, emphaticized vowels showed higher F1 at the onset and midpoint positions, lower F2 throughout the vowel, and higher F3 at the onset and offset positions. For a valid account of the potential differences (i.e, social) between males and females in terms of vowel formants, Abudalbuh (2010) pinpointed, it became inevitably necessary to use a normalization algorithm. Following this, he utilized Nearey's (1978) log-mean normalization technique. The analysis of the normalized formant values revealed that the emphasis by gender interaction yielded significant effects on F1, F2, and F3. To clarify, F1 of emphaticized vowels was significantly higher for males than for females at both the onset and midpoint position. Similar to F1, F2 of emphaticized vowels was significantly lower for males than for females at the onset and midpoint. However, F3 of emphaticized vowels was not significantly different between males and females.

A more recent, yet more delineated, account of the sociophonetics of emphasis in JA is Alzoubi's (2017) study, where he examined the possible bearings of gender, social class (lower class vs. upper class), and speaker's origin (rural Palestinian vs. rural Jordanian vs. urban Palestinian) on the production of emphasis in Amman, the capital of the Hashemite Kingdom of Jordan. His data were divided into two forms: wordlists and minimal pairs, with the former comprising 30 frequently used words and the latter comprising 36 minimal pairs, both contrasting in /tˤ/-/t/ and /sˤ/-/s/ in three different word positions: word-initial, word-medial, and word-final. Therefore, these target consonants, both emphatic and plain, were investigated in pre- and post-vocalic positions in different vowel environments, which included both monophthongs and diphthongs, viz. /æ, aː, ʊ, uː, ɪ, iː/ and /aɪ, aʊ/. The stimulus materials were produced by 28 native speakers of JA, unequally divided in terms of their gender, social class, and origin (for details, see Alzoubi, 2017, p. 68). Several acoustic cues were investigated, including VOT of voiceless stops, COG of stops and fricatives, and the vowel's first three formant frequencies[75] (F1-F3) only at ten percent of either the vowel onset for vowels to the right of the emphatic obstruent or the vowel offset for vowels to the left of the emphatic obstruent.

Overall, he found that emphasis had a statistically significant effect on VOT, COG of stops, F1, F2, and F3. That is, shorter VOT, lower stop COG, higher F1, lower F2, and higher F3 turned out to be reliable exponents of emphasis. Besides, the study indicated other statistically significant interactions between emphasis, on the one hand, and other linguistic and non-linguistic (social) factors, on the other hand. The emphasis by manner interaction indicated a statistically significant effect only on F3. While vowels in the vicinity of both emphatic stops and fricatives showed higher F3 as compared to those in plain environment, emphatic stops had a more salient effect on vowels, which showed a higher emphatic-plain contrast in terms of F3.

In addition, the emphasis by VQ interaction had a statistically significant effect on F2 and F3. The former was significantly lower in an emphatic environment than in a plain environment only in the context of /æ, aː, ɪ, iː, aɪ/. The latter, on the other hand, was significantly higher in an emphatic environment as compared to that in a plain environment across the different vowel contexts. At a greater level of detail, F2 lowering for emphaticized vowels was highest for /æ, aː/, followed by /ɪ, iː, aɪ/, respectively. F3 raising for emphaticized vowels was highest for /ʊ, uː/, followed by /aʊ, aɪ/, /æ, aː/, and /ɪ, iː/, respectively. However, the interaction between emphasis and VQ did not yield any statistically significant effect in terms of VOT, COG, or F1.

[75] Similar to the current study, formant frequencies were normalized against sex differences using Nearey I normalization algorithm (for details, see Chapter Three: Section 3.6).

Moreover, the emphasis by position of the target vowel interaction indicated a statistically significant effect in terms of COG of stops, F1, and F2. COG of emphatic stops at the end (coda) of the syllable , but not at the beginning of the syllable, was significantly lower than that of their plain counterparts. F1 was significantly higher for vowels to the left of the emphatic consonant, but not for vowels to the right of the emphatic consonant, as compared to that of plain vowels in the same environment. Conversely, F2 was significantly lower for vowels to the right of the emphatic consonant, but not to the left of the emphatic consonant, as compared to that of plain vowels in the same environment. Notwithstanding these significant differences, the interaction between emphasis and position of the target vowel did not yield any significant effects in terms of either COG of fricatives or F3.

As for the interaction between emphasis and social factors, the study indicated significant differences. The emphasis by gender interaction had a statistically significant effect in terms of VOT, F1, F2, and F3. Both males and females showed contrast in their VOTs between emphatic and plain environments. In other words, emphatic VOTs were shorter than their plain counterparts for both males and females, with males showing a higher emphatic-plain contrast in terms of VOT. Besides, while both males and females exhibited higher F1 in an emphatic environment as compared to that in a plain environment, males spearheaded females in showing a higher emphatic-plain contrast in terms of F1 raising. Similarly, both males and females maintained lower F2 in an emphatic environment as compared to that in a plain environment, yet males showed a higher emphatic-plain contrast in term of F2 lowering. Similar to F1, F3 was significantly higher for both males and females in an emphatic environment than in a plain environment, with males showing a greater emphatic-plain contrast in F3 raising. However, the interaction between emphasis and gender did not yield any significant findings in terms of COG.

Furthermore, the interaction between emphasis and social class[76] indicated a statistically significant effect in terms of F3. Both males and females from East and West Amman showed higher F3 in an emphatic environment as compared to that in a plain environment. Nevertheless, speakers from East Amman exhibited a higher emphatic-plain

[76] Alzoubi (2017, pp. 96-98) identified an effect trending towards significance (p= 0.081 > .05) in the interaction between emphasis and social class on COG of stops, where speakers from East Amman showed a higher emphatic-plain contrast than their peers from West Amman.

contrast than those from West Amman in terms of F3 raising. On the other hand, the interaction between emphasis and social class did not yield any statistically significant differences in terms of VOT, COG, F1, and F2.

Lastly, the interaction between emphasis and speaker's origin or "ORD", to use Alzoubi's acronym (2017, p. 99), indicated a statistically significant effect on VOT, COG of stops, F2, and F3. While all speakers from different origins maintained a shorter VOT for emphatic stops as compared to that of plain stops, emphatic VOT was shortest for speakers from rural Palestinian origin, followed by speakers from rural Jordanian urban Palestinian origins, respectively, as compared to plain VOT. Moreover, the COG of emphatic stops[77] was significantly lower for speakers from rural Jordanian origin, but not for those from either rural or urban Palestinian origins, as compared to that of plain stops. In terms of F2, all speakers, regardless of their origin, maintained F2 lowering for emphaticized vowels as compared to that for plain vowels. Yet, speakers from rural Palestinian origin maintained the highest amount of F2 lowering, followed by speakers from rural Jordanian and urban Palestinian origins. Similar to F2, while F3 was significantly higher in an emphatic environment than in a plain environment for all speakers irrespective of their origin, the degree of F3 raising was highest for speakers from rural Palestinian origin, followed by speakers from rural Jordanian and urban Palestinian origins, respectively.

Omari and Jaber (2019) analyzed the bearings of gender and social class on the production of emphasis in JA. Their corpus included a list of 12 monosyllabic CVC minimal pairs[78], contrasting in /tˤ/-/t/, /dˤ/-/d/, /sˤ/-/s/, and /ðˤ/-/ð/ in prevocalic position in three vowel contexts /aː, uː, iː/. Participants, divided equally to represent two distinct social classes (lower-middle class versus upper class) and two gender categories (male versus female), comprised 40 native speakers of JA, with ages ranging from 17 to 20 years. Each participant articulated each of the target words three times, resulting in a total of 72 tokens per speaker. Several temporal and spectral means were utilized, including vowel duration, VOT of

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[77] Alzoubi (2017, p. 101) argued that the difference between the COG of emphatic and plain stops for speakers from rural Palestinian origin was near to significance level ($p = .079 > 0.05$).

[78] Omari and Jaber's (2019) data inevitably included some nonsense words to complete the desired set of minimal pairs.

voiceless stops, post-release duration of voiced stops, friction duration, and the vowel's first three formant frequencies[79] (F1-F3) at the onset and midpoint of the vowel.

In conclusion, the analysis indicated that emphasis exerted a statistically significant influence on VOT, vowel duration, F1, F2, and F3. The VOT for /tˤ/ was notably shorter than that of /t/. Furthermore, emphaticized vowels exhibited substantially longer durations compared to their non-emphatic counterparts. Similarly, the F1 of emphaticized vowels was significantly higher than that of plain vowels, albeit solely at the onset of the vowel. More distinctively, the F2 of emphaticized vowels was substantially lower than that of plain vowels at both the onset and midpoint of the vowel. Likewise, the F3 of emphaticized vowels was considerably higher than that of plain vowels at both the onset and midpoint of the vowel. Notwithstanding these significant discrepancies, emphasis did not yield any statistically significant variations in terms of post-release duration and friction duration between emphatic and plain environments.

Moreover, the emphasis by gender interaction indicated a statistically significant effect on F1 and F2. While both males and females maintained a higher F1 in an emphatic environment as compared to that in a plain environment at both the onset and midpoint positions, males showed a greater emphatic-plain contrast in terms of F1 than females. F2 of emphaticized vowels was, as compared to that of plain vowels, also significantly lower for both males and females. Yet, males exhibited a greater emphatic-plain contrast in terms of F2 than females. However, the interaction between emphasis and gender did not yield any statistically significant differences in terms of VOT, post-release duration, friction duration, and F3 between emphatic and plain environmens.

Furthermore, the emphasis by social class interaction indicated a statistically significant effect on post-release duration, vowel duration, F1, and F2. For lower-middle class speakers, the post-release duration of /dˤ/ was notably shorter compared to that of /d/, whereas upper-class speakers exhibited an inverse pattern. This suggests a reversal in the trajectory of change. Similar to post-release duration, vowel duration of emphaticized vowels was, as compared to that of plain vowels, longer for lower-middle class speakers, unlike that

[79] Similar to the present study, Omari and Jaber (2019) utilized Nearey I normalization algorithm to minimize the potential effects of sex between males and females in distorting the interactions between emphasis and social factors.

of upper-class speakers, which was similar in both emphatic and plain environments. Although the interaction between emphasis and social class was statistically significant on F1 at both the onset and midpoint[80], F1 raising in an emphatic environment as compared to that in a plain environment was only significant for lower-middle-class speakers at the onset position. Unlike F1, F2 of emphaticized vowels was significantly lower than that of plain vowels for speakers from both socioeconomic groups. Yet, the proportion of F2 lowering was higher for lower-middle-class speakers than that of upper-class speakers. Nevertheless, the interaction between emphasis and social class did not yield any statistically significant variation in terms of VOT, friction duration, and F3 between emphatic and plain environments.

Finally, the emphasis by gender by social class interaction indicated a statistically significant effect on both F1 at the onset and midpoint and F2 at the midpoint. As for the former at the onset position, F1 of emphaticized vowels, as compared to that of plain vowels, was significantly higher for males as compared to that of females, which was insignificantly lowered rather than raised within the upper class. Unlike upper-class speakers, males and females in the lower-middle class showed comparable differences in terms of F1 between emphatic and plain environments. At the midpoint, upper-class speakers maintained a similar pattern of change. That is, while males showed a significantly higher F1 for emphaticized vowels compared to plain vowels, females did the opposite, with a significant lowering of F1. On the other hand, although both males and females exhibited contrasting behaviors in terms of F1, where males significantly maintained a higher F1 of emphaticized vowels, as compared to that of plain vowels, and where females showed an insignificant lowering of F1, gender differences between the two groups were statistically insignificant. Unlike F1, gender differences between males and females for upper-class speakers were statistically insignificant in terms of F2 lowering, given that both groups maintained significantly lower F2 of emphaticized vowels compared to that of plain vowels. Nevertheless, gender differences between males and females of the lower-middle class were significantly different in terms of F2 lowering, where males were at the forefront of F2 lowering. The findings

[80]At the onset, upper-class speakers insignificantly raised F1 in an emphatic environment as compared to that in a plain environment. At the midpoint, while lower-middle-class speakers showed insignificant F3 raising in an emphatic environment as compared to that in a plain environment, their upper-class peers showed lower F3 in an emphatic environment as compared to that in a plain environment at the midpoint.

suggest that gender differences are not uniform, displaying overlap with social class distinctions. Furthermore, the complexities of social meaning and identity contribute to shaping speech patterns. In essence, a comprehensive understanding of gender differences is largely contingent upon social class (Omari and Jaber, 2019).

In their subsequent study, Omari and Jaber (2020) scrutinized the effects of linguistic and social variables on the production of emphasis in UJA, a variety of Arabic spoken in Jordan. Their data consisted of 12 CVC minimal pairs, contrasting in /tˤ/-/t/, /dˤ/-/d/, /sˤ/-/s/, and /ðˤ/-/ð/ in prevocalic position in three vowel contexts /aː, uː, iː/. The target words were each embedded in a carrier sentence and were then randomized. The population sample comprised 40 native speakers of UJA, systematically stratified by gender and social class[81] (upper class versus lower-middle class). Each participant read the stimulus materials three times, resulting in a total of 72 tokens per speaker. The acoustic parameters that were measured included the vowel's first (F1), second (F2), and third (F3) formant frequencies[82] at the beginning and middle of the vowel. The study confirmed that emphasis is marked by a higher F1 only at the onset, lower F2, and higher F3 at both the onset and midpoint.

Other statistically significant interaction effects between emphasis and other factors were obtained. First, the emphasis by manner interaction indicated a statistically significant effect on F2 and F3. The former showed a significantly lower F2 value following an emphatic stop than following an emphatic fricative both at the onset and midpoint, whereas the latter showed a significantly higher F3 value following an emphatic stop than following an emphatic fricative only at the midpoint. However, the interaction between emphasis and manner did not yield any statistically significant effects, neither on F1 onset and midpoint nor on F3 onset. Second, the interaction between emphasis, manner, gender, and social class indicated a statistically significant effect on F1 onset. To clarify, while lower-middle class males, but not females, showed a higher F1 following an emphatic fricative than following an emphatic stop, their upper class peers showed the opposite (i.e., higher F1 following an emphatic stop than following an emphatic fricative).

[81] Omari and Jaber's (2020) classification of speakers into two social classes was informed by their area of residence, parental occupation, and school type.
[82] To avoid any potential effects arising from physiological differences between males and females, Omari and Jaber (2020) utilized Nearey I normalization algorithm.

Third, the emphasis by voicing (voiced versus voiceless) interaction indicated a statistically significant effect on F1 midpoint and F2 onset and midpoint. Although the interaction on the former was statistically significant, it was not in the direction of emphasis. In other words, emphaticized vowels showed lower F1 values than raised. F2, on the other hand, was consistently lower following a voiced emphatic consonant than following a voiceless emphatic consonant. What these findings would suggest is that social factors such as gender and social class did not affect the interactions between either emphasis and manner or emphasis and voicing, except for the interaction between emphasis, manner, gender, and social class on F1 onset. It was argued that this interaction was not influenced by any of the social variables but rather by the combined effect of gender and social class (Omari and Jaber, 2020). However, it could also be argued that speakers from different social groups would manifest emphasis differently, at least acoustically.

Almomany (2023a) examined the effects of gender on the production of emphasis in AJA, the variety under current investigation. His data consisted of a set of 48 mono- and bi-syllabic minimal pairs, with the target consonants, namely /tˤ, t, sˤ, s/, occurring word-initially and word-finally. The target consonants were analyzed in pre- and post-vocalic positions in six vowel contexts /æ, aː, ɪ, iː, ʊ, uː/, as produced by 12 native speakers of AJA (6 males and 6 females). Five acoustic means were investigated, including VOT, consonant duration, and the vowel's first three formant frequencies[83] (F1-F3) of both the target syllable (the syllable containing the emphatic consonant) and the adjacent syllable at the midpoint. In a nutshell, the researcher found that while neither consonant duration nor formant frequencies in the target and adjacent syllables were affected by the interaction between emphasis and gender, VOT was. That is, males' emphatic VOTs were significantly longer than those of females, probably suggesting that, as per the figure (Almomany, 2023a, p. 65), females produced a stronger emphatic-plain contrast in terms of VOT.

In a later investigation, Almomany (2023b) studied the effects of age on the production of emphasis in AJA. The researcher adhered to the same methodological framework delineated in his preceding study (Almomany, 2023a), with the sole modification pertaining to the participant distribution, which was stratified into three distinct age cohorts: 18-35, 36-

[83] Almomany (2023a) did not normalize vowel formants against any potential effects originating from physiological differences between males and females, which would have affected his conclusions.

50, and 51 and above. In summary, the analysis revealed that the interaction between emphasis and age was statistically significant effect on VOT. In other words, speakers of the second age cohort maintained the strongest emphatic-plain contrast in terms of VOT, followed by speakers of the third and first age cohorts, respectively. However, the interaction between emphasis and age did not yield any statistically significant differences in terms of either consonant duration or formant frequencies at the target and distant syllables between emphatic and plain environments.

In his continued research, Almomany (2024) tackled the effects of both age and gender on the production of emphasis in AJA. Employing a methodology closely aligned with his preceding study (see above, Almomany, 2023a), Almomany (2024) systematically allocated his sample population into two gender categories (6 males and 6 females) and three age cohorts (2: 18-35, 2: 36-50, 2: 51 and above). On the whole, the study indicated that emphasis had a main effect on VOT, on the one hand, and F1, F2, and F3 in the target syllable, on the other hand. Emphatic VOTs were substantially shorter as compared to plain VOTs. F1 and F3 of emphaticized vowels, compared to those of plain vowels, were significantly higher, whereas F2 of emphaticized vowels, compared to that of plain vowels, was significantly lower. Nevertheless, emphasis had no statistically significant effects on either consonant duration or formant frequencies in the adjacent syllable.

Moreover, the interaction between emphasis, age, and gender indicated a statistically significant effect on VOT. To clarify, while males and females across the different age groups maintained emphatic-plain contrast in terms of VOT, significant gender differences were only notable between males and females in the third age group (51 and above). In other words, females in the third age group showed a greater degree of VOT shortening than males between emphatic and plain environments. Although the differences in VOT between males and females from the first (M: 14.33 ms versus F: 15.12 ms) and second (M: 22.08 ms versus F: 23.04 ms) age groups were not substantial, Almomany (2024) identified them, indicating a consistent trend whereby women exhibited a greater magnitude of change towards emphasis. Nevertheless, it could be posited that this finding underscores the necessity of investigating the synergistic effects of age and gender, which would yield a more comprehensive and informative depiction of the underpinnings of the interaction effects between emphasis and gender, as well as emphasis and age. This finding partially aligns with

Holmes' (2013, pp. 177-178) sociolinguistic model, describing the correlation between speakers' age and their use of the vernacular. According to Holmes (2013), older speakers tend to use more vernacular forms again later in life, as reduced social pressure allows for more relaxed language use.

Chapter 3: Methodology

This chapter provides a detailed account of the methods and procedures that were followed in this dissertation. Section 3.1. reviews the variables of the present study; Section 3.2 provides details on the sample of the current study; Section 3.3 sheds light on the production stimuli of the current study; Section 3.4 presents information on the data collection procedures; Section 3.5. provides details on the segmentation and acoustic measurement procedures; Section 3.6. provides details on vowel formants normalization; Section 3.7. provides information on the statistical analysis that was utilized in the current study.

3.1. Variables of the Study

This subsection provides details on the variables of the present study. In Section 3.1.1, the researcher outlines the independent variables used in the current study. In Section 3.1.2, the researcher summarizes the dependent variables of the present study.

3.1.1. Independent Variables

The present study included eight independent variables of which five were linguistic and three were extra-linguistic. Section 3.1.1.1 provides details on the former, whereas Section 3.1.1.2 provides details on the latter.

3.1.1.1. Linguistic Variables

The present study included five linguistic variables, namely emphasis, manner, position of the trigger consonant, VQ, and VL, as outlined in Table 14 below.

Table 14. *Linguistic variables of the present study.*

Variable	Value
Emphasis	Emphatic vs. Plain
Manner of articulation	Stop vs. Fricative
PTC	Word-initial vs. Word-final
VQ	/i/-/a/-/u/-/o/-/e/
VL	Short vs. Long

The choice of this set of linguistic variables was far from being random. Linguistically speaking, since Arabic in general and AJA in specific as discussed in the introduction and literature review sections differentiate between emphatic vis-à-vis plain consonants, it was inevitably necessary to include emphasis as an independent linguistic variable. In addition, how a consonant is articulated seemed to play a very significant role in affecting the acoustics of neighboring speech sounds. For instance, the production of /tˤ/ entails a higher degree of tongue retraction than that of /sˤ/ (Ghazeli, 1977; Laufer and Baer, 1988). Moreover, PTC, though confined to monosyllables, was reported to be significant in researching emphasis in JA, as certain segments were found to obstruct emphasis spread (Davis, 1995). As for VQ and length, Ghazeli (1977), among others, argued that the tongue gets retracted in correlation with the vowel environment in which the emphatic segment occurs.

With all that being said, the researcher argues that the choice of these variables was thus to (1) increase the amount of the data and (2) make more solid generalizations based on a comprehensive linguistic environment. Needless to say, the exclusion of any of the variables would result in a less cohesive linguistic environment, and hence fewer insights into the phenomenon of emphasis in AJA.

3.1.1.2. Extra-linguistic Variables

The current study incorporated three extra-linguistic variables[84], namely age, gender, and parental education, as represented in Table 15 below.

Table 15. *Extra-linguistic variables of the current study.*

Variable	Value
Gender	Male vs. Female
Age	Child vs. Adolescent
Parental education	Tertiary vs. Below tertiary

As discussed earlier in the literature review, very few studies (Almomany, 2023b; Almomany, 2024) accounted for the effects of age as a social variable on emphasis production in Arabic in general and in JA in specific. More importantly, the researcher believes that shifting the focus from examining emphasis in adults' speech to examining emphasis at an earlier stage (children vs. adolescents) would yield robust findings, which would probably unravel new underpinnings of emphasis. This intuition was based on the fact that acquisition studies of emphasis disputed the age at which children acquire the four primary emphatics. For instance, while Amayreh and Dyson (1998) found that none of the

[84]An earlier version of this dissertation, in its naïve form, the proposal, included intermarriage effects as a social variable but was later excluded as per the recommendation of one of the examiners of the examination committee. Therefore, all of the participants descended from families where both parents share the same and only dialect, namely AJA.

primary emphatic sounds was acquired by the age of 6;4 (years; months), Mashaqba et al. (2022) argued that children between 4;0 and 4;11 acquired the three primary emphatic sounds, namely /tˤ/, /dˤ/, and /sˤ/.

Gender was also reported to influence phonetic variation (Labov, 2001), where women were found to adopt more of the standard variants than men. However, the more/less use of the standard in the Arab World did not yield similar findings to those in Western societies rather it was the use of the socially prestigious variants (Ibrahim, 1986). To this end, the present study sought to investigate the possible effects of gender on emphasis production in AJA.

As for parental education (i.e., the educational background of the participant's parents), it was reported that the way a person speaks tells more about his educational background (Labov, 1966; Holmes, 2013). For this, the present study tackled the plausible effects of education on emphasis production in AJA.

3.1.2. Dependent Variables

The dependent variables of the present study included seven acoustic cues, as outlined in Table 16 below.

Table 16. *Acoustic cues of the current study.*

Item Number	Acoustic Cue
1.	Friction duration (FD)
2.	Stop closure (SC)
3.	Voice Onset Time (VOT)
4.	Vowel duration (VD)
5.	First formant frequency (F1)
6.	Second formant frequency (F2)
7.	Third formant frequency (F3)

The present study investigated these acoustic cues in a quest both to include as many cues as possible and to verify whether these cues are reliable/unreliable in detecting emphasis, as was reported in the related literature. However, no study, to the best of my knowledge, tackled SC in JA or its varieties.

3.2. Sample of the Study

The sample of the present study consisted of 40 native AJA-speaking children (2^3= 8)= (40 > 8*4= 32) enrolled in public schools in the villages of Ajloun City. All of the children were between 8 and 11 years old, and all of the adolescents were between 13 and 17 years old. The determining factor between a child and an adolescent is puberty, which was verified as reported by the school teacher and by the participant's parent. The choice for these age ranges was far from being random but was rather done for a purpose. That is, children whose age is less than 8 were hard to deal with for a couple of reasons. First, the reading-list task was not suitable for them as they were at a early stage, and thus flash cards would not suffice since there were some nonwords. Second, it was inevitable to control the noise of these children, which would have ruined the PRAAT analysis. Third, it was a great obstacle for the author to get official permission to interview children at such an early stage.

The sample was equally distributed to satisfy the variables (i.e. age, gender, and education) of the current study, as simplified in Table 17 below.

Table 17. *Distribution of the sample of the present study.*

Age	No.	Gender	No.	Parental education	No.
Children	20	Male	10	Tertiary	5
				Below Tertiary	5
		Female	10	Tertiary	5
				Below Tertiary	5
Adolescents	20	Male	10	Tertiary	5
				Below Tertiary	5
		Female	10	Tertiary	5
				Below tertiary	5
Total	40		40		40

The participants of the current study were meticulously selected, as the selection process was set according to strict criteria to control for other sociolinguistic effects. All of the participants and their parents had to be native speakers of AJA, who never lived at any settlements outside the territory of Ajloun City prior to the study. Potential bidialectal participants (i.e., participants whose parents come from different origins and/or speak different dialects) were excluded by examining the family names of the participants' parents, which clearly indicate the origin, and hence the dialect, of the speaker. For instance, family names such as Al-Momani, Al-Zghoul, Al-Qudah, et cetera, denote that the speaker is originally from Ajloun unless specified otherwise. In addition, none of the participants suffered from any speech/hearing impairment as reported by their school teachers and verified by their parents. Furthermore, all of the participants had to be excellent in the Arabic Language subject to ensure their proper reading.

3.3. Stimulus Materials

Since the present study seeks to explore the acoustic correlates of emphasis in the /tˤ/-/t/, /sˤ/-/s/, and /ðˤ/-/ð/ contrasts, each of these segments was investigated word-initially and word-finally in monosyllabic minimal pairs, which inevitably included a total of 32 nonwords. Moreover, each of these sounds was investigated in the vicinity of the low short and long vowels /æ/-/aː/, mid-high back short /ʊ/, high back long /uː/, mid-high front short /ɪ/, high front long /iː/, mid back long /oː/, and mid front long /eː/, as displayed in Tables 18-20 below.

Table 18. *Stimulus materials for /tˤ/ and /t/ in different word positions and vowel environments. A shaded cell denotes a non-word.*

Vowel	Word-Initial				Word-Final			
	Emphatic	Gloss	Plain	Gloss	Emphatic	Gloss	Plain	Gloss
aː	tˤaːb	recovered	taːb	repented	baːtˤ		baːt	stayed
æ	tˤæl	looked	tæl	hill	fætˤ	moved abruptly	fæt	fragment
uː	tˤuːb	bricks	tuːb	repent!	fuːtˤ		fuːt	enter!
ʊ	tˤʊb	fell	tʊb	top	fʊtˤ	move quickly!	fʊt	fragment!
iː	tˤiːn	mud	tiːn	figs	biːtˤ		biːt	
ɪ	tˤɪf		tɪf		zɪtˤ		zɪt	Throw!
oː	tˤoːr	limit	toːr		ʃoːtˤ	round	ʃoːt	kicking
eː	tˤeːf	shadow	teːf		heːtˤ	wall	heːt	

Table 19. *Stimulus materials for /sˤ/ and /s/ in different word positions and vowel environments. A shaded cell denotes a non-word.*

Vowel	Word-Initial				Word-Final			
	Emphatic	Gloss	Plain	Gloss	Emphatic	Gloss	Plain	Gloss
aː	sˤaːb	touched	saːb	dissipated	baːsˤ	bus	baːs	kissed
æ	sˤæb	poured	sæb	insulted	bæsˤ		bæs	enough!
uː	sˤuːf	wool	suːf	a village's name	buːsˤ		buːs	kiss!
ʊ	sˤʊb	pour!	sʊb	insult!	hʊsˤ	shhh!	hʊs	
iː	sˤiːb	touch!	siːb		niːsˤ	hystrix	niːs	
ɪ	sˤɪd	hold off!	sɪd	close!	bɪsˤ		bɪs	cat
oː	sˤoːt	sound	soːt		boːsˤ		boːs	kissing
eː	sˤeːf	summer	sˤeːf	sword	teːsˤ		teːs	ram

Table 20. *Stimulus materials for /ðˤ/ and /ð/ in different word positions and vowel environments. A shaded cell denotes a non-word*[85].

Vowel	Word-Initial				Word-Final			
	Emphatic	Gloss	Plain	Gloss	Emphatic	Gloss	Plain	Gloss
aː	ðˤaːb		ðaːb	melted	faːðˤ	overflowed	faːð	
æ	ðˤæl	dissipated	ðæl	humiliated	ʤæðˤ	complained	ʤæð	
uː	ðˤuːg	taste!	ðuːg		tuːðˤ		tuːð	
ʊ	ðˤʊb	pack!	ðʊb		xʊðˤ	take!	xʊð	
iː	ðˤiːm	conquer!	ðiːm		biːðˤ	lay eggs!	biːð	
ɪ	ðˤɪl	shadow	ðɪl	humiliate!	ʤɪðˤ	complain!	ʤɪð	
oː	ðˤoːg	the act of tasting	ðoːg		ħoːðˤ	garden-bed	ħoːð	
eː	ðˤeːf	guest	ðeːf		beːðˤ	eggs	beːð	

To control for any potential context effects, each target word was incubated in the carrier sentence *ɪħki ___ kamaːn marrah* [Say ___ once more]. The production stimuli were then sorted into three lists: the /tˤ/-/t/, /sˤ/-/s/, and /ðˤ/-/ð/ lists in the Arabic language orthography, with diacritics added where necessary. The lists were therefore randomized to

[85] The real words [ðˤuːg] (taste!), [ðˤoːg] (the act of tasting), and [xʊðˤ] (take!) are in free variation with their plain counterparts, namely [ðuːg] (taste!), [ðoːg] (the act of tasting), and [xʊð] (take!).

distract the participants' attention from the goal of the study and to encourage their spontaneous production (see Appendix A). A total of 48 minimal pairs were put into the lists, yielding a sum of 96 (48*2= 96) tokens per speaker.

The exclusive choice of these three emphatic sounds is not arbitrary but rather due to the precise, yet limited, dialectal scope of the current study (i.e., AJA). In this variety, the voiced emphatic stop /dˤ/ merges with the voiced emphatic fricative /ðˤ/, and since this study is intended to investigate the phonetic variation of emphasis in AJA, it is probably better to study sounds that are shared among speakers of the whole population sample.

3.4. Data Collection

After obtaining an authorization letter from Ajloun Directorate of Education (see Appendix B), the data collection took place in either the school library or the computer laboratory, which are both considered the calmest and most noise-free facilities in the school. First, each participant was given a consent letter in the Arabic language[86] (see Appendix C) to be signed by either of their parents prior to the recording session. Next, each participant was invited to one of the designated places[87], where he/she was seated in a comfortable place and entertained by a friendly discussion with the author and his wife[88] using AJA before the recording. The participant was then verbally instructed on the dos and don'ts[89] to maintain a good quality recording, and was given lists A, B, and C, respectively (see Appendix A). For consistency, only the second repetition was acoustically analyzed, given that it was the most appropriately produced token as inferred by the author. The total sum of tokens that were acoustically analyzed was 3840.

All of the recordings were elicited using a REMAX RP1 digital recorder that was equipped with noise reduction quality. Following that, the recordings were stored on a Lenovo Corei5- 1135G7 laptop labelled according to the distribution of the sample distribution (see Section 3.2.).

[86] The consent letter was written in Arabic to ensure that all of the participants' parents fully understand the content of the letter and also to avoid any inconveniences since half of the participants' parents had below tertiary education.
[87] The choice of either of the facilities was decided depending on availability by the school's principal.
[88] The presence of the author's wife in the data collection sessions only for female participants was to reduce the socio-cultural sensitivity borne towards the author, which would otherwise result in the rejection of voluntary participation.
[89] The do's and don'ts included instructions related to the procedure such as that he/she had to repeat each token thrice in a normal tone and pace, and also related to any unexpected background noise.

3.5. Segmentation and Acoustic Measurements

All of the segmentation and acoustic measurements[90] were executed using PRAAT 6.4 (Boersma and Weenink, 2023). Following Alarifi (2010) and Omari and Jaber (2019), the maximum formant frequency was set to 5000 Hz for males and 5500 Hz for females. The segmentation process was, for the most part, informed by Abudalbuh (2011) and Jongman et al. (2011).

All of the target emphatic segments, along with their plain counterparts, were segmented relying on both spectrograms and waveforms. For stops, SC in word-initial position was determined as the interval between the falling of F2 of the preceding vowel and the release burst for the VOT on the waveform. As for SC in word-final position, this was decided as the interval between the falling of F2 of the preceding vowel and the release burst. VOT was measured as the time interval between the release of the stop and the onset of voicing of the following vowel, marked by a spike on the spectrogram and waveform, as shown in Figure 4 below.

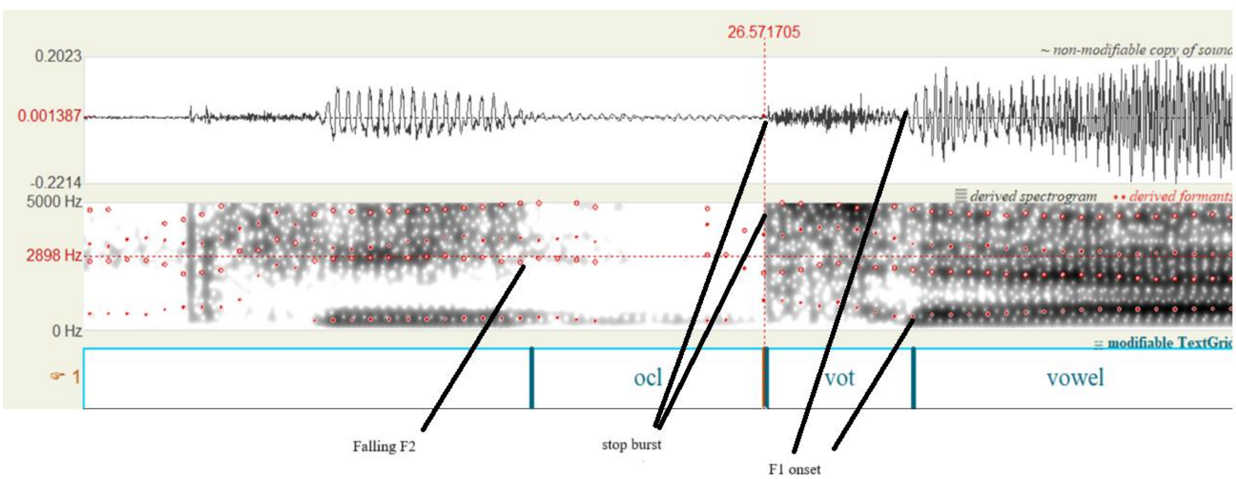


Figure 4. Illustrative example on the segmentation procedure for SC and VOT for the word [ta:b].

For fricatives, the FD for the sibilants /sˤ/ and /s/ were measured through the high-frequency energy bands, which were visible in the spectrogram, as shown in Figure 5 below.

[90] To ensure the maximum reliability of the data, a sample of the segmentation and acoustic measurement procedures was voluntarily peer-reviewed by Dr. Mujdey Abudalbuh, a Phonetics and Phonology associate professor at Yarmouk University, Jordan.

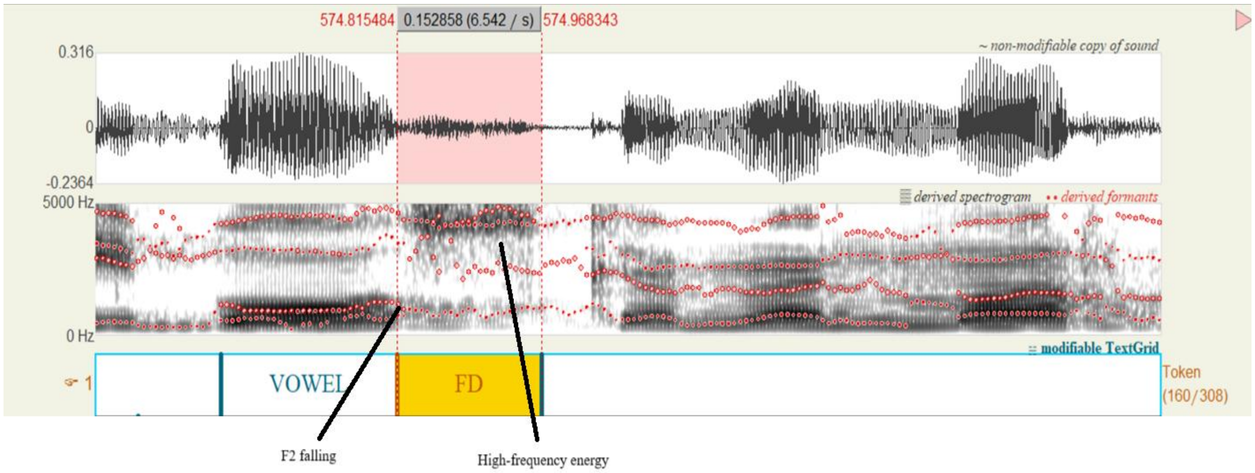


Figure 5. Illustrative example on the segmentation procedure for FD of /sˤ/ in the nonword [bo:sˤ].

As for FD of the voiced interdental emphatic fricative /ðˤ/ and its plain counterpart /ð/, it was measured as the time interval between the falling of F2 of the preceding vowel and the F1 onset of the following target vowel. FD of /ðˤ/ and /ð/ in word-final position was measured as the time interval between the falling F2 of the preceding target vowel and the loss of the aperiodic signal and/or high-frequency energy visible in the spectrogram, as shown in Figures 6 and 7 below.

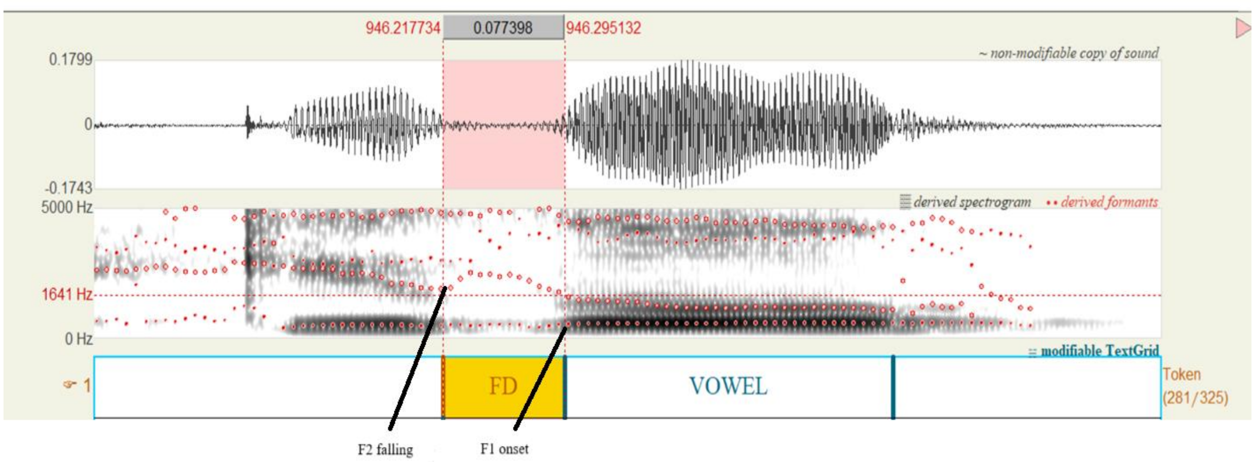


Figure 6. Illustrative example on the segmentation procedure for FD of /ðˤ/ in the word [ðˤo:g].

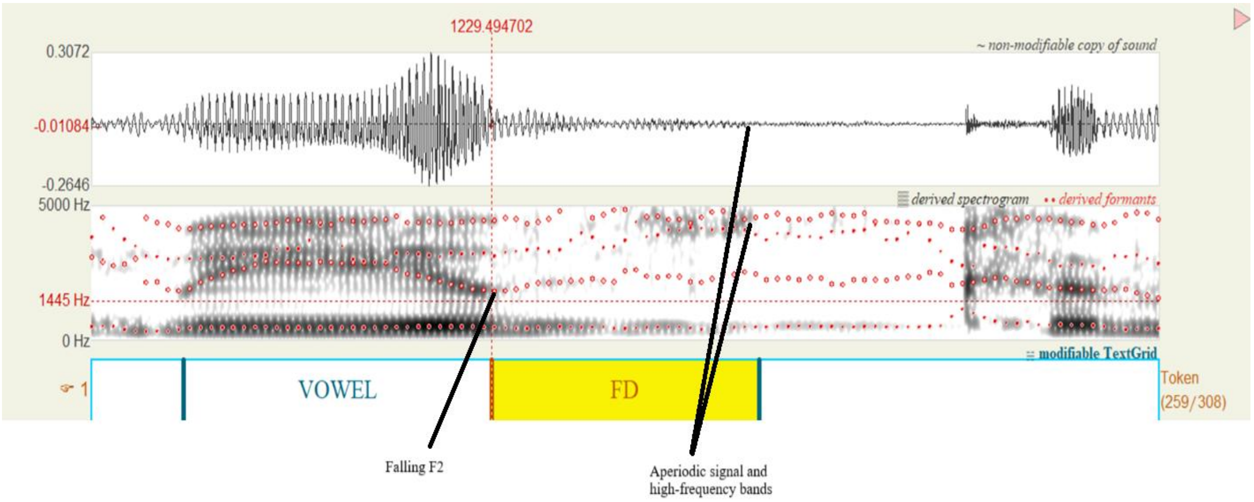


Figure 7. Illustrative example on the segmentation procedure for FD of /ðˤ/ in the word [biːðˤ].

Vowel duration, on the other hand, was determined as the time interval between F1 onset and F2 falling, as shown in Figure 8 below.

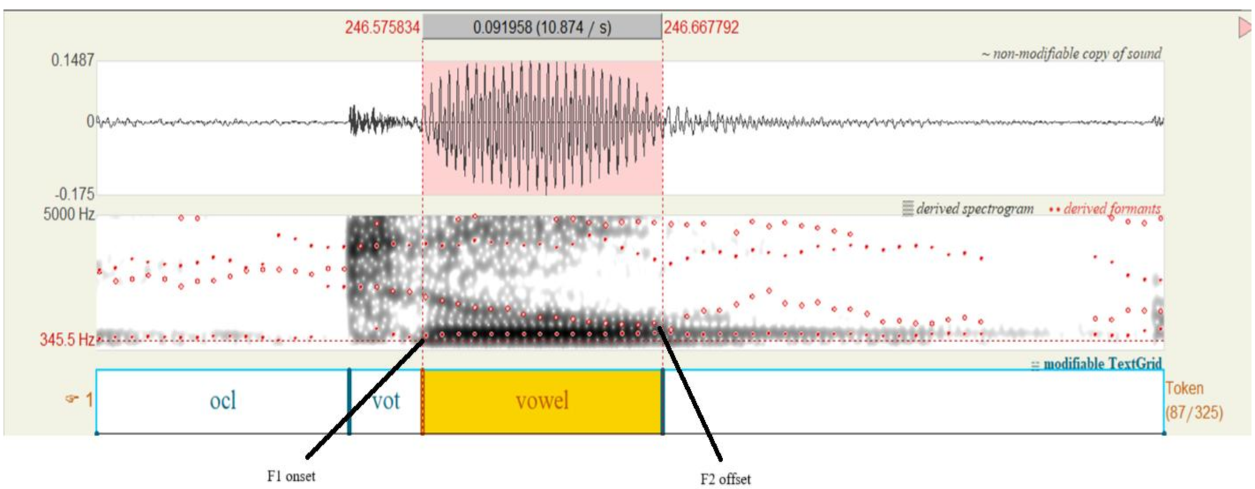


Figure 8. Illustrative example on the segmentation procedure for VD in the word [tʊb].

Following this, a modified version[91] of a developed PRAAT script (Herrero de Haro, 2020) was utilized to measure the temporal cues as well as the formant frequencies at the beginning, middle, and end of the vowel.

[91] The initial version of this PRAAT script did not include the measurement point at the midpoint of the vowel, that is why it was slightly modified.

3.6. Vowel Formants Normalization

One of the main observations of this study is to identify the potential differences in emphasis production between males and females, on the one hand, and between children and adolescents, on the other hand. It is well attested in the literature that there are anatomical differences between males and females at least in the vocal tract size, being larger for males than for females (Holmes, 2013), which would affect the relative formant frequencies (Abudalbuh, 2010). Besides, age also seems to play a vital role in shaping these differences, as the formant frequency differences among children inversely correlate with age. That is, the older the child is, the lower their formant frequencies become. In addition, inter-speaker variation decreases as the speaker becomes maturer (Vorperian and Kent, 2007). Following this, it becomes inevitably important to normalize the raw vowel formant data so that proper comparability between different gender and age groups can be achieved.

Adank, Smits, and Van Hout (2004) evaluating the efficiency of 11 normalization methods against: (i) how successfully the transformed vowel data reflected original phonemic variation, (ii) how effectively anatomical and physiological differences were reduced, and (iii) how effectively sociolinguistic (including regional) differences were maintained. The researchers found that only Nearey I, Lobanov, and Gertsman methods fit their evaluation criteria. Following this, the author used Nearey (1977) formant-intrinsic formula:

(1) F*n[V] = anti-log(log(Fn[V]) – mean(log(Fn))

To do so, the author utilized Thomas and Kendall's (2007) free web service The Vowel Normalization and Plotting Suite (NORM), in which this formula is labelled as Nearey I[92]. The normalized vowel formants were kept as is in non-Hertz values following Thomas and Kendall's (2007) recommendation.

3.7. Statistical Analysis

The statistical analysis[93] was performed using IBM SPSS statistics version 27. Several statistical tests were utilized by the author, including One-Way, Two-Way, Three-Way, Four-Way, Five-Way, and Multiple-Way Analyses of Variance (ANOVA). This was done so to

[92] One of the main motivations for using Nearey's (1977) formant-intrinsic formula is that it allows for the inclusion of F3.

[93] To ensure the reliability and compatibility of the statistical analysis, it was peer-reviewed by a statistics professional.

measure: (i) the main effect of emphasis, (ii) the interaction effects between emphasis and each of the other independent variables, and (iii) the other interaction effects in any possible combination as far as emphasis is included.

Chapter 4: Findings

This section presents the findings of the acoustic experiments. This section is divided into two main subsections according to the dependent variables. Section 4.1. presents the findings on the temporal cues, viz. FD, SC, VOT, and VD. Section 4.2. presents the findings on the spectral cues, namely the vowel's F1, F2, and F3 at the three measurement points: onset, midpoint, and offset of the vowel. It is worth mentioning here that interactions of the main effect of each independent variable will be reported throughout this section, but not further discussed or commented on later in the discussion section unless emphasis is involved.

4.1. Temporal Cues

This section introduces the findings of the acoustic measurements of the emphatic vis-à-vis plain sounds. These findings include FD of the two sibilants /s/ and /sˤ/ and the two non-sibilant fricatives /ðˤ/ and /ð/, SC and VOT of the voiceless stops /tˤ/ and /t/, and VD of all the target vowels. One-Way, Two-Way, and Three-Way Analyses of Variances (ANOVAs) were utilized to assess both the main effect of each independent variable and the possible interaction effects between these independent variables on the temporal data. It is worth mentioning that the data will be presented according to the dependent variables.

4.1.1. Friction Duration (FD)

A One-Way ANOVA showed that there was no significant main effect of emphasis on FD [$F(1.2558)= .311$, $p= .577$]. A One-Way ANOVA also showed that there was no main effect of gender on FD [$F(1.2558) = 1.786$, $p= .182$]. On the other hand, a One-Way ANOVA indicated that there was a significant main effect of age on FD [$F(1.2558)=44.563$, $p= .000$], where the mean value of FD was higher for children (114.33 ms) as compared to that of their adolescent peers (104 ms), as shown in Figure 9 below.

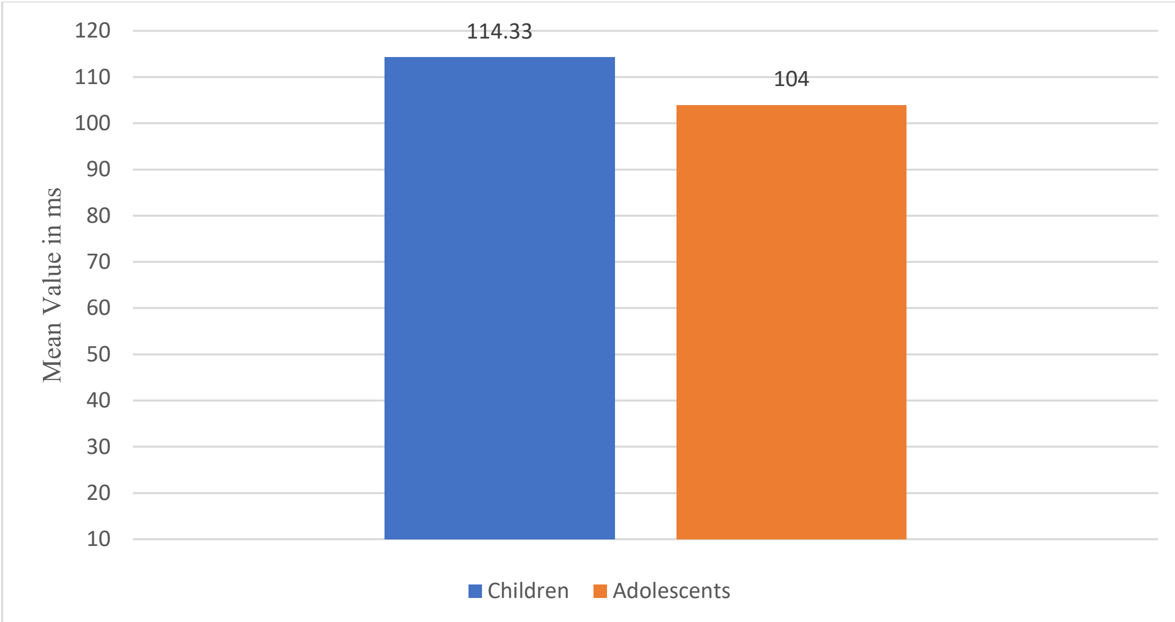


Figure 9. Mean values of FD for children and adolescents.

Similarly, a One-Way ANOVA indicated that there was a significant main effect of parental education on FD [F(1.2558)=9.859, p= .002], where participants whose parents had received tertiary education showed a higher mean value of FD (111.61 ms) than those whose parents had received below-tertiary education (106.72 ms), as shown in Figure 10 below.

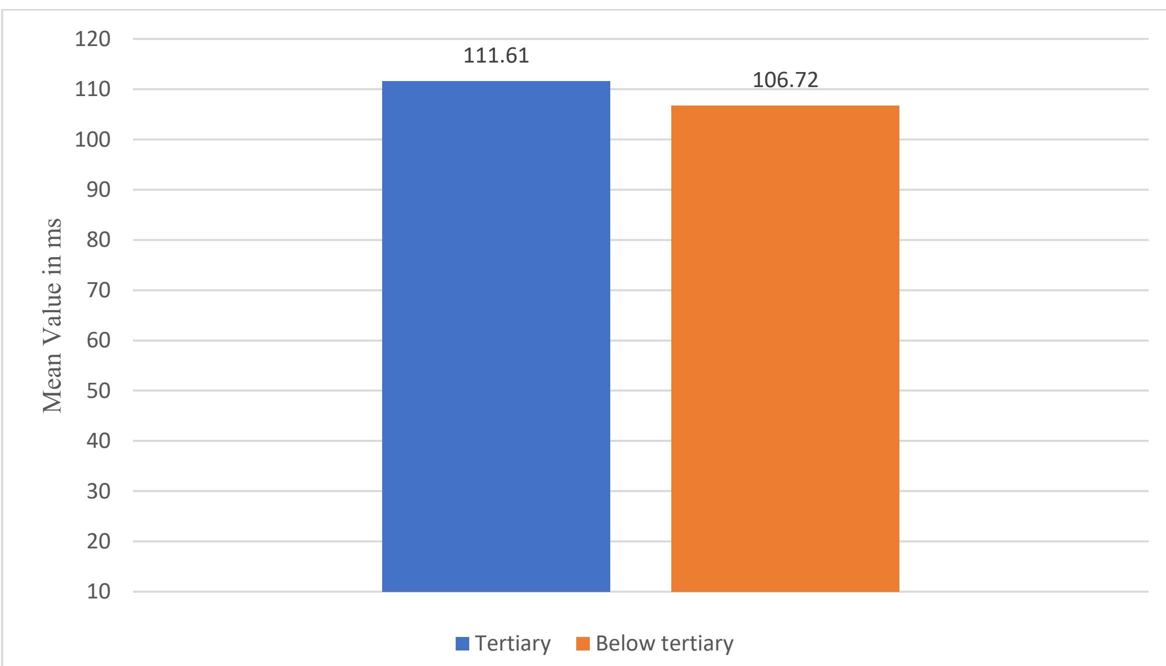


Figure 10. Mean values of FD for participants from different educational backgrounds.

In addition[94], a One-Way ANOVA indicated that there was a significant main effect of PTC on FD (F= 91.655, p= .000), where word-final fricatives showed a higher mean value of FD (116.51 ms) than word-initial fricatives (101.83 ms), as shown in Figure 11 below.

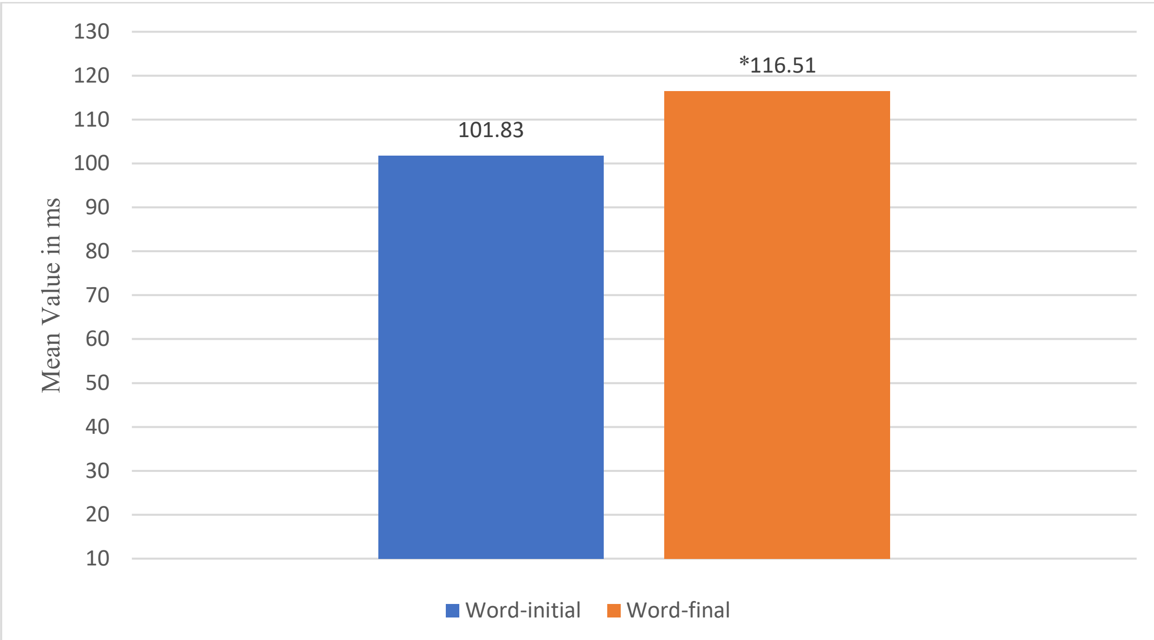


Figure 11. Mean values of FD for word-initial and word-final fricatives.

Likewise, a One-Way ANOVA indicated that there was a significant main effect of VQ on FD [F(4.2555)= 10.416, p= .000]. A Bonferroni post hoc analysis revealed that FD was significantly longer in the /i/ environment than in those of /a/, /e/, and /o/. Likewise, the FD in the /u/ environment was significantly longer than in those of /e/ and /o/. However, there was no significant difference in terms of FD between /i/ and /u/, /a/ and /u/, or /o/ and /e/ environments. Figure 12 below displays these differences.

[94] Findings related to the main effect of Manner was supposed to be displayed here, but these were unmeasurable due to the fact that Manner has only one variant, fricative.

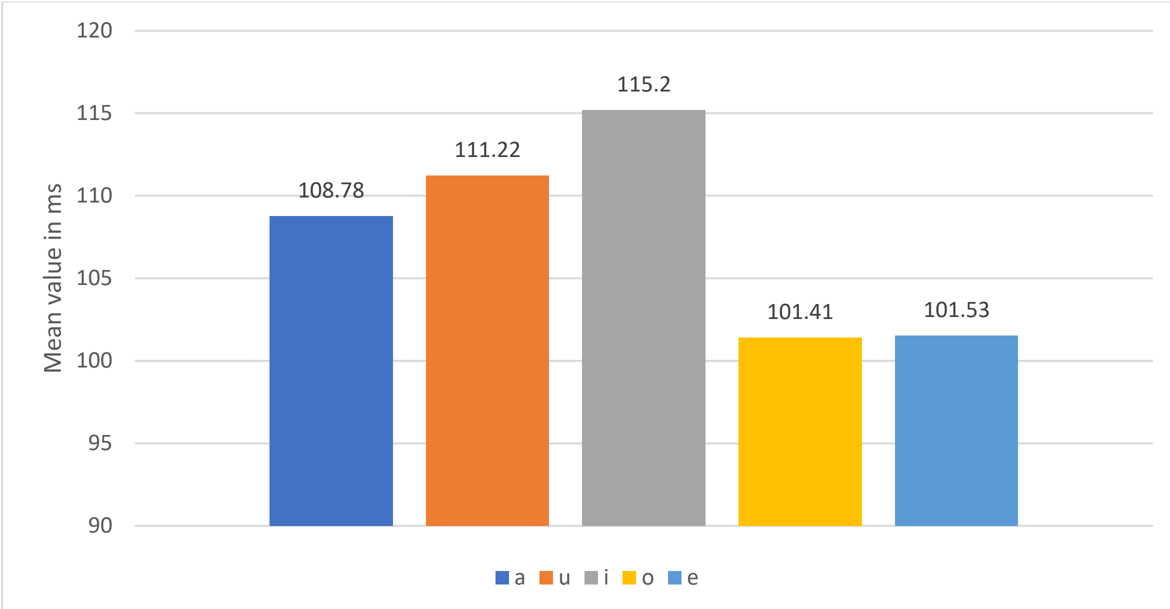


Figure 12. Mean values of FD in different vowel environments.

A One-Way ANOVA indicated that there was a significant main effect of VL on FD [F(1.2558)= 100.649, p= .000], where FD was longer in the environment of a short vowel (119.08 ms) than in that of a long vowel (103.22 ms), as shown in Figure 13 below.

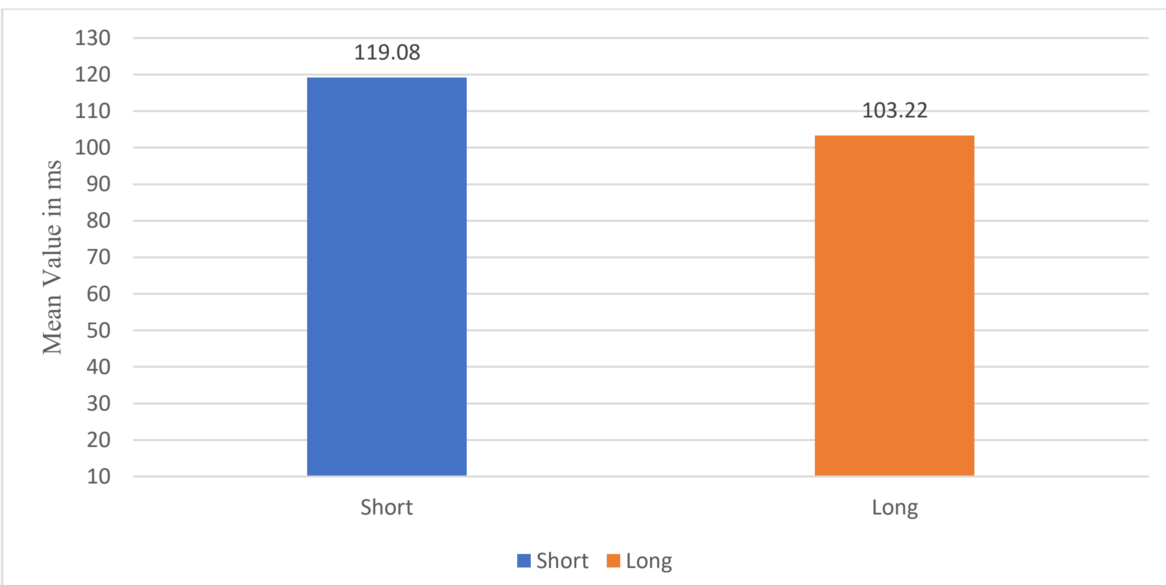


Figure 13. Mean values of FD for long and short vowels.

As for the other interactions between emphasis, on the one hand, and the other independent variable on FD, on the other hand, there were no statistically significant interactions in any combination.

4.1.2. Stop Closure (SC)

A One-Way ANOVA indicated that there was a significant main effect of emphasis on SC [F(1.1278)= 34.673, p= .000], where emphatic sounds showed a longer mean value of SC (88.32 ms) than that of plain sounds (78.90 ms), as shown in Figure 14 below.

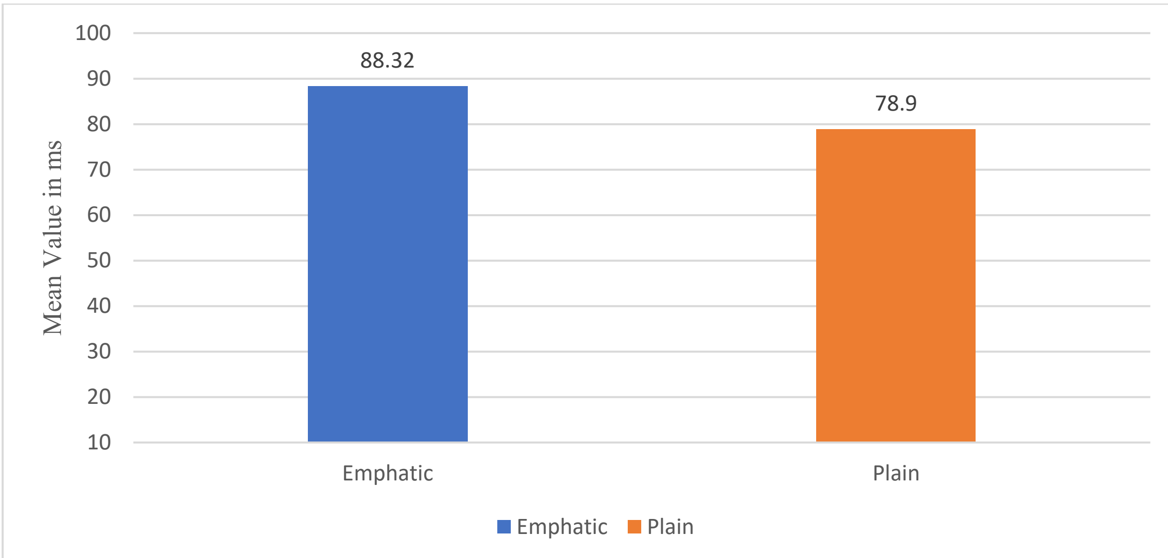


Figure 14. Mean values of SC for emphatic and plain consonants.

Likewise, a One-Way ANOVA indicated that there was a significant main effect of gender on SC [F(1.1278)= 5.642, p= .018], where females (85.53 ms) produced slightly longer intervals of SC than males (81.69 ms), as shown in Figure 15 below.

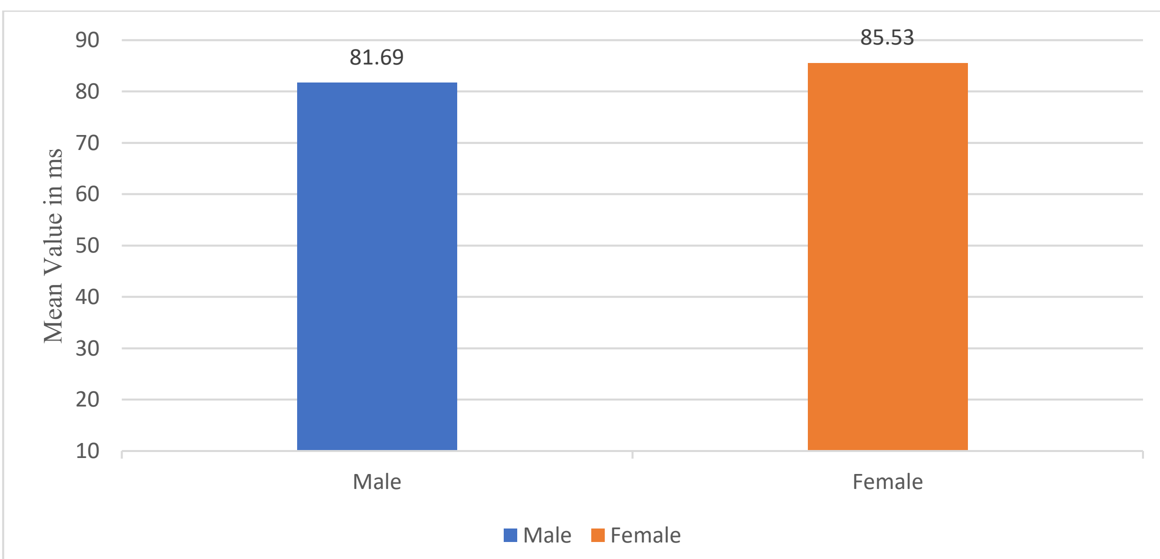


Figure 15. Mean values of SC for males and females.

A One-Way ANOVA also showed that there was a significant main effect of age on SC [F(1.1278)= 56.232, p= .000], where children maintained a higher mean value of SC (89.56 ms) than that of their adolescent equals (77.66 ms), as shown in Figure 16 below.

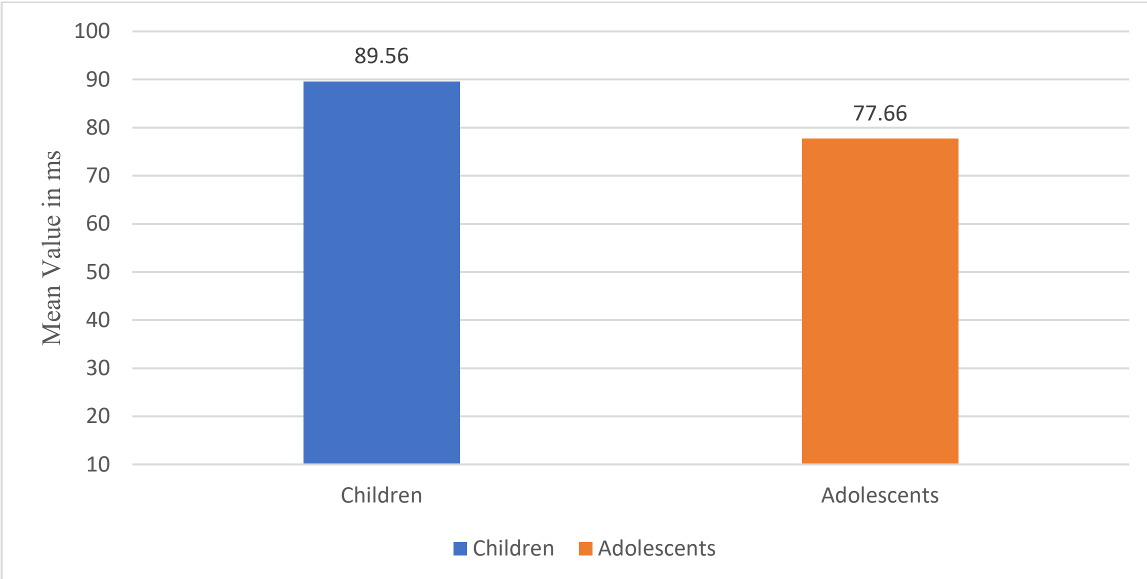


Figure 16. Mean values of SC for children and adolescents.

Conversely, a One-Way ANOVA showed that there was no significant main effect of either parental education [F(1.1278)= 2.179, p= .140] or PTC[95] on SC [F(1.1278)= .297, p= .586].

A One-Way ANOVA indicated that there was a significant main effect of VQ on SC [F(4.1275)= 8.573, p= .000]. A Bonferroni post hoc analysis indicated that SC was significantly longer in the /a/ environment than in the /o/ and /e/ environments. In addition, SC in the /u/ environment was significantly longer than in the /o/ and /e/ environments. Similarly, SC in the /i/ environment was significantly longer than in the /o/ and /e/ environments. However, there was no significant difference in terms of SC between /a/ and /u/, /i/ and /u/, or /o/ and /e/ environments, as shown in Figure 17 below.

[95] Findings related to the main effect of manner was supposed to be displayed here, but these were unmeasurable due to the fact that manner has only one variant, stop.

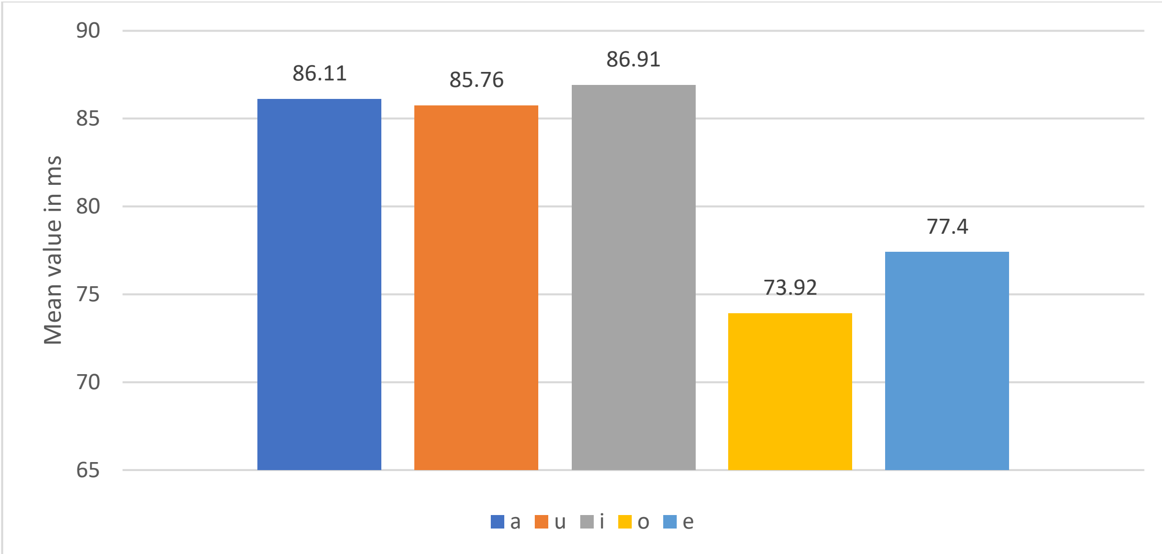


Figure 17. Mean values of SC in different vowel environments.

A One-Way ANOVA also indicated a significant main effect of VL on SC [F(1.1278)= 117.068, p= .000], where SC mean value in the environment of a short vowel was significantly higher (94.44 ms) than in that of a long vowel (77.11 ms), as shown in Figure 18 below.

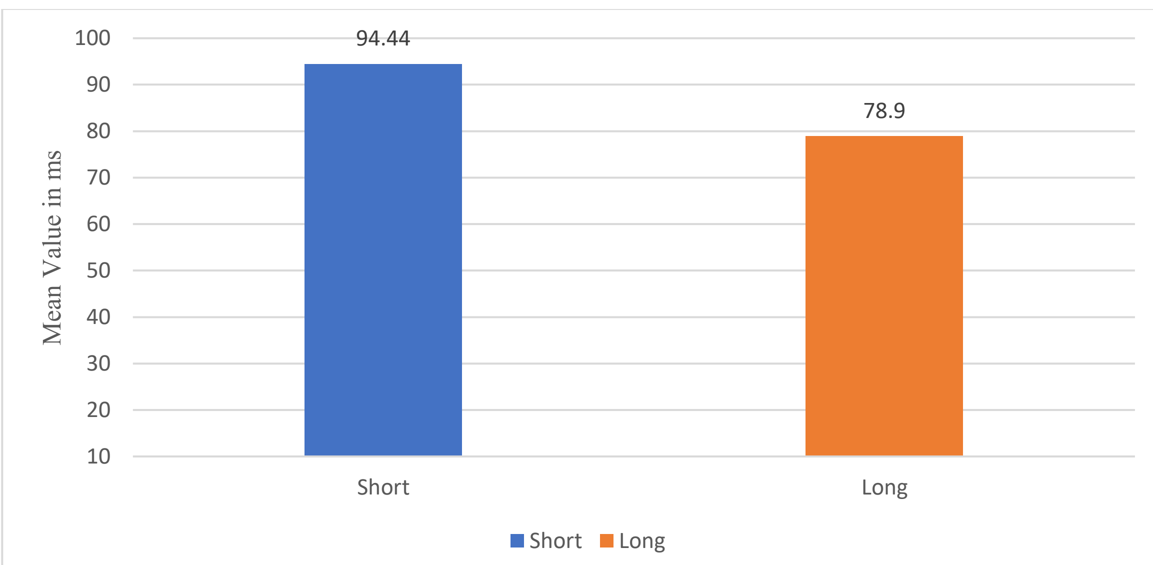


Figure 18. Mean values of SC in the environments of short and long vowels.

In addition, a Three-Way ANOVA indicated that there was a significant interaction in the combination of emphasis*VQ*VL on SC [F(2.1264)= 3.328, p= .036], where the emphatic-plain contrast was highest in the environment of /ʊ/ and lowest in that of /ɪ/, as shown in Figure 19 below.

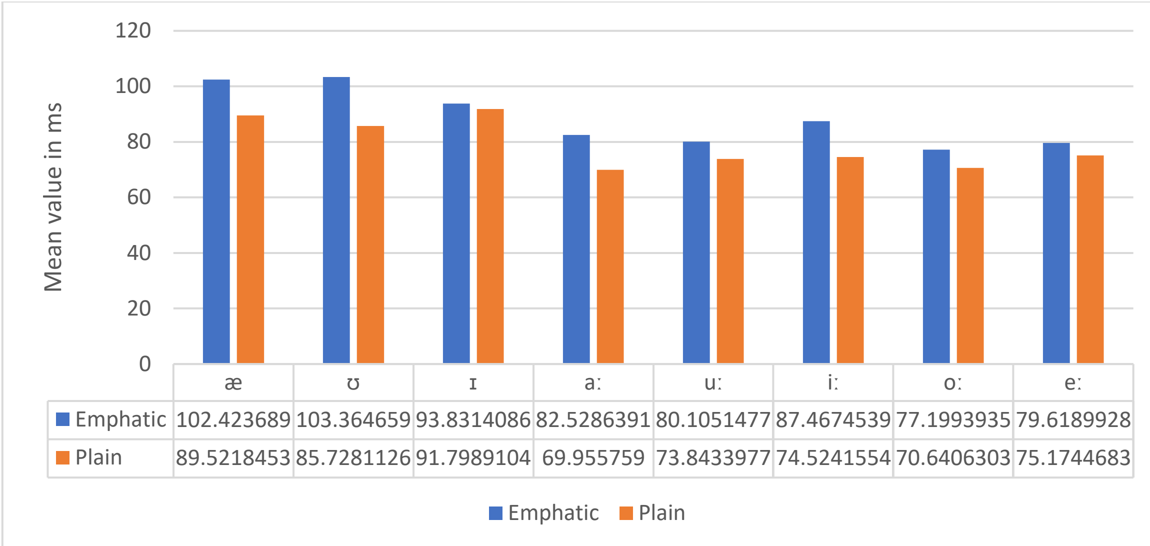


Figure 19. Mean values of emphatic and plain SCs in the environment of different vowels.

4.1.3. Voice Onset Time (VOT)

A One-Way ANOVA indicated that there was a significant main effect of emphasis on VOT [F(1.638)= 835.811, p= .000], where emphatic VOTs (16.73 ms) were significantly shorter than plain VOTs (44.60 ms), as shown in Figure 20 below.

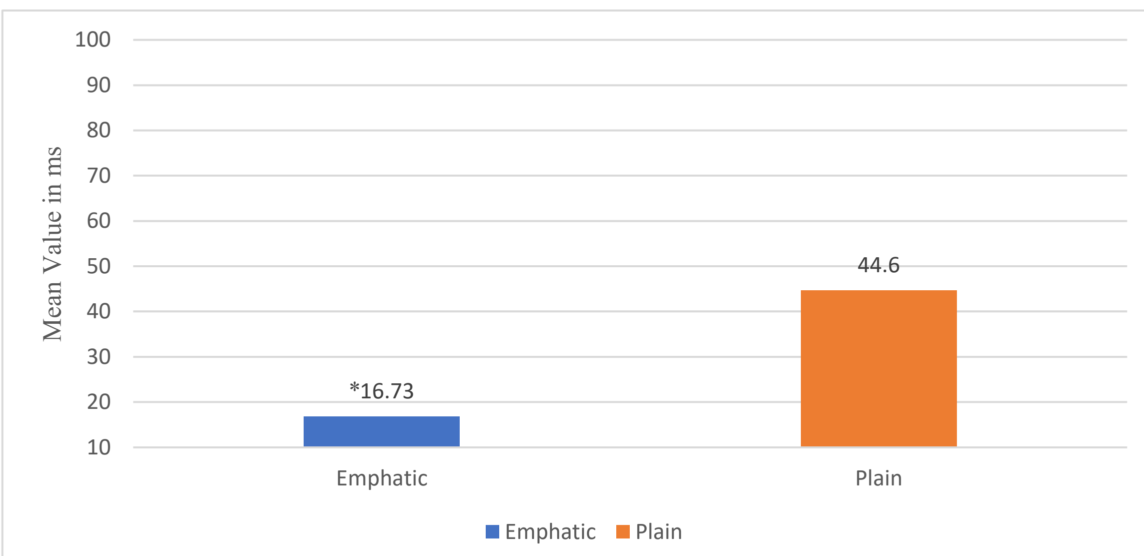


Figure 20. Mean values of emphatic and plain VOTs.

However, a One-Way ANOVA[96] showed that there was no significant main effect of gender [F(1.638)= 3.010, p= .083], age [F(1.638)= .238, p= .626], parental education [F(1.638)= 1.511, p= .219], or VQ [F(4.635)= .977, p= .977] on VOT. There was, on the other hand, a significant main effect of VL on VOT [F(1.638)= 11.913, p= .001], where VOTs were shorter in the environment of a short vowel (27.43 ms) than in that of a long vowel (32.61 ms), as shown in Figure 21 below.

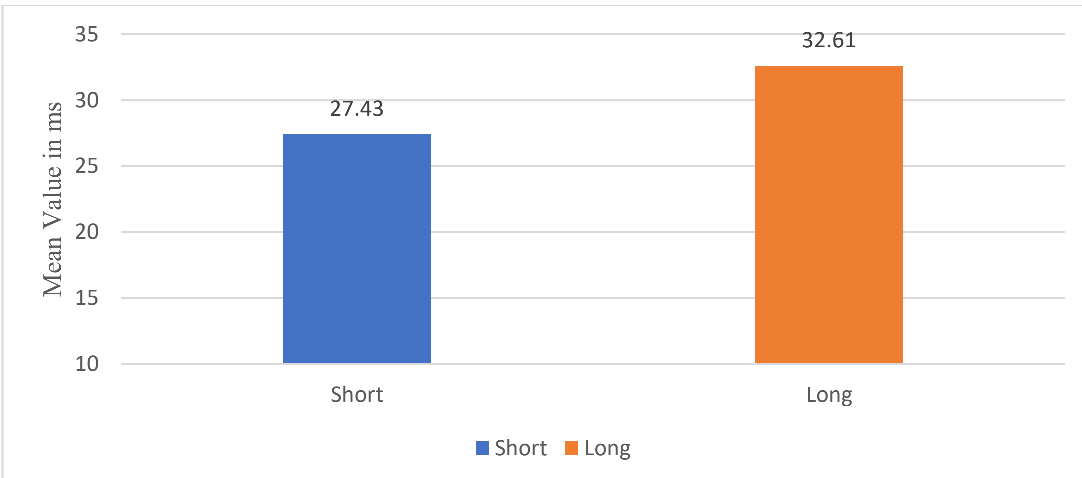


Figure 21. Mean values of VOT in the environments of short and long vowels.

As for the other interactions between emphasis, on the one hand, and the other independent variables, on VOT, a Two-Way ANOVA indicated that there was a significant interaction between emphasis and VL only on VOT [F(1.636)= 11.461, p= .001], where the emphatic-plain contrast was higher for VOT in the environment of a long vowel (30.322 ms) than in that of a short vowel (23.775 ms), as shown in Figure 22 below.

[96] Findings related to the main effects of manner and position of the trigger consonant were supposed to be displayed here, but these were unmeasurable since only word-initial stops have VOTs.

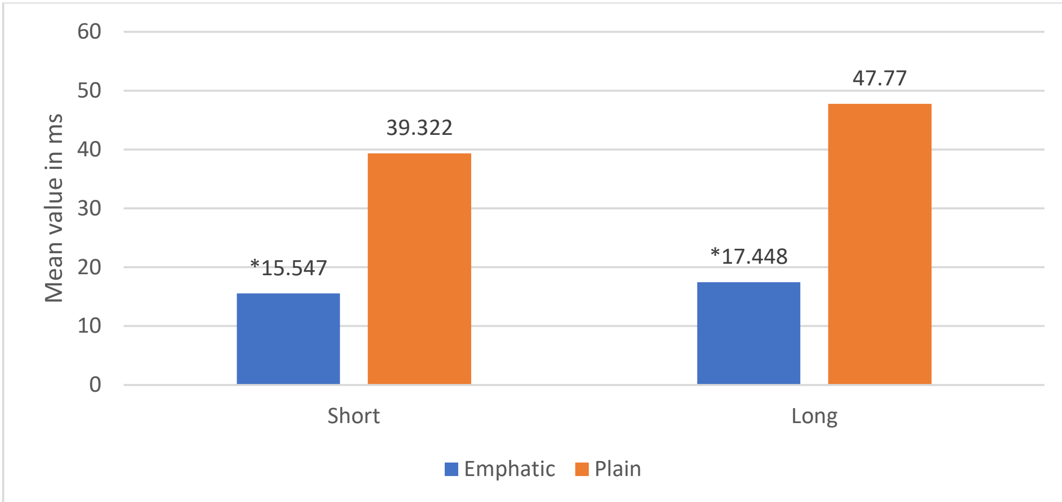


Figure 22. Mean values of emphatic and plain VOTs in the environment of short and long vowels.

Similarly, a Three-Way ANOVA indicated that there was a significant interaction in the combination of emphasis*VQ*VL on VOT [F(2.624)= 6.415, p= .002], where the emphatic-plain contrast was highest for VOT in the environment of /iː/ and lowest in the environment of /ɪ/. However, a Bonferroni post hoc test showed that the differences among the different VQs were statistically insignificant. Figure 23 below displays these differences.

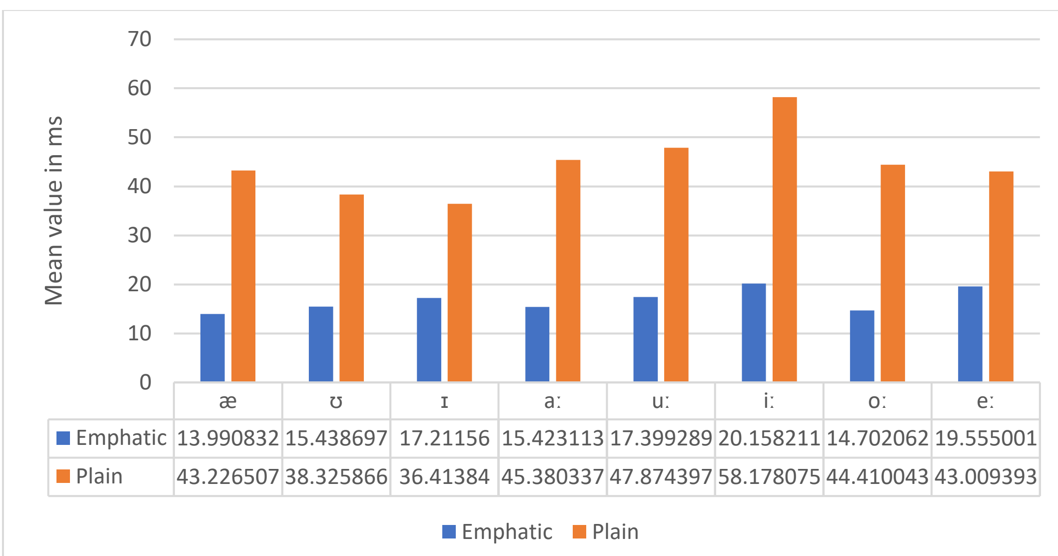


Figure 23. Mean values of emphatic and plain VOTs in the environment of different vowels.

However, no other statistically significant interactions were found in any combination

4.1.4. Vowel Duration (VD)

A One-Way ANOVA showed that there was no significant main effect of emphasis [F(1.3838)= .534, p= .465] or gender [F(1.3838)= .649, p= .421] on VD. On the other hand, the ANOVA analysis indicated that there was a significant main effect of age on VD [F(1.3838)= 396.529, p= .000], where VD mean value was significantly longer for children than for adolescents, as shown in Figure 24 below.

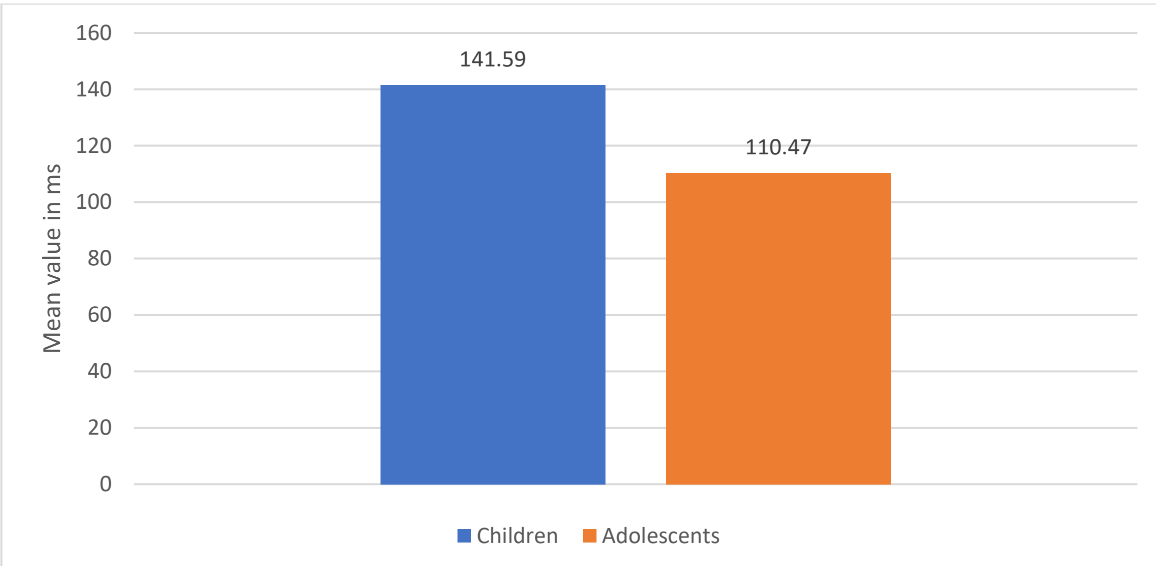


Figure 24. Mean values of VD for children and adolescents.

In addition, the One-Way ANOVA showed that there was no significant main effect of parental education on VD [F(1.3838)= .267, p= .606]. However, the analysis indicated that there was a significant main effect of manner on VD [F(1.3838)= 12.341, p= .000], where VD was longer in the environment of a fricative than in that of a stop, as shown in Figure 25 below.

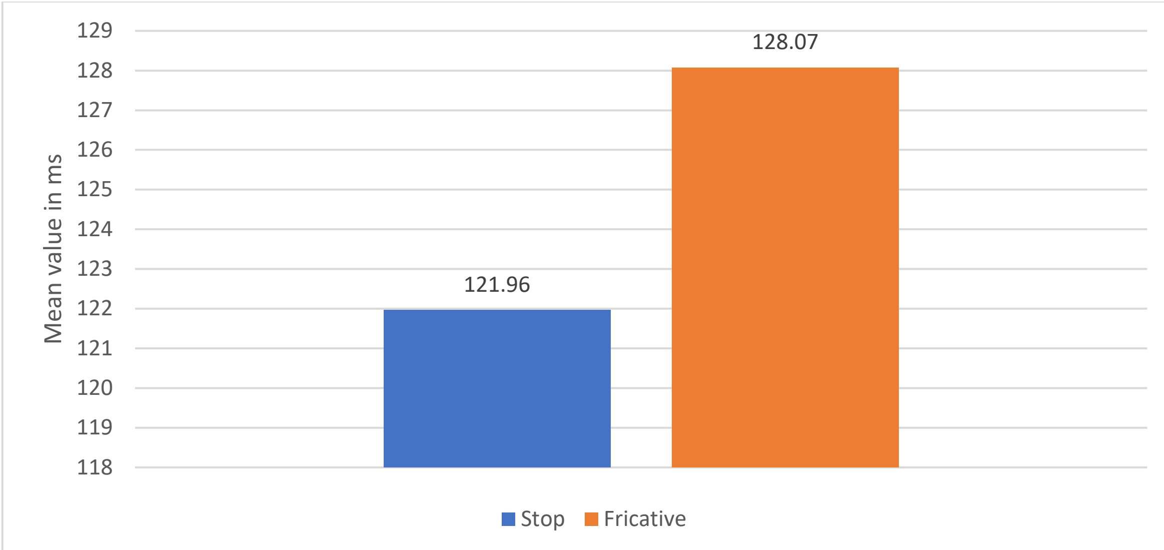


Figure 25. Mean values of VD in the environments of stops and fricatives.

A One-Way ANOVA also indicated that there was a significant main effect of PTC on VD [F(1.3838)= 18.853, p= .000], where the mean value of VD was significantly longer in the environment of a word-final consonant than in that of a word-initial consonant[97], as shown in Figure 26 below.

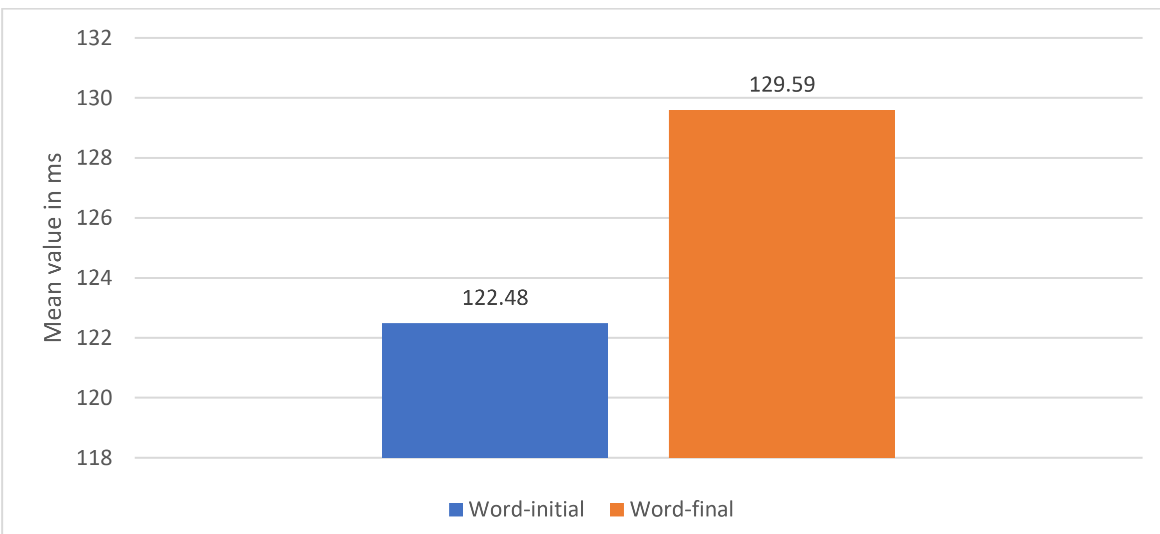


Figure 26. Mean values of VD in the environment of different word positions.

Likewise, the analysis indicated a significant main effect of VQ on VD [F(4.3835)= 138.264, p= .000]. A Bonferroni post hoc analysis revealed that /e/ and was significantly

[97] This effect is likely attributable to the fact that the triggering consonants were either emphatic consonants or their non-emphatic cognates, both of which are obstruents. By contrast, many of the non-triggering consonants were either voiced obstruents or sonorants, which are well documented as inducing lengthening of a preceding vowel but are not typically associated with any systematic effect on a following vowel.

longer than /a/, /u/, and /i/, which were significantly shorter than /o/. However, the difference between /e/ and /o/ was not significantly different, as shown in Figure 27 below.

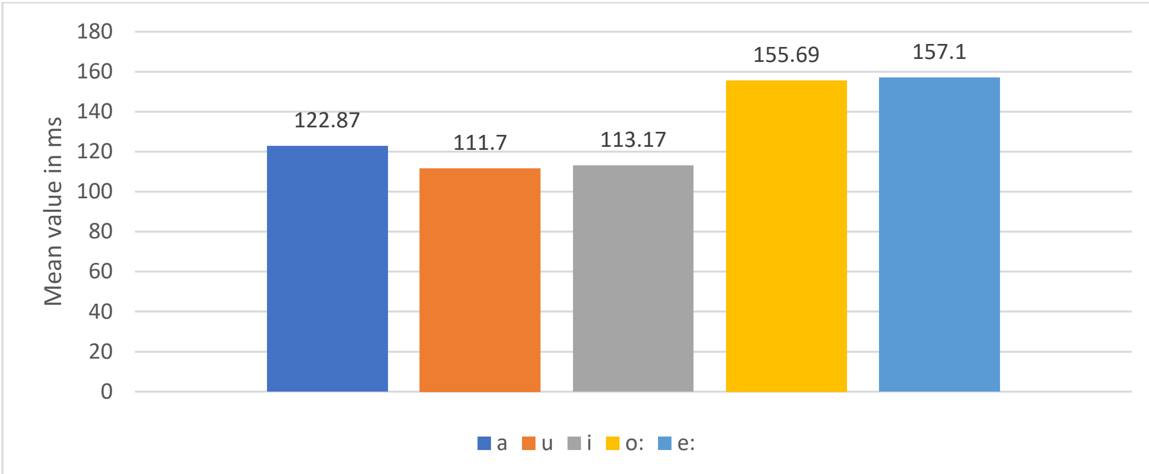


Figure 27. Mean values of VD in the environment of different vowels.

As for the other interactions between emphasis, on the one hand, and the other independent variables, on VD, on the other hand, there were no statistically significant interactions in any combination.

4.1.5. Summary of the Interaction Effects on the Temporal Cues

Table 21 below summarizes the main findings on FD, SC, VOT, and VD. An asterisk (*) denotes a significant interaction effect, the (Ø) symbol shows an insignificant interaction effect, the (≠) denotes an incomputable effect, the (↑) symbol indicates increased value, and the (↓) symbol denotes decreased value, and the more (↑)/(↓) symbols there are, the more/less increased values there are.

Table 21. *Summary of the main effect of the independent variables on consonant data.*

Dependent Variable	Independent Variable	Interaction Effect	Groups[98]				
FD	Emphasis	Ø	--				
	Gender	Ø	--				
	Age	*	Ch.	↑↑	Adol.	↑	
	Parental education	*	T.	↑↑	B. T.	↑	
	Manner	≠	--				
	PTC	*	W.I.	↑	W.F.	↑↑	
	VQ	*	i ↑↑↑↑↑	a ↑↑↑↑	u ↑↑↑↑↑	e ↑↑↑	o ↑↑↑
	VL	*	S.	↑↑	L.	↑	
SC	Emphasis	*	E.	↑↑	P.	↑	
	Gender	*	M.	↑	F.	↑↑	
	Age	*	Ch.	↑↑	Adol.	↑	
	Parental education	Ø	--				
	Manner	≠	--				
	PTC	Ø	--				
	VQ	*	i ↑↑↑↑ ↑	a ↑↑↑↑↑	u ↑↑↑↑↑	e ↑↑↑	o ↑↑↑
	VL	*	S.	↑↑	L.	↑	

[98] Ch. stands for child, Adol. for adolescent, T. for tertiary, B.T. for below tertiary, E. for emphatic, P. for Plain, W.I. for word initial, W.F. for word final, S. for short, and L. for long, St. for stop, and Fr. for fricative.

	Emphasis*VQ*VL	*	Longest for /ʊ/ and shortest for /ɪ/				
VOT	Emphasis	*	E.	↓↓	P.	↓	
	Gender	Ø	--				
	Age	Ø	--				
	Parental education	Ø	--				
	Manner	≠	--				
	PTC	≠	--				
	VQ	Ø	--				
	VL	*	S.	↓↓	L.	↓	
	Emphasis*VL	*	S.	↓	L.	↓↓	
	Emphasis*VQ*VL	*	Shortest for /i:/ and least for /ɪ/				
VD	Emphasis	Ø	--				
	Gender	Ø	--				
	Age	*	Ch.	↑↑	Adol.	↑	
	Parental education	Ø	--				
	Manner	*	St.	↑	Fr.	↑↑	
	PTC	*	W.I.	↑	W.F.	↑↑	
	VQ	*	i ↑↑↑	a ↑↑↑↑	u ↑↑↑	e ↑↑↑↑↑	o ↑↑↑↑↑

4.2. Spectral Cues

This section provides a delineated account of the findings on the normalized vowel formant values. These values were kept as is in non-Hertz following Thomas and Kendall's (2007) recommendation.

4.2.1. First Formant Frequency (F1)

A One-Way ANOVA indicated that there was a significant main effect of emphasis on F1 at the onset [F(1.3838)= 92.657, p= .000], midpoint [F(1.3838)= 20.454, p= .000], and offset [F(1.3838)= 20.067, p= .000] of the vowel, where F1 mean values in an emphatic environment were consistently higher as compared to those in a plain environment, as shown in Figure 28 below.

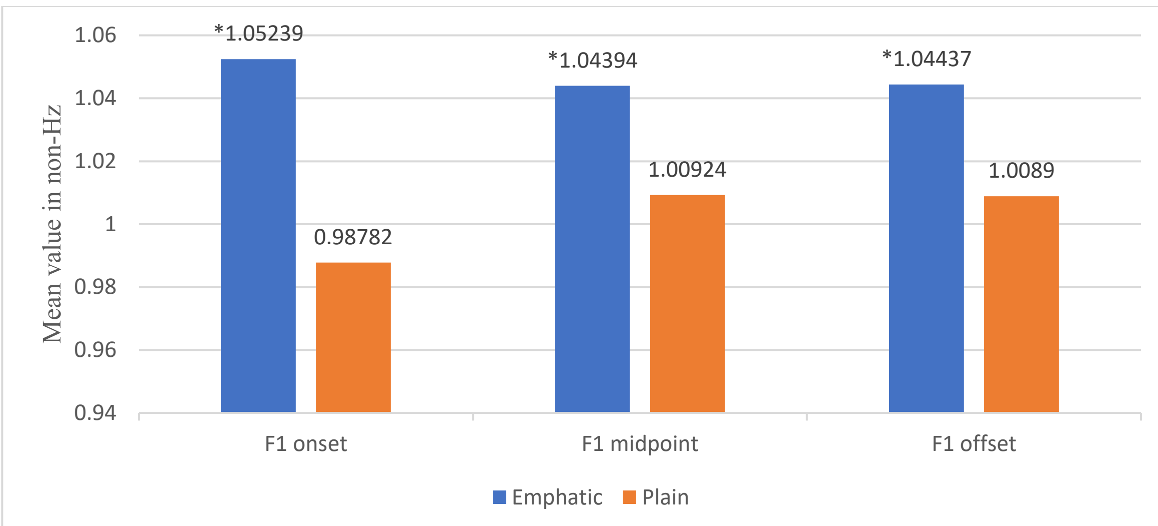


Figure 28. F1 mean values for emphatic and plain consonants.

On the other hand, the One-Way analysis showed that there was no significant main effect of gender on F1 at the onset [F(1.3838)= .653, p= .419], midpoint [F(1.3838)= .006, p= .938], or offset [F(1.3838)= .109, p= .741] of the vowel. Similarly, the analysis showed that there was no significant main effect of age on F1 at the onset [F(1.3838)= .019, p= .889], midpoint [F(1.3838)= .572, p= .449], or offset [F(1.3838)= .177, p= .674] of the vowel. The One-Way analysis also showed that there was no significant main effect of parental education on F1 at the onset [F (1.3838) = .822, p= .365], midpoint [F(1.3838)= .246, p= .620], or offset [F(1.3838)= .126, p= .723] of the vowel.

However, a One-Way ANOVA indicated that there was a significant main effect of manner on F1 at the onset [F (1.3838)= 42.499, p= .000] and midpoint [F(1.3838)= 6.327, p= .012] of the vowel, where F1 mean values were consistently higher in the environment of a stop than in that of a fricative, as shown in Figure 29 below.

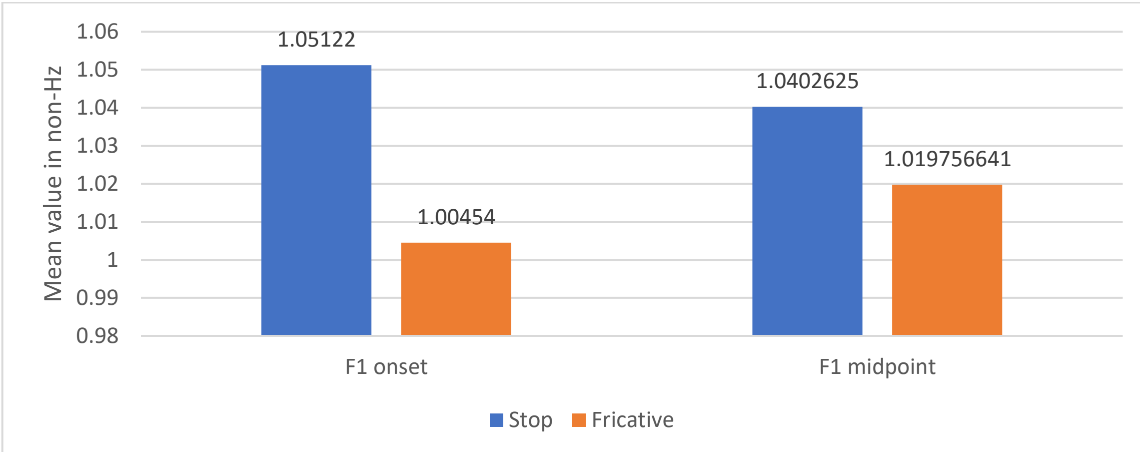


Figure 29. F1 mean values in the environment of stops and fricatives.

Notwithstanding these significant differences, the analysis showed that there was no significant main effect of manner on F1 at the offset [F(1.3838)= .079, p= .778] of the vowel.

In addition, a One-Way ANOVA indicated that there was a significant main effect of PTC on F1 at the onset [F(1.3838)= 19.597, p= .000] and offset [F(1.3838)= 4.349, p= .037] of the vowel, where F1 mean values were consistently higher in the in the environment of a word-final consonant than in that of a word-initial consonant, as shown in Figure 30 below.

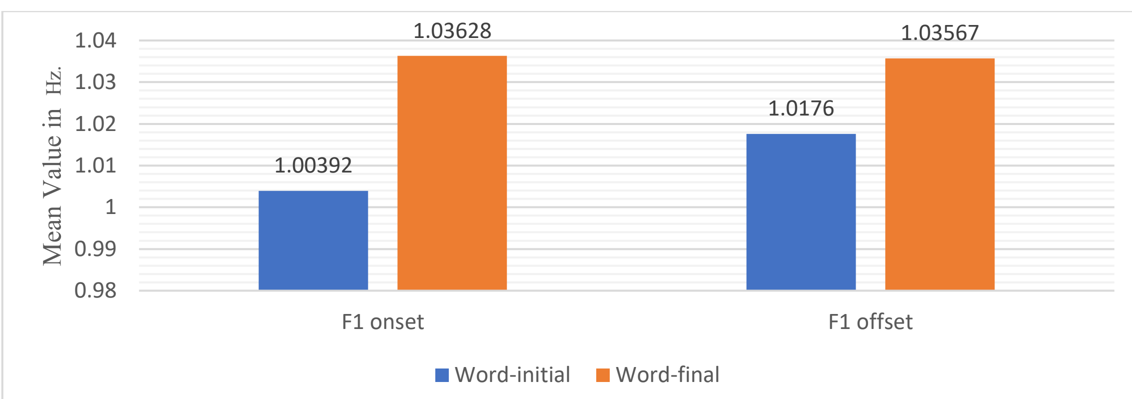


Figure 30. F1 mean values in the environments of word-initial and word-final consonants.

However, a One-Way ANOVA showed that there was no significant main effect of PTC on F1 at the midpoint [F(1.3838)= .001, p= .975] of the vowel.

Similarly, a One-Way ANOVA indicated that there was a significant main effect of VL on F1 at the onset [F(1.3838)= 37.679, p= .000] and offset [F(1.3838)= 15.791, p= .000] of the vowel, where in the former F1 mean value was higher for short than for long vowels and where in the latter the opposite was true, as shown in Figure 31 below.

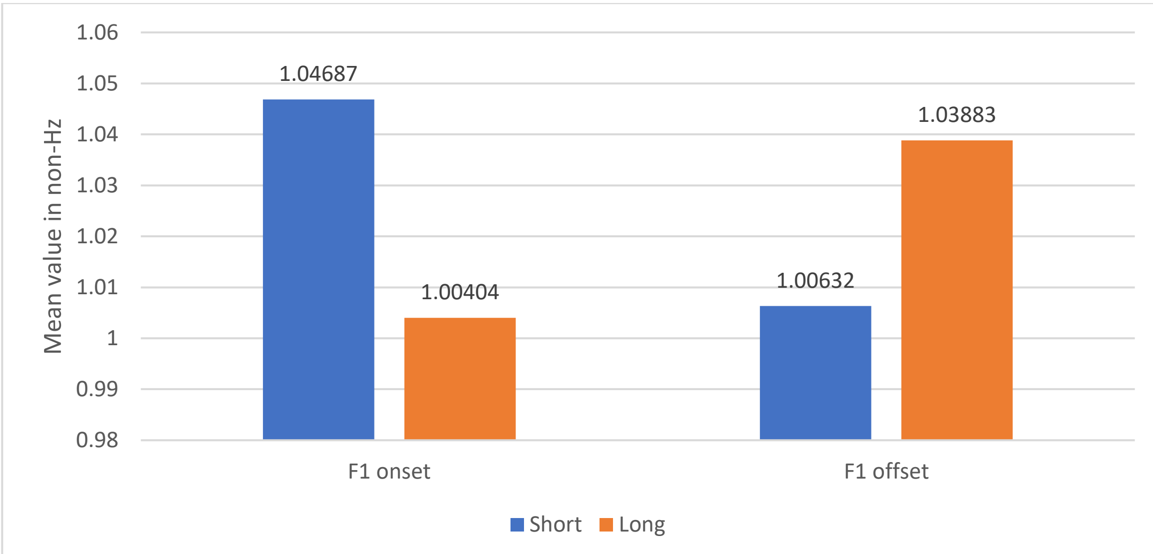


Figure 31. Mean values of F1 in the environment of short and long vowels.

Notwithstanding these statistically significant effects, a One-Way ANOVA showed that there was no significant main effect of VL on F1 at the midpoint [F(1.3838)= 1.399, p= .237] of the vowel.

As for the other interactions between emphasis, on the one hand, and the other independent variables on F1, on the other hand, a Two-Way ANOVA indicated that there was a significant interaction between emphasis and gender on F1 at the onset [F(1.3836)= 30.886, p= .000], midpoint [F(1.3836)= 5.127, p= .024], and offset [F(1.3836)= 6.560, p= .010] of the vowel, where the proportion of F1 raising in an emphatic environment was consistently higher for males than for females, as shown in Figure 32 below.

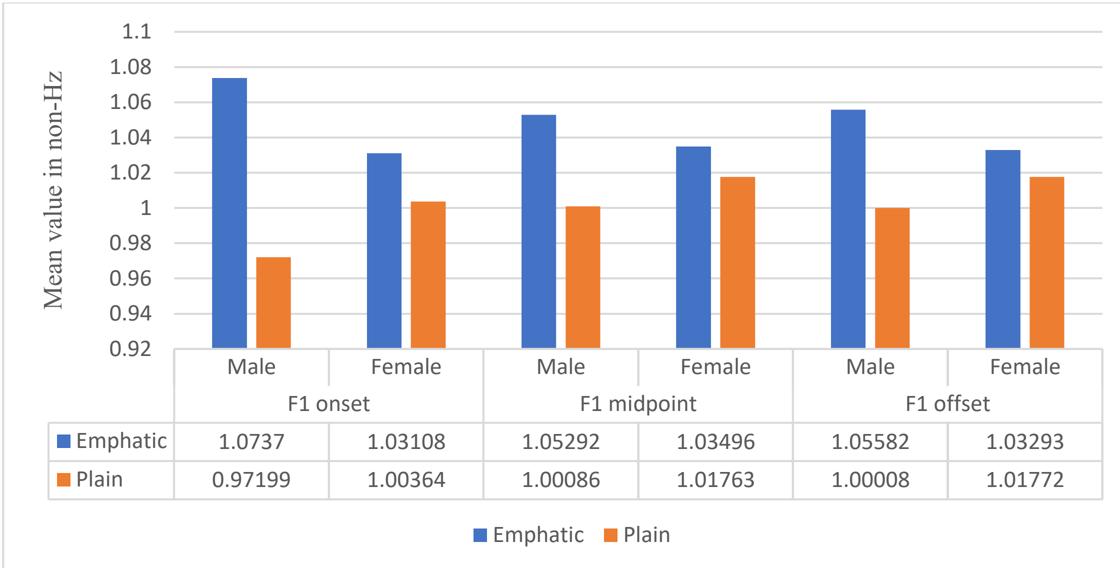


Figure 32. Mean values of F1 for males and females in emphatic and plain environments.

Similarly, a Two-Way ANOVA indicated that there was a significant interaction between emphasis and age on F1 at the midpoint [$F(1.3836)= 5.299$, $p= .021$] and offset [$F(1.3836)= 4.933$, $p= .026$] of the vowel, where the proportion of F1 raising in an emphatic environment was consistently higher for adolescents than for children, as shown in Figure 33 below.

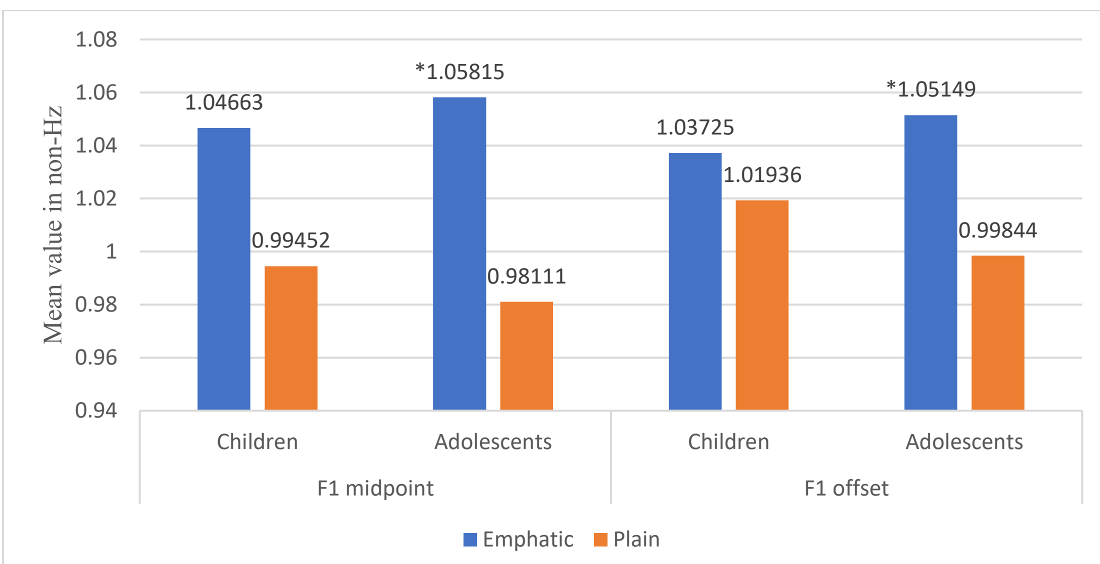


Figure 33. Mean values of F1 for children and adolescents in emphatic and plain environments.

Likewise, a Two-Way ANOVA indicated that there was a significant interaction between emphasis and PTC on F1 at the onset [$F(1.3836)=11.861$, $p= .001$] and offset

[F(1.3836)= 4.609, p= .032] of the vowel, where the proportion of F1 raising in an emphatic environment was consistently higher in the environment of word-initial consonants than in that of word-final consonants, except for F1 offset[99], as shown in Figure 34 below.

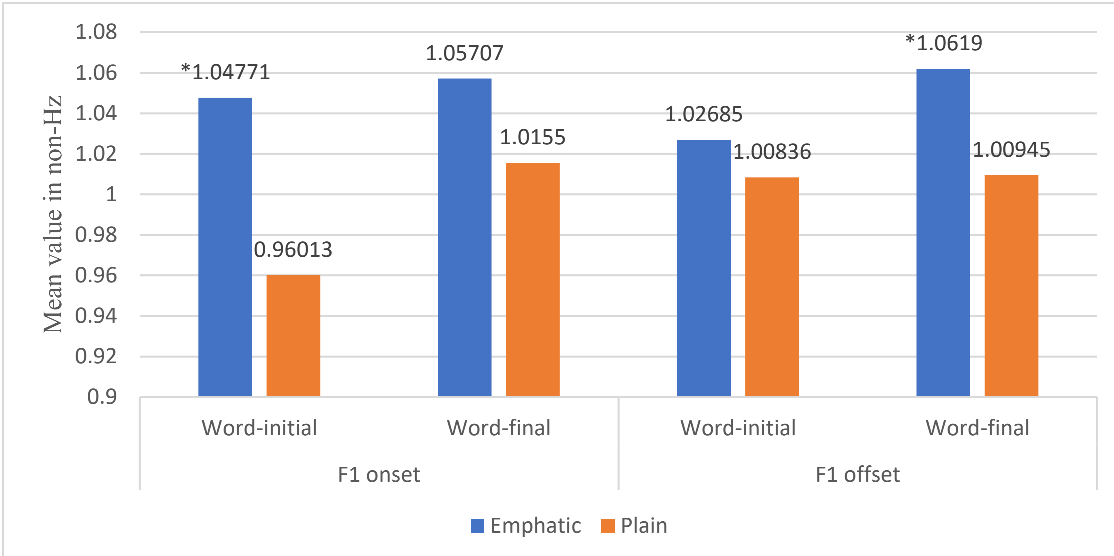


Figure 34. Mean values of F1 for different word positions in emphatic and plain environments.

On the other hand, the ANOVA analysis showed that there was no significant interaction between emphasis and PTC on F1 at the midpoint [F(1.3836)= .014, p= .906].

A Two-Way ANOVA also showed that there was no significant interaction between emphasis and VQ on F1 at the onset [F(4.3830)= .990, p= .412], midpoint [F(4.3830)= 1.663, p= .156], or offset [F(4.3830)= 1.544, p= .187] of the vowel.

Besides, a Two-Way ANOVA indicated that there was a significant interaction between emphasis and VL on F1 at the midpoint [F(1.3836)= 9.023, p= .003] and offset [F(1.3836)= 5.960, p= .015] of the vowel, where the proportion of F1 raising in an emphatic environment was consistently higher in the environment of a short vowel than in that of a long vowel, as shown in Figure 35 below.

[99] Although this interaction was significant, it was in favor of word-final emphatics rather than word-initial ones.

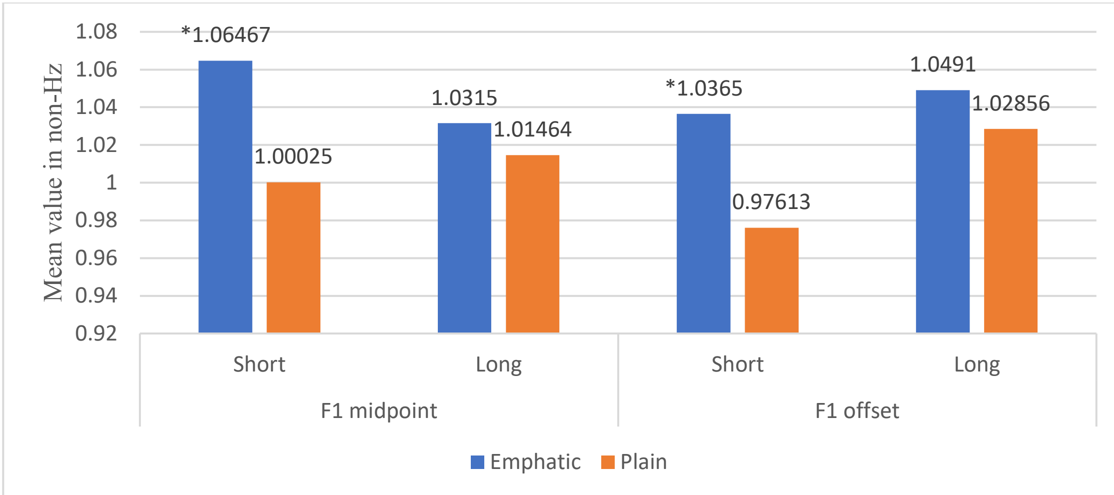


Figure 35. Mean values of F1 for short and long vowels in emphatic and plain environments.

Notwithstanding these statistically significant interaction effects, the ANOVA showed that there was no significant interaction between emphasis and VL on F1 at the onset [F(1.3836)= .866, p= .352] of the vowel.

In addition, a Three-Way ANOVA indicated that there was a significant interaction in the combination of emphasis*manner*PTC on F1 only at the onset [F(1.3832)= 4.682, p= .031], where the proportion of F1 raising was greater in the environment of a word-initial emphatic stop than in that of a word-initial emphatic fricative. However, the proportion of F1 raising in the environment of word-final emphatic stops and fricatives was almost the same, as shown in Figure 36 below.

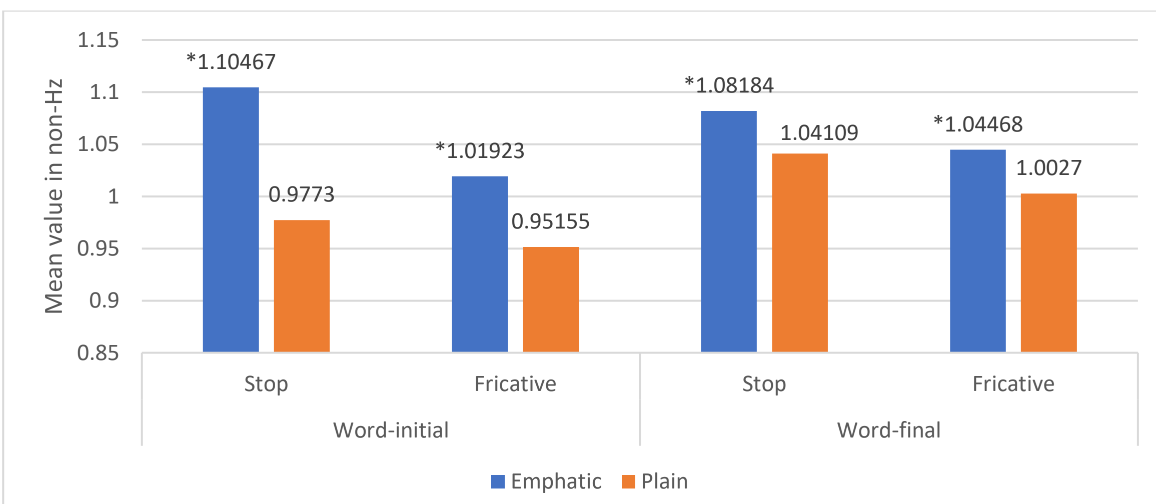


Figure 36. F1 mean values for stops and fricatives in different word positions in emphatic and plain environments.

Moreover, a Three-Way ANOVA indicated that there was a significant interaction in the combination of emphasis*VQ*VL on F1 only at the midpoint [F(2.3824)= 4.415, p= .012] and offset [F(2.3824)= 6.039, p= .002] of the vowel, where in the former the proportion of F1 raising in an emphatic environment was consistently greater for /æ/ than for /ɪ/, /ʊ/, /eː/, /uː/, /iː/, and /oː/ and where in the latter the proportion of F1 raising in an emphatic environment was greater for /æ/ than for /uː/, /ɪ/, /ʊ/, /iː/, /eː/, and /oː/, as shown in Figure 37 below.

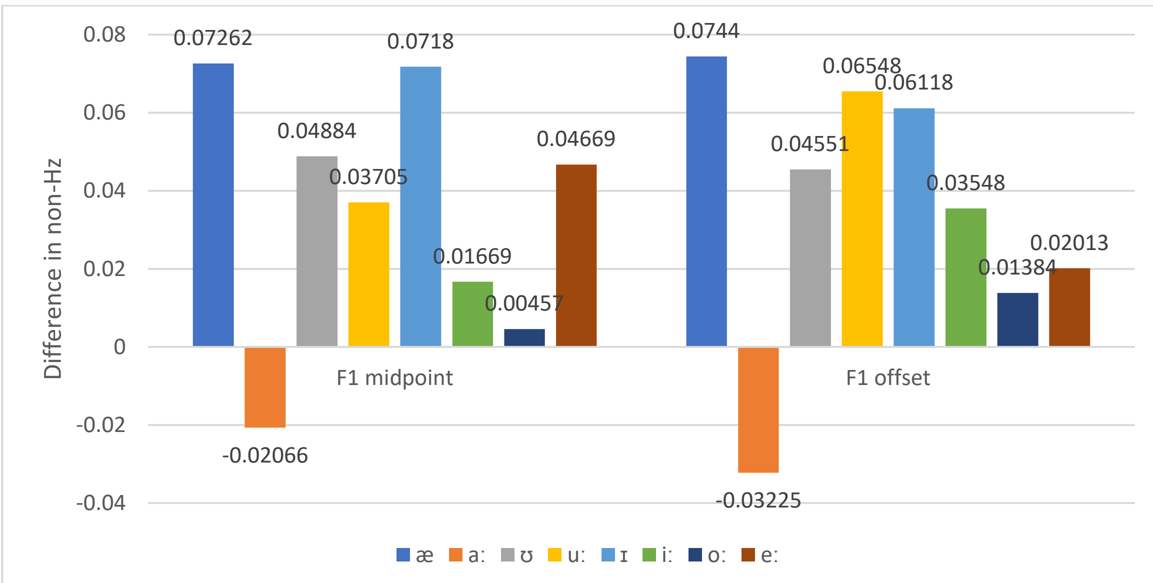
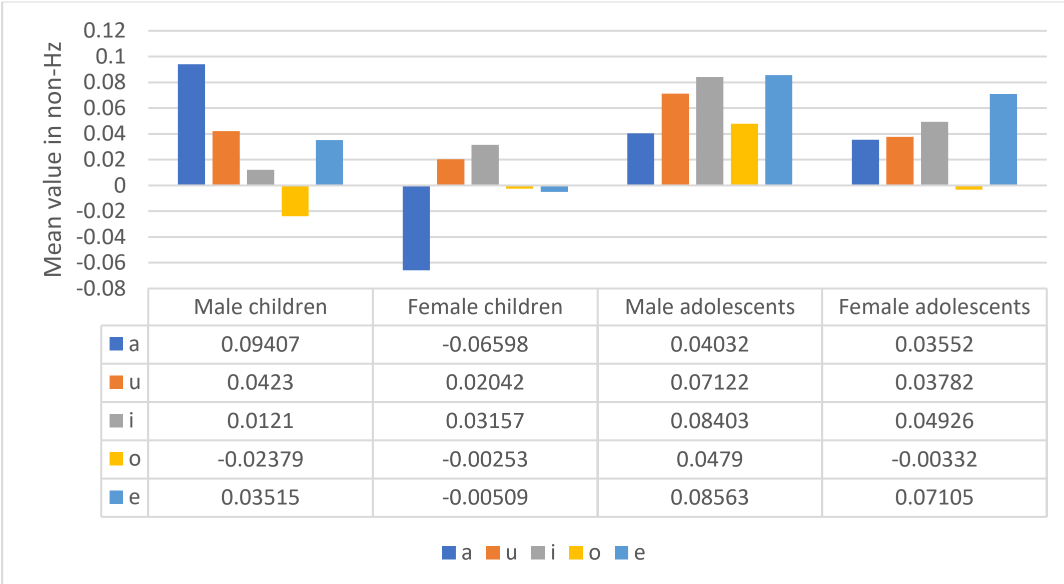


Figure 37. The proportion of F1 raising in an emphatic environment for different VL pairs.

In addition, a Four-Way ANOVA indicated that there was a significant interaction in the combination of emphasis*gender*age*VQ on F1 only at the midpoint [F(4.3800)= 4.026, p= .003] of the vowel, where despite the substantial overlap in the children's data male participants generally showed a higher degree of F1 raising than females and the proportion of F1 raising increased as a function of age. Moreover, the proportion of F1 raising was also higher for front vowels than for back vowels, as shown in Figure 38 below.



	Male children	Female children	Male adolescents	Female adolescents
a	0.09407	-0.06598	0.04032	0.03552
u	0.0423	0.02042	0.07122	0.03782
i	0.0121	0.03157	0.08403	0.04926
o	-0.02379	-0.00253	0.0479	-0.00332
e	0.03515	-0.00509	0.08563	0.07105

Figure 38. The proportion of F1 raising for different genders and age groups in different vowel environments.

A Bonferroni post hoc analysis revealed that the difference among all the different vowels was statistically significant.

Furthermore, a Four-Way ANOVA indicated that there was a significant interaction in the combination of emphasis*gender*age*parental education on F1 only at the offset [F(1.3824)= 6.469, p= .011] of the vowel, where the proportion of F1 raising in an emphatic environment was highest for male adolescents whose parents had received tertiary education (0.0907), followed by male children (0.06362) and female adolescents (0.06019) whose parents had received below tertiary education, male adolescents whose parents had received below tertiary education (0.05109), male children whose parents had received tertiary education (0.01755), and female adolescents (0.01023) and children (0.00785) whose parents had received tertiary education, respectively. Although the above interaction was significant for female children whose parents had received below tertiary education, the interaction effect was not in the direction of emphasis (-2.306), as shown in Figure 39 below.

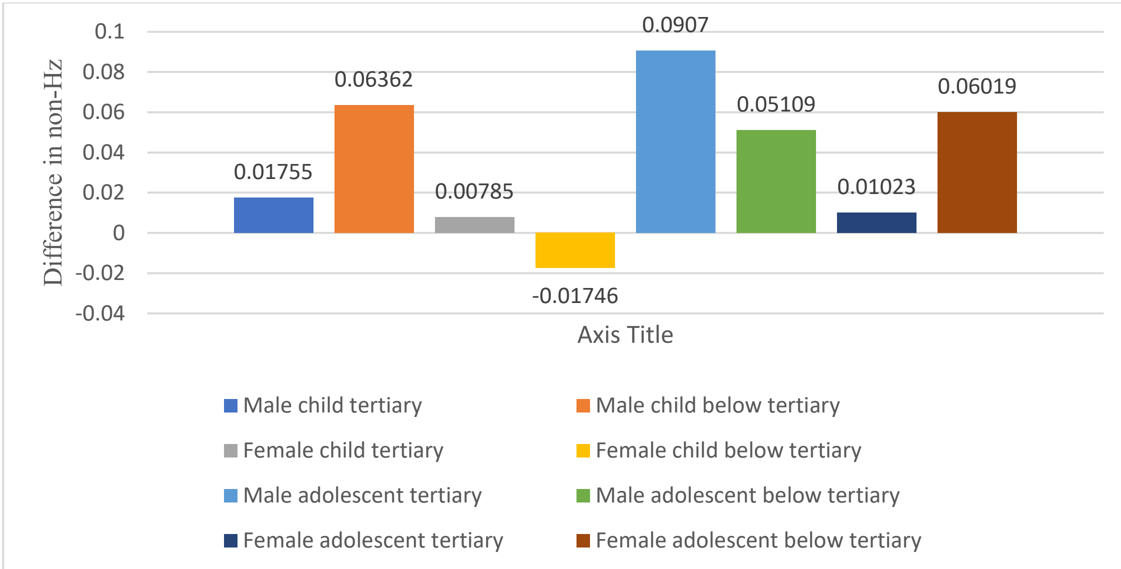


Figure 39. F1 mean difference in emphatic and plain environments for different gender, age, and parental education groups.

4.2.1.1. Summary of the Main Findings on F1

Table 22 below summarizes the main findings on F1 at different vowel positions. An asterisk (*) denotes a significant interaction effect, the (Ø) symbol shows an insignificant interaction effect, the (the (≠) denotes an incomputable effect, the (↑) symbol indicates increased value, and the (↓) symbol denotes decreased value, and the more (↑)/(↓) symbols there are, the more/less increased values there are.

Table 22. *Summary of the significant interaction effects on F1.*

Independent Variable	**Dependent Variable**	**Interaction Effect**	**Groups**[100]			
Emphasis	F1 onset	*	E.	↑↑	P.	↑
Gender		Ø	--			
Age		Ø	--			
Parental education		Ø	--			
Manner		*	St.	↑↑	Fr.	↑
PTC		*	W.I.	↑	W.F.	↑↑

[100] Ch. stands for child, Adol. for adolescent, T. for tertiary, B.T. for below tertiary, E. for emphatic, P. for Plain, St. for stop, Fr. for fricative, W.I. for word initial, W.F. for word final, S. for short, and L. for long.

VL		*	S.	↑↑	L.	↑		
Emphasis*Gender		*	M.	↑↑	F.	↑		
Emphasis*PTC		*	W.I.	↑↑	W.F.	↑		
Emphasis*Manner*PTC		*	W.I.	St. ↑↑	Fr. ↑	W.F.	St. ↑↑	Fr. ↑↑
Emphasis	F1 midpoint	*	E.	↑↑	P.	↑		
Gender		Ø	--					
Age		Ø	--					
Parental education		Ø	--					
Manner		*	St.	↑↑	Fr.	↑		
PTC		Ø	--					
VL		Ø	**--**	--	**--**	--		
Emphasis*Gender		*	M.	↑↑	F.	↑		
Emphasis*Age		*	Ch.	↑	Adol.	↑↑		
Emphasis*VL		*	S.	↑↑	L.	↑		
Emphasis*Gender*Age*VQ		*	See Section 4.2.1.					
Emphasis*VQ*VL		*	See Section 4.2.1.					
Emphasis	F1 offset	*	E.	↑↑	P.	↑		
Gender		Ø	--					
Age		Ø	--					
Parental education		Ø	--					
Manner		Ø	--					
PTC		*	W.I.	↑	W.F.	↑↑		
VL		*	**S.**	↑	L.	↑↑		
Emphasis*Gender		*	M.	↑↑	F.	↑		
Emphasis*Age		*	Ch.	↑	Adol.	↑↑		

Emphasis*PTC		*	W.I.	↑	W.F.	↑↑
Emphasis*VL		*	S.	↑↑	L.	↑
Emphasis*Gender*Age*Parental education		*	See Section 4.2.1.			

4.2.2. Second Formant Frequency (F2)

A One-Way ANOVA indicated that there was a significant main effect of emphasis on F2 at the onset [F(1.3838)= 389.883, p= .000], midpoint [F(1.3838)= 94.794, p= .000] and offset [F(1.3838)= 286.487, p= .000] of the vowel, where emphaticized vowels consistently showed lower F2 mean values as compared to those of plain vowels, as shown in Figure 40 below.

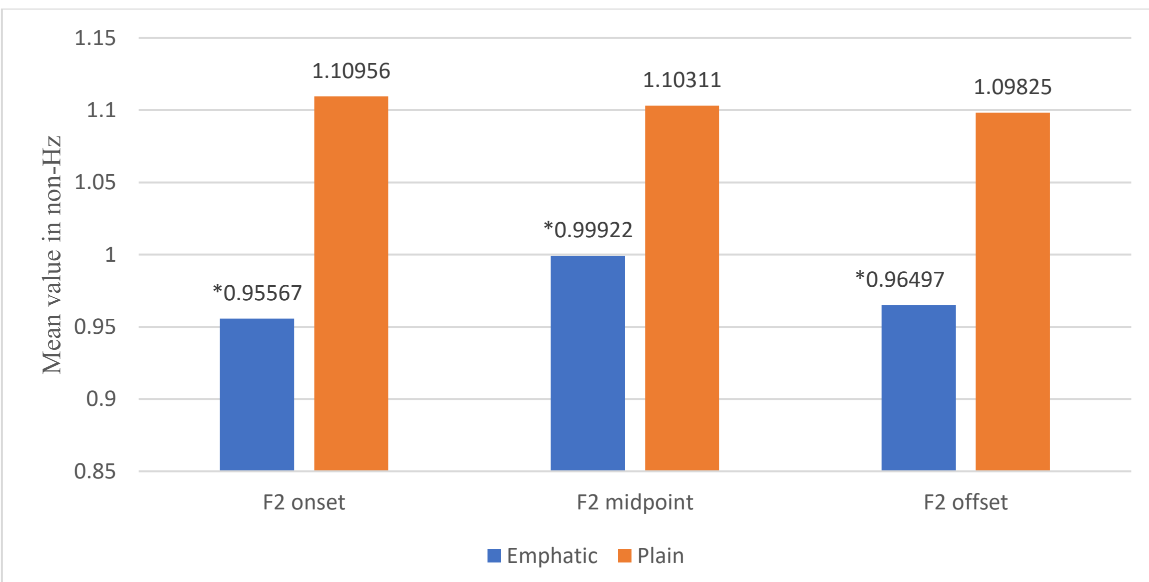


Figure 40. F2 mean values in emphatic and plain environments.

However, the One-Way ANOVA showed that there was no significant main effect of gender on F2 at the onset [F(1.3838)= .033, p= .855], midpoint [F(1.3838)= .244, p= .621], or offset [F(1.3838)= .030, p= .862] of the vowel. Similarly, the ANOVA analysis showed that there was no significant main effect of age on F2 at the onset [F(1.3838)= 2.199, p= .138], midpoint [F(1.3838)= .894, p= .345], or offset [F(1.3838)= .325, p= .569] of the vowel. In addition, a One-Way ANOVA showed that there was no significant main effect of parental education on F2 at the onset [F(1.3838)= .067, p= .796], midpoint [F(1.3838)= .079, p= .779], or offset [F(1.3838)= .006, p= .936] of the vowel.

Conversely, a One-Way ANOVA indicated that there was a significant main effect of manner on F2 at the onset [F(1.3838)= 4.624, p= .032] and offset [F(1.3838)= 8.385, p= .004] of the vowel, where F2 mean values were consistently lower for fricatives than for stops, as shown in Figure 41 below.

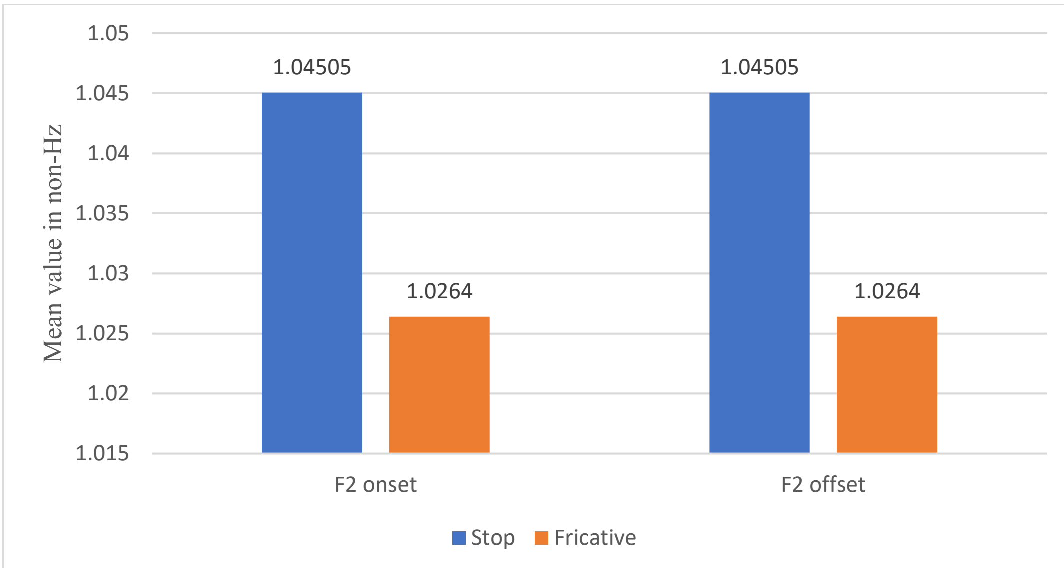


Figure 41. F2 mean values for stops and fricatives at the onset position.

Yet, the One-Way ANOVA showed that there was no significant main effect of manner on F2 at the midpoint [F(1.3838)= 1.060, p= .303] of the vowel.

Furthermore, a One-Way ANOVA indicated that there was a significant main effect of PTC on F2 at the onset [F(1.3838)= 6.579, p= .010] and offset [F(1.3838)= 42.468, p= .000] of the vowel, where F2 mean value was lower in the environment of word-final consonants than for word-initial consonants for F2 onset, and lower in the environment of word-initial consonants than for word-final consonants for F2 offset, as shown in Figure 42 below.

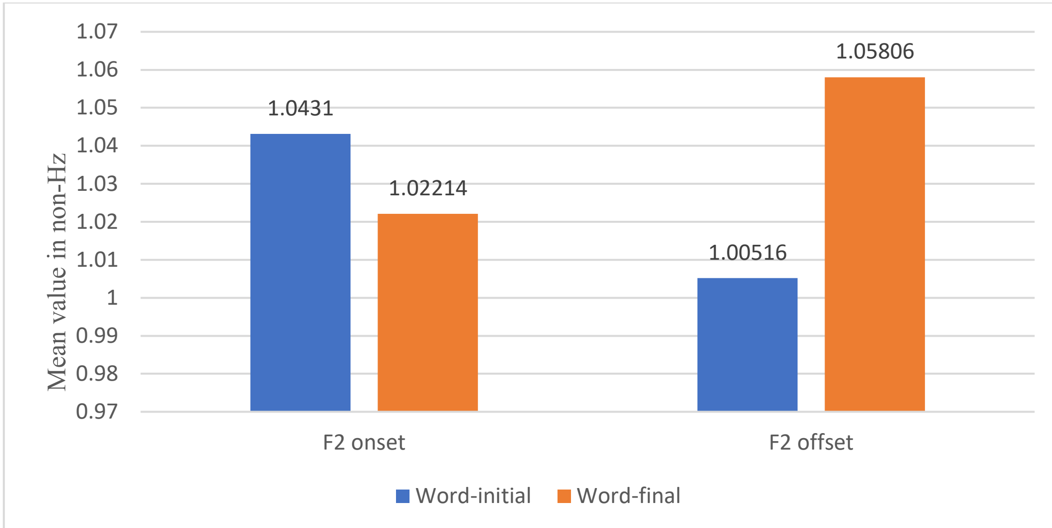
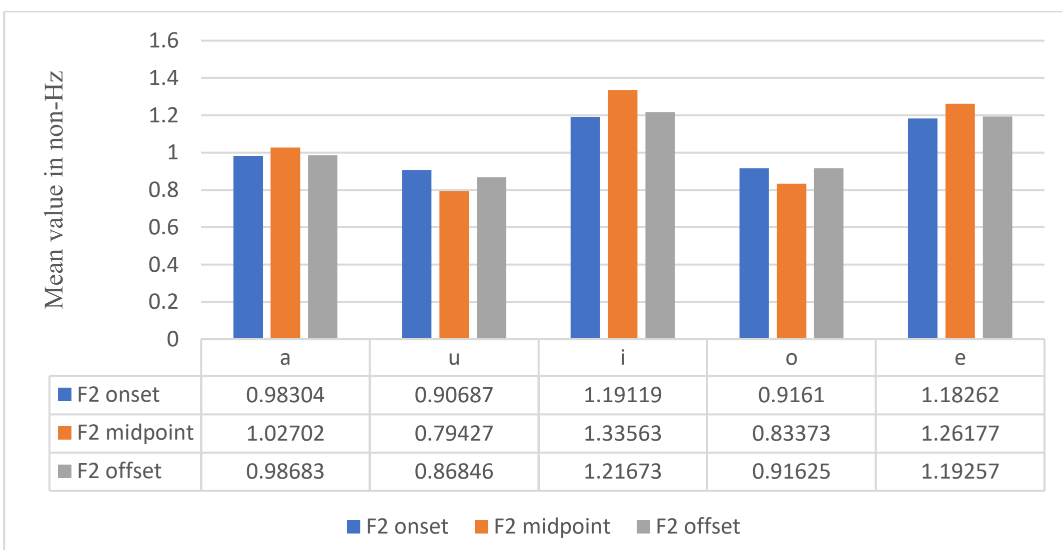


Figure 42. F2 mean values in the environments of word-initial and word-final consonants.

On the other hand, the ANOVA test showed that there was no significant main effect of PTC on F2 at the midpoint [F(1.3838)= .019, p= .890] of the vowel.

Besides, a One-Way ANOVA indicated that there was a significant main effect of VQ on F2 at the onset [F(4.3835)= 301.631, p= .000], midpoint [F(4.3835)= 728.265, p= .000], and offset [F(1.3838)= 456.658, p= .000] of the vowel, where F2 mean values were lowest in the environment of /u/ followed by /o/, / a /, /e /, and /i/, respectively. A Bonferroni post hoc analysis revealed that /i/ was not significantly different from /e/ at both the onset and offset positions and that /u/ was not significantly different from /o/ at the onset and midpoint positions, as shown in Figure 43 below.



	a	u	i	o	e
F2 onset	0.98304	0.90687	1.19119	0.9161	1.18262
F2 midpoint	1.02702	0.79427	1.33563	0.83373	1.26177
F2 offset	0.98683	0.86846	1.21673	0.91625	1.19257

Figure 43. F2 mean values in the environment of different vowel qualities.

Similarly, a One-Way ANOVA indicated that there was a significant main effect of VL on F2 at the onset [F(1.3838)= 11.041, p= .001] and offset [F(1.3838)= 5.182, p= .023] of the vowel, where F2 mean values were consistently lower for short vowels than for long vowels, as shown in Figure 44 below.

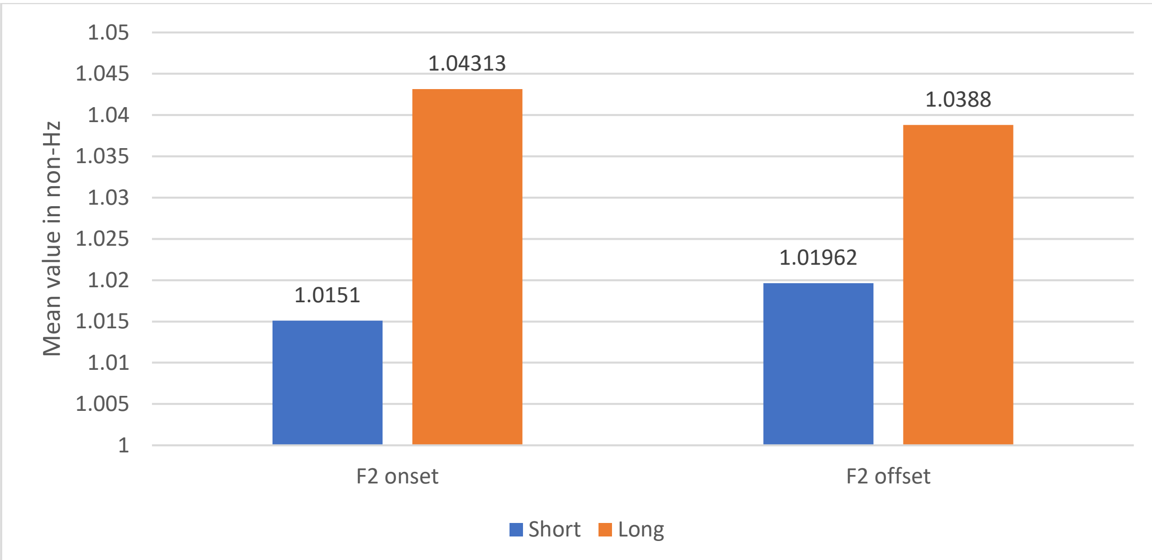


Figure 44. F2 mean values in the environment of short and long vowels.

Conversely, the One-Way ANOVA showed that there was no significant main effect of VL on F2 at the midpoint [F(1.3838)= 1.818, p= .178].

As for the other interactions between emphasis, on the one hand, and the other independent variables on F2, on the other hand, a Two-Way ANOVA indicated that there was a significant interaction between emphasis and gender on F2 at the midpoint [F(1.3836)= 6.089, p= .014] and offset [F(1.3836)= 6.251, p= .012] of the vowel, where the proportion of F2 lowering in an emphatic environment was almost the same for males and females at the midpoint of the vowel and where it was slightly higher for males than for females at the offset of the vowel, as shown in Figure 45 below.

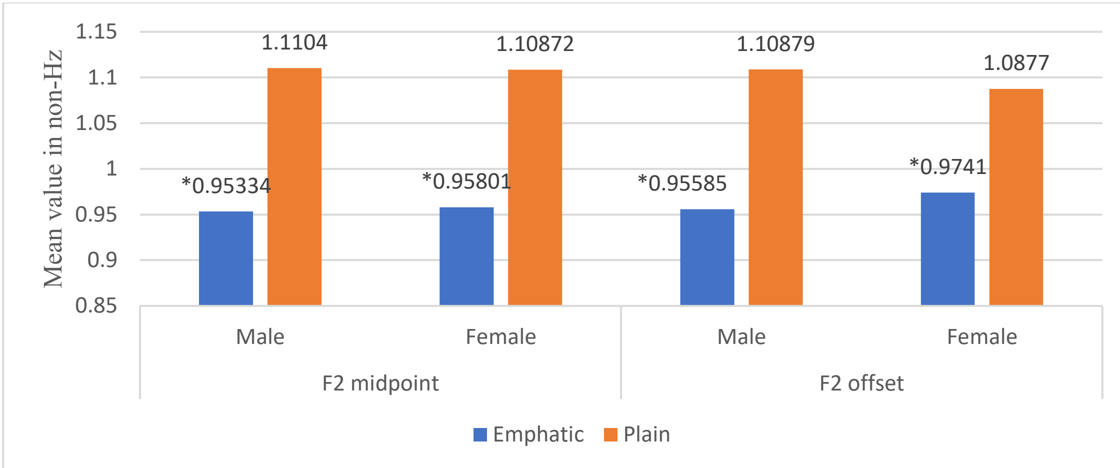


Figure 45. F2 mean values for males and females in emphatic and plain environments.

On the other hand, the ANOVA test showed that the emphasis by gender interaction was not significant on F2 at the onset [F(1.3836)= .165, p= .684] position.

Conversely, a Two-Way ANOVA showed that there was no significant interaction between emphasis and age in terms of F2 at the onset [F(1.3836)= 1.733, p= .188], midpoint [F(1.3836)= 1.528, p= .217], or offset [F(1.3836)= 2.800, p= .094] of the vowel.

Besides, a Two-Way ANOVA also indicated that there was a significant interaction between emphasis and parental education on F2 only at the onset [F(1.3836)= 8.181, p= .004] of the vowel, where the proportion of F2 lowering in an emphatic environment was slightly higher for participants whose parents had received tertiary education than for those whose parents had received below tertiary education, as shown in Figure 46 below.

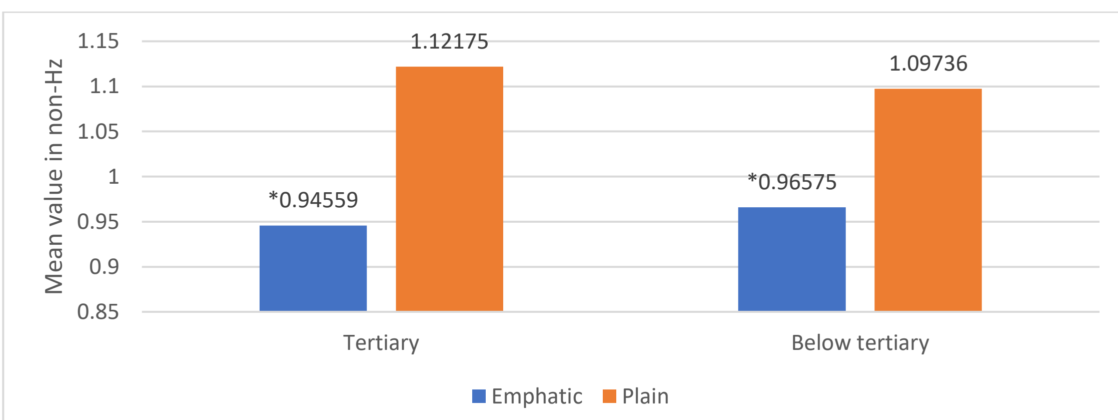


Figure 46. F2 mean values for different educational backgrounds in emphatic and plain environments at the onset position.

However, the ANOVA test showed that the emphasis by parental education interaction was not significant on F2 at the midpoint [F(1.3836)= .203, p= .625] or offset [F(1.3836)= 2.327, p= .127] positions.

Similarly, a Two-Way ANOVA indicated that there was a significant interaction between emphasis and manner on F2 only at the onset [F(1.3836)= 4.286, p= .038] of the vowel, where the proportion of F2 lowering in an emphatic environment was higher in the environment of a stop than in that of a fricative, as shown in Figure 47 below.

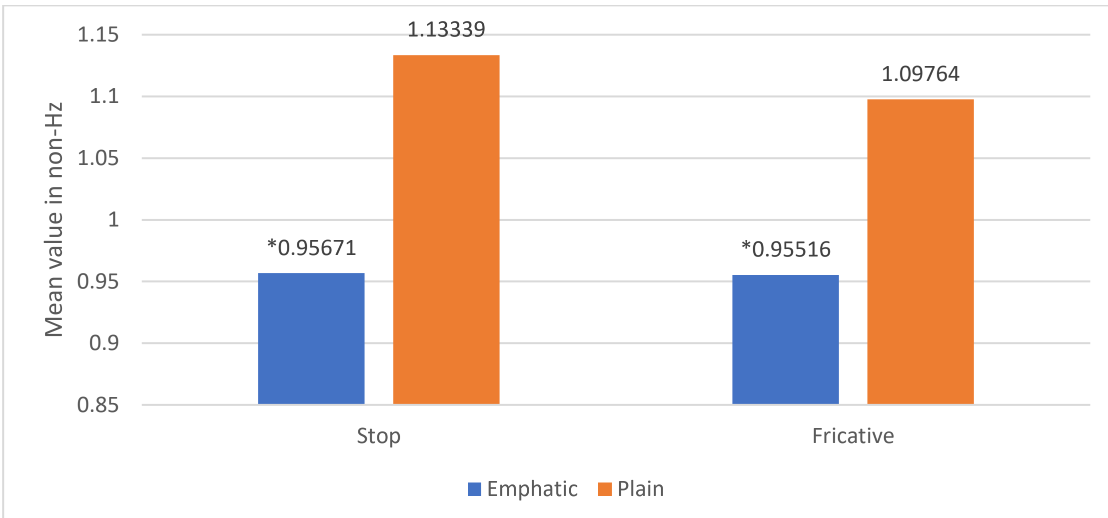


Figure 47. F2 mean values for stops and fricatives in emphatic and plain environments at the onset position.

Conversely, the ANOVA test showed that the emphasis by manner interaction was not significant on F2 at the midpoint [F(1.3836)= 1.284, p= .257] and offset [F(1.3836)= 1.238, p= .266] positions.

A Two-Way ANOVA indicated that there was a significant interaction between emphasis and PTC on F2 at the onset [F(1.3836)= 119.471, p= .000], on the one hand, and F2 at the offset [F(1.3836)= 27.176, p= .000], on the other hand, where the former showed that the proportion of F2 decrease was higher in the environment of a word-initial emphatic consonant than in that of a word-final emphatic consonant. In contrast, the latter showed the opposite, as shown in Figure 48 below.

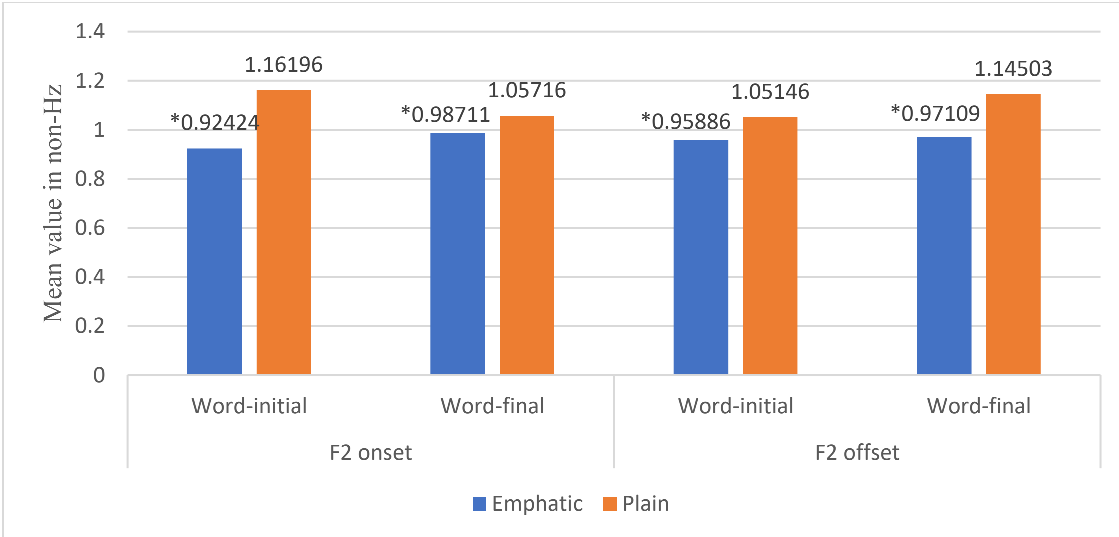
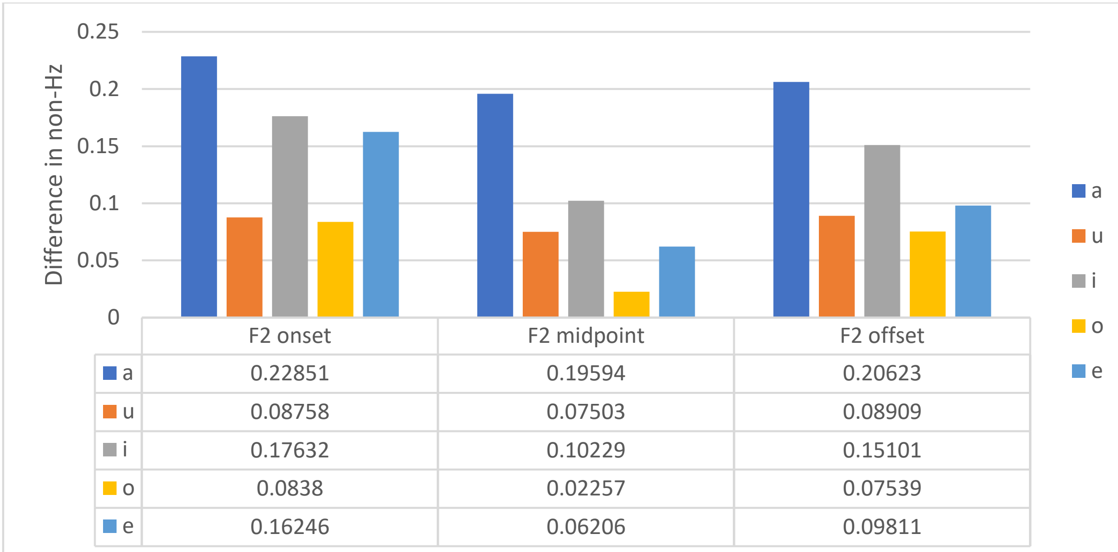


Figure 48. F2 mean values in the environments of word-initial and word-final emphatic and plain segments.

On the other hand, the ANOVA test showed that the emphasis by PTC interaction was not significant on F2 at the midpoint [F(1.3836)= .158, p= .691] position.

In addition, a Two-Way ANOVA indicated that there was a significant interaction between emphasis and VQ on F2 at the onset [F(4.3830)= 18.424, p= .000], midpoint [F(4.3830)= 13.436, p= .000], and offset [F(4.3830)= 15.464, p= .000] of the vowel. At the onset position, a Bonferroni post hoc analysis revealed that /a/ was significantly higher than /i/ and /e/, which were significantly higher than /u/ and /o/. The analysis also showed that /u/ was not significantly different from /o/, on the one hand, and /i/ was not significantly different from /e/, on the other hand. At the midpoint position, a Bonferroni post hoc analysis revealed that /a/ was significantly higher than /i/ and /u/, which were significantly higher than /e/ and /o/. At the offset position, a Bonferroni post hoc analysis revealed a similar pattern to the one at the onset, except that the test only showed an insignificant difference between /i/ and /e/, as shown in Figure 49 below.



	F2 onset	F2 midpoint	F2 offset
a	0.22851	0.19594	0.20623
u	0.08758	0.07503	0.08909
i	0.17632	0.10229	0.15101
o	0.0838	0.02257	0.07539
e	0.16246	0.06206	0.09811

Figure 49. The proportion of F2 decrease in different vowel environments.

Moreover, a Two-Way ANOVA indicated that there was a significant interaction between emphasis and VL on F2 at the midpoint [F(1.3836)= 13.950, p= .000] and offset [F(1.3836)= 13.950, p= .000] of the vowel, where the proportion of F2 decrease in an emphatic environment was consistently higher in the environment of a short vowel than in that of a long vowel, as shown in Figure 50 below.

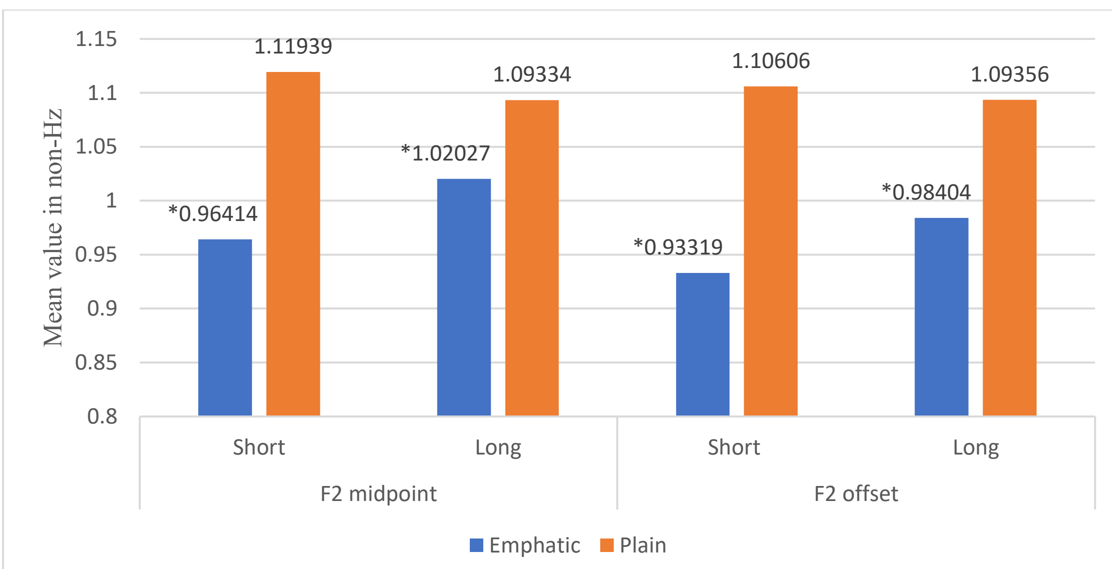


Figure 50. F2 mean values of short and long vowels in emphatic and plain environments.

On the other hand, the ANOVA test showed that the emphasis by VL interaction was not significant at the onset [F(1.3836)= 3.551, p= .060] position.

A Three-Way ANOVA indicated that there was a significant interaction in the combination of emphasis*gender*age on F2 only at the onset [F(1.3832)= 9.920, p= .002] of the vowel, where the proportion of F2 decrease was slightly higher for male children than for female children, on the one hand, and slighlty higher for female adolescents than for male adolescents, on the other hand, as shown in Figure 51 below.

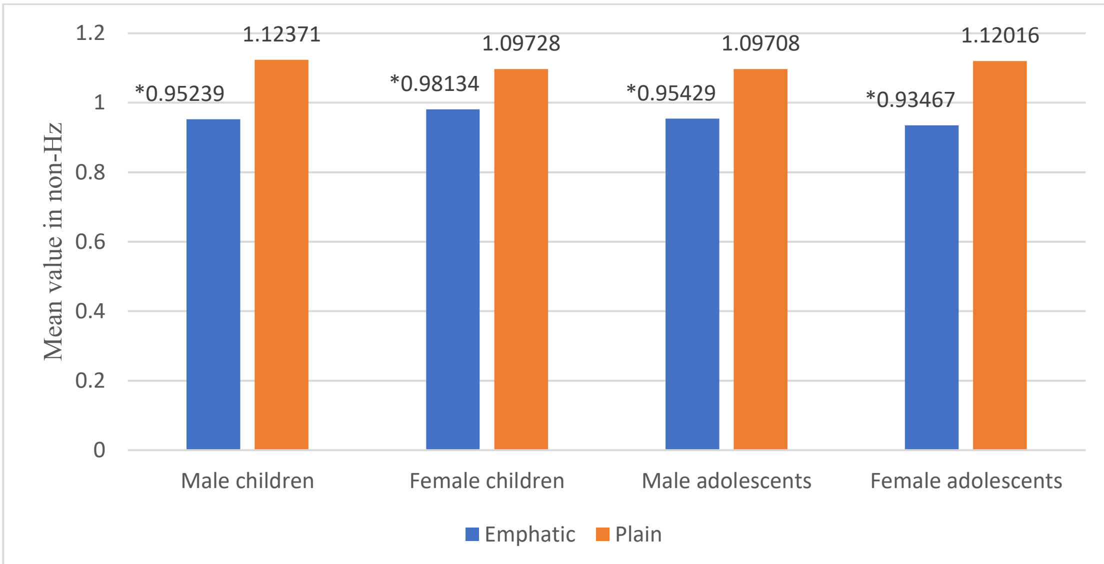


Figure 51. F2 mean values for different genders and age groups in emphatic and plain environments at the onset position.

Nevertheless, the ANOVA test showed that the emphasis by gender by age interaction was not significant on F2 at the midpoint [F(1.3832)= .000, p= .987] and offset [F(1.3832)= 1.601, p= .206] positions.

Similarly, a Three-Way ANOVA indicated that there was a significant interaction in the combination of emphasis*gender*VQ on F2 only at the offset [F(4.3820)= 2.387, p= .049] of the vowel, where the proportion of F2 decrease was generally higher for males than for females in the environment of low than in that of high front and back vowels, except for /u/, which showed a higher degree of F2 decrease for females than for males, as shown in Figure 52 below.

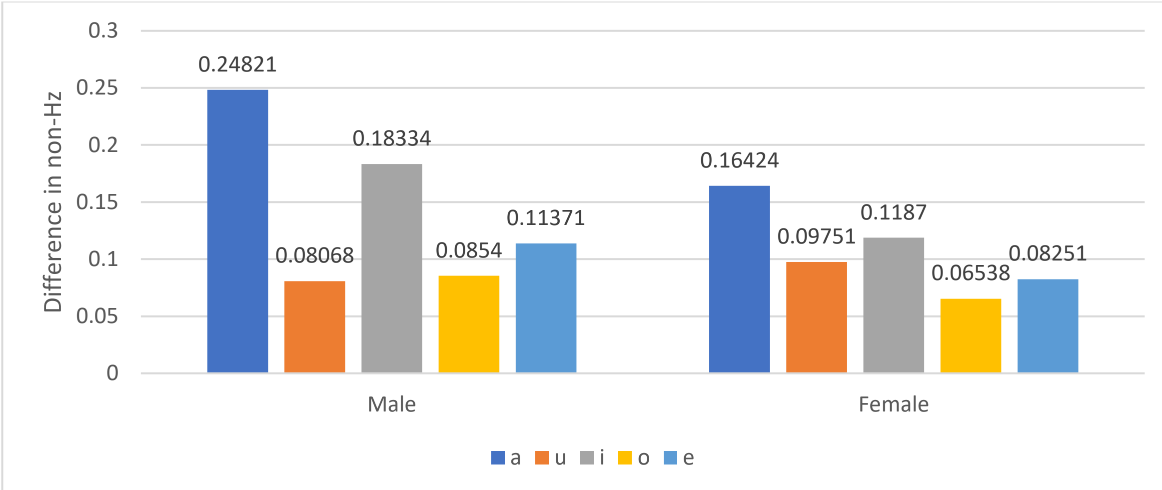


Figure 52. The proportion of F2 lowering in an emphatic environment for males and females in different vowel environments at the offset position.

On the other hand, the ANOVA test showed that the emphasis by gender by VQ interaction was not significant on F2 at the onset [F(4.3820)= 2.290, p= .057] and midpoint [F(4.3820)= 2.021, p= .089] positions.

In addition, a Three-Way ANOVA indicated that there was a significant interaction in the combination of emphasis*manner*PTC on F2 only at the offset [F(1.3832)= 6.003, p= .014] of the vowel, where the proportion of F2 lowering was minimally higher in the vicinity of a word-initial emphatic fricative than in that of a word-initial emphatic stop and where the proportion of F2 lowering was higher in the vicinity of a word-final emphatic stop than in that of a word-final emphatic fricative, as shown in Figure 53 below.

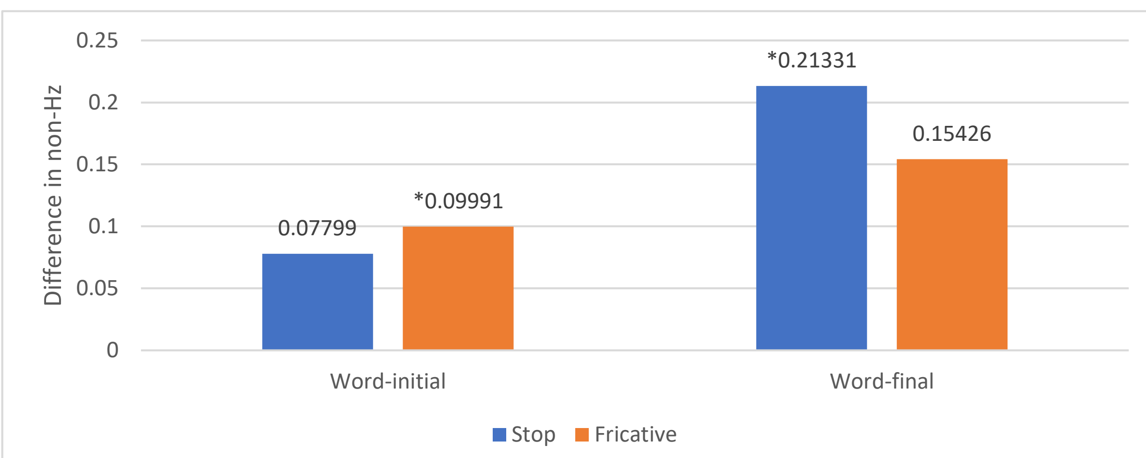
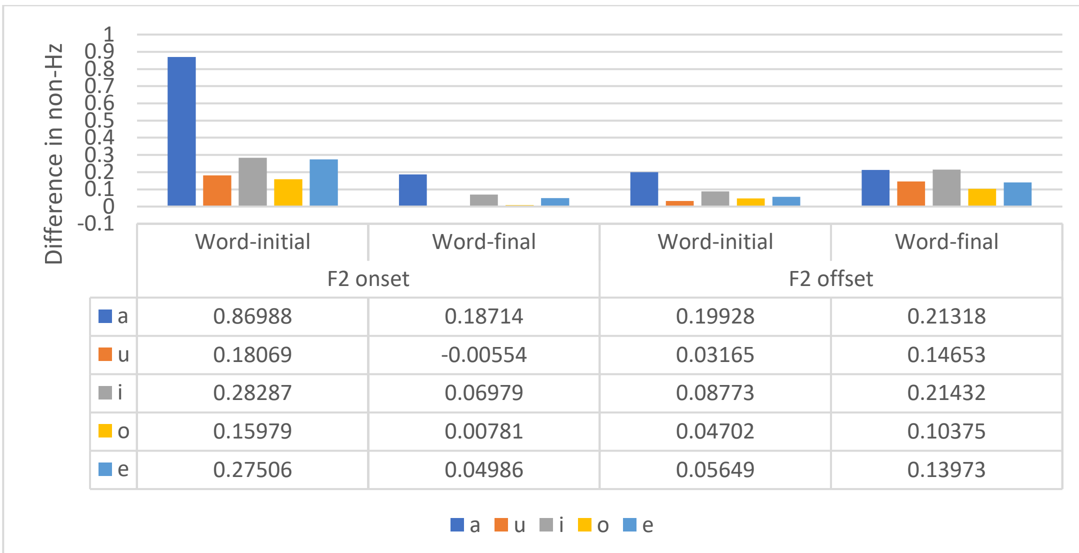


Figure 53. The proportion of F2 lowering in the environments of word-initial and word-final emphatic stops and fricatives at the offset position.

Conversely, the ANOVA test showed that the emphasis by manner by PTC was not significant on F2 at the onset [F(1.3832)= 2.805, p= .094] and midpoint [F(1.3832)= .069, p= .793] positions.

Furthermore, a Three-Way ANOVA indicated that there was a significant interaction in the combination of emphasis*PTC*VQ on F2 at the onset [F(4.3820)= 4.360, p= .002] and offset [F(4.3820)= 3.338, p= .010] of the vowel, where in the former the proportion of F2 decrease was higher in the environment of word-initial emphatics than in that of word-final emphatics across the different vowel environments and where in the latter the opposite was true, as shown in Figure 54 below.



	F2 onset: Word-initial	F2 onset: Word-final	F2 offset: Word-initial	F2 offset: Word-final
a	0.86988	0.18714	0.19928	0.21318
u	0.18069	-0.00554	0.03165	0.14653
i	0.28287	0.06979	0.08773	0.21432
o	0.15979	0.00781	0.04702	0.10375
e	0.27506	0.04986	0.05649	0.13973

Figure 54. The proportion of F2 lowering in an emphatic environment in the environment of different word positions and across different vowel environments.

However, the ANOVA test showed that the emphasis by PTC by VQ interaction was not significant on F2 at the midpoint [F(4.3820)= 1.801, p= .126] position.

Besides, a Three-Way ANOVA indicated that there was a significant interaction in the combination of emphasis*PTC*VL on F2 only at the offset [F(1.3832)= 4.894, p= .027], where the proportion of F2 lowering was consistently higher for short than for long vowels in the environment of both word-initial and word-final emphatic consonants, with prominence of short vowels in the former, as shown in Figure 55 below.

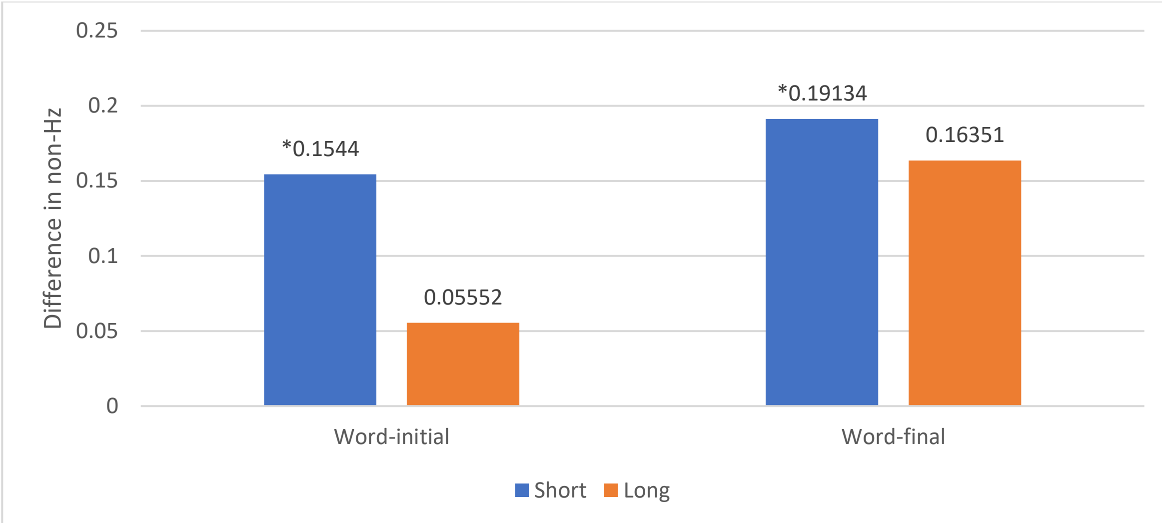


Figure 55. The proportion of F2 lowering in an emphatic environment in the environment of different word positions and across different vowel environments.

However, the ANOVA test showed that the emphasis by PTC by VL was not significant on F2 at the onset [F(1.3832)= 2.634, p= .105] and midpoint [F(1.3832)= .255, p= .614] positions.

In addition, a Three-Way ANOVA indicated that there was a significant interaction in the combination of emphasis*VQ*VL on F2 only at the midpoint [F(2.3824)= 13.442, p= .000] and offset [F(2.3824)= 3.253, p= .039] of the vowel, where the proportion of F2 lowering was consistently higher for short than for long vowels, except for /æ/ at the midpoint position, as shown in Figure 56 below.

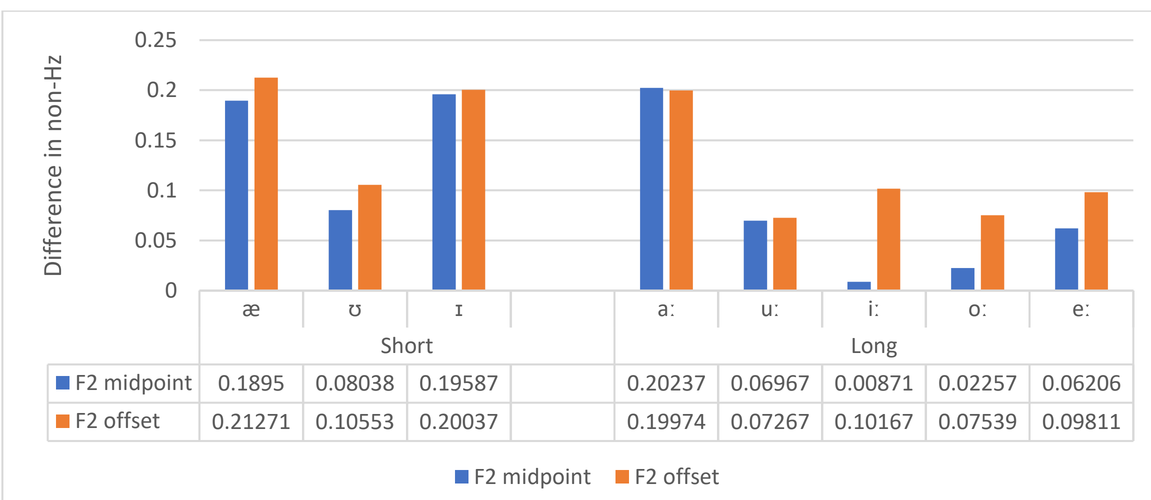


Figure 56. The proportion of F2 lowering for different VL pairs in the environment of word-initial and word-final emphatic consonants at the midpoint and offset positions.

On the other hand, the ANOVA test showed that the emphasis by VQ by VL interaction was not significant on F2 at the onset [F(2.3824)= 2.422, p= .089] position.

Moreover, a Four-Way ANOVA indicated that there was a significant interaction in the combination of emphasis*manner*PTC*VQ on F2 only at the offset [F(4.3800)= 3.680, p= .005] of the vowel, where the proportion of F2 lowering was higher in the environment of a word-final emphatic stop than in that of a word-final emphatic fricative across the different vowel environments and where the proportion of F2 lowering was higher in the environment of a word-initial emphatic stop than in that of a word-initial emphatic fricative only in the vicinity of /a/ and /u/. Figure 57 below displays these differences.

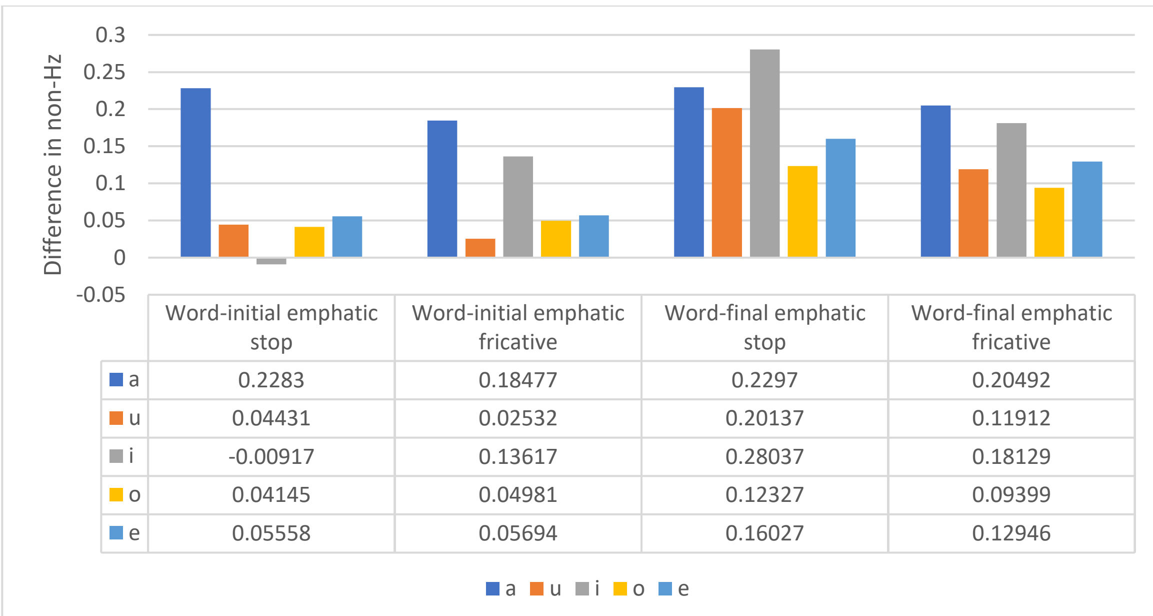


Figure 57. The proportion of F2 lowering in different environments at the offset position.

Nevertheless, the ANOVA test showed that the emphasis by manner by PTC by VQ was not significant on F2 at the onset [F(4.3800)= .423, p= .792] position.

4.2.2.1. Summary of the Main Findings on F2

Table 23 below summarizes the main findings on F2 at different positions of the vowel. An asterisk (*) denotes a significant interaction effect, the (Ø) symbol shows an insignificant interaction effect, the (the (≠) denotes an incomputable effect, the (↑) symbol indicates increased value, and the (↓) symbol denotes decreased value, and the more (↑)/(↓) symbols there are, the more/less increased values there are.

Table 23. *Summary of the main findings on F2.*

Independent Variable	Dependent Variable	Interaction Effect	Groups[101]				
Emphasis	F2 onset	*	E.	↓↓	P.	↓	
Gender		Ø	--				
Age		Ø	--				
Parental education		Ø	--				
Manner		*	St.	↓	Fr.	↓↓	
PTC		*	W.I.	↓	W.F.	↓↓	
VL		*	S.	↓↓	L.	↓	
Emphasis*Parental education		*	T.	↓↓	B.T.	↓	
Emphasis*Manner		*	St.	↓↓	Fr.	↓	
Emphasis*PTC		*	W.I.	↓↓	W.F.	↓	
Emphasis*VQ		*	i ↓↓↓↓	æ ↓↓↓↓↓	u ↓↓	e ↓↓↓	o ↓
Emphasis*Gender*Age		*	See Section 4.2.2.				
Emphasis*PTC*VQ			See Section 4.2.2.				
Emphasis	F2 midpoint	*	E.	↓↓	P.	↓	
Gender		Ø	--				
Age		Ø	--				
Parental education		Ø	--				
Manner		Ø	--				
PTC		Ø	--				
VL		Ø	--				
Emphasis*Gender		*	M.	↓↓	F.	↓	
Emphasis*VQ		*	i ↓↓↓↓	æ ↓↓↓↓↓	u ↓↓↓	e ↓↓	o ↓

[101] Ch. stands for child, Adol. for adolescent, T. for tertiary, B.T. for below tertiary, E. for emphatic, P. for Plain, St. for stop, Fr. for fricative, W.I. for word initial, W.F. for word final, S. for short, and L. for long.

Emphasis*VL		*	S.	↓↓	L.	↓		
Emphasis*VQ*VL[102]		*	See Section 4.2.2.					
Emphasis		*	E.	↓↓	P.	↓		
Gender		Ø	--					
Age		Ø	--					
Parental education		Ø	--					
Manner		*	St.	↓	Fr.	↓↓		
PTC		*	W.I.	↓↓	W.F.	↓		
VL		*	S.	↓↓	L.	↓		
Emphasis*Gender		*	M.	↓↓	F.	↓		
Emphasis*PTC		*	W.I.	↓	W.F.	↓↓		
Emphasis*VQ	F2 offset	*	i ↓↓↓↓	æ ↓↓↓↓↓	u ↓↓	e ↓↓↓	o ↓	
Emphasis*VL		*	S.	↓↓	L.	↓		
Emphasis*Gender*VQ[103]		*	M.	↓↓	F.	↓		
Emphasis*Manner*PTC		*	W.I.	St. ↓	Fr. ↓↓	W.F.	St. ↓↓	Fr. ↓
Emphasis*PTC*VQ		*	See Section 4.2.2.					
Emphasis*PTC*VL		*	W.I.	S. ↓↓	L. ↓	W.F.	S. ↓↓	L. ↓
Emphasis*VQ*VL[104]		*	See Section 4.2.2.					
Emphasis*Manner*PTC*VQ		*	W.I.[105]	St. ↓↓	Fr. ↓	W.F.	St. ↓↓	Fr. ↓↓

[102] This interaction effect was consistent across the different vowel environments, except for /æ/ and /a:/, which were comparable.
[103] This effect was consistent across the different vowel environments except for /u/, which showed a higher F2 decrease for females.
[104] This effect was consistent across the different vowel environments.
[105] This effect was only valid in the /a/ and /u/ environments.

4.2.3. Third Formant Frequency (F3)

A One-Way ANOVA indicated that there was a significant main effect of emphasis on F3 at the onset [F(1.3838)= 10.655, p= .001], where F3 mean value was lower in the environment of an emphatic consonant than in that of a plain consonant, as shown in Figure 58 below.

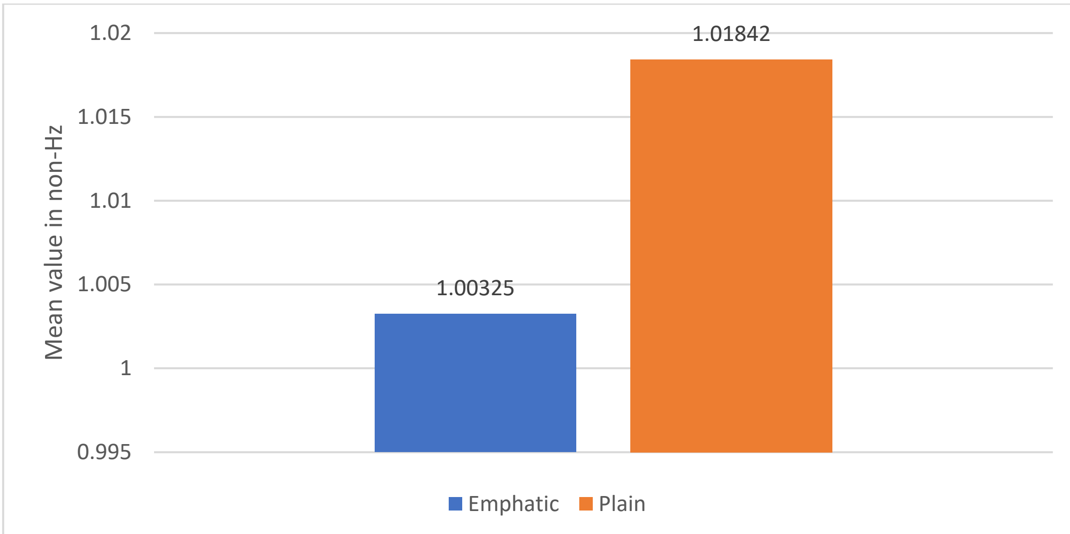


Figure 58. F3 mean values in emphatic and plain environments at the onset of the vowel.

However, the One-Way ANOVA showed that there was no significant main effect of emphasis on F3 at the midpoint [F(1.3838)= .642, p= .423] or offset [F(1.3838)= .068, p= .794] positions.

Although the ANOVA revealed a statistically significant main effect of emphasis on F3, the corresponding interaction pattern did not align with the predicted direction of emphasis. Consequently, F3 cannot be regarded as a robust acoustic correlate of emphasis, and no further analyses involving F3 were conducted.

Chapter 5: Discussion

This chapter discusses the findings of the present study in light of the reviewed literature in Chapter 2. Section 5.1. discusses the main effect of emphasis on the acoustic cues. Section 5.2. discusses the interaction effects between emphasis and each of the other linguistic variables on the acoustic cues; Section 5.3. discusses the interaction effects between emphasis and each of the other social variables on the acoustic cues.

5.1. Main Effect of Emphasis

The current study was designed to test the reliability of each of the acoustic cues, namely FD, SC, VOT, VD, F1, F2, and F3, in detecting emphasis among children and adolescents in AJA. Consequently, the following subsections discuss the main effects of emphasis in light of previous research.

5.1.1. Temporal Cues

The analysis demonstrates that emphatic voiceless stops, compared to plain voiceless stops, exhibited a longer SC interval. This acoustic cue had not, to the best of the researcher's knowledge, been previously examined in JA. Moreover, the analysis revealed that emphatic voiceless stops were characterized by a shorter VOT as compared to plain voiceless stops. This finding, though not very much tackled in previous studies, was corroborated not only in JA but also in a variety of Arabic dialects (Khattab et al., 2006; Abudalbuh, 2010; Alzoubi, 2017; Almomany, 2024, for JA; Almbark, 2008, for Syrian Arabic; Alarifi, 2010, for Urban Najdi Arabic). However, while this finding was opposed by Al Omary (2024), who found that VOT was virtually the same in emphatic and plain environments, few other researchers (Al Malwi, 2017; Kulikov et al., 2020; Al-Ansari and Kulikov, 2022-2023) proposed that the voiceless stops /tˤ/ and /t/ belong to two different VOT categories, namely short-lag and long-lag.

On the other hand, the analysis showed that neither FD nor VD was reliable in detecting emphasis among children and adolescents in AJA. The former finding was attested by the majority of previous research on emphasis (Almbark, 2008; Alarifi, 2010; Al-Ansari and Kulikov, 2022-2023; Omari and Jaber, 2019; Almomany, 2024). Nevertheless, our finding in terms of FD contradicts Abudalbuh's (2010), where he found that emphatic fricatives exhibited a longer duration than their plain cognates. Regarding our finding on VD, it confirms those of Almbark (2008), Al-Masri (2009), and Salem and Sebane (2023) while simultaneously running counter to those of Abudalbuh (2010) and Omari and Jaber (2019), who found that emphaticized vowels were longer than their plain counterparts.

5.1.2. Spectral Cues

The current study indicates that F1 of emphaticized vowels was, though not as robust as F2, significantly higher than that of plain vowels throughout the vowel. This finding replicates those of Zawaydeh (1998), Khattab et al. (2006), Jongman et al. (2007), Al-Masri (2009), Abudalbuh (2010), Alarifi (2010), Jongman et al. (2011), Kalaldeh and Al-Shdaifat (2019), Alahmari (2020), Kulikov 2020, Al-Ansari and Kulikov (2022-2023), and Almomany (2024). Despite this conformity, our finding in terms of F1 opposes those of Card (1983), Saed et al., 2022; Al Omary (2024), who found that emphaticized and plain vowels showed comparable F1 values.

In addition, the present study shows that F2 was consistently lower in an emphatic environment than in a plain environment throughout the vowel. This finding ratifies almost all previous studies on the acoustics of emphasis not only in JA but also in other varieties of Arabic (Card, 1983; Zawaydeh, 1998; Al-Masri and Jongman, 2004; Khattab et al., 2006; Embarki et al., 2007; Jongman et al., 2007; Al-Masri, 2009; Abudalbuh, 2010; Alarifi, 2010; Jongman et al., 2011; Alfraikh, 2015; Alzoubi, 2017; Jaber et al., 2019; Kalaldeh and Al-Shdaifat, 2019; Omari and Jaber, 2019; Alahmari, 2020; Kulikov et al., 2020; Omari and Jaber, 2020; Alsuhaibani, 2022; Saed et al., 2022; Al-Ansari and Kulikov, 2022-2023; Salem and Sebane, 2023; Almomany, 2024; Al Omary, 2024).

On the other hand, although the current study demonstrates that emphasis had a statistically significant main effect on F3 at the onset of the vowel, this interaction effect was in the opposite direction of emphasis. That is, F3 of emphaticized vowels was lower than that of plain vowels. Although F3 was not investigated as extensively as F1 and F2, our finding on F3 lends support to some previous studies (Card, 1983; Saed et al., 2022; Salem and Sebane, 2023). However, our finding contradicts those of the bulk of previous research (Jongman et al., 2007; Almbark, 2008; Al-Masri, 2009; Abudalbuh, 2010; Alarifi, 2010; Jongman, 2011; Alzoubi, 2017; Jaber et al., 2019; Omari and Jaber, 2019; Kulikov et al., 2020; Omari and Jaber, 2020; Al-Ansari and Kulikov, 2022-2023; Almomany, 2024), where F3 of emphaticized vowels was found to be higher than lower.

In summary, emphasis is predominantly identifiable via F2, whereas it is less so through F1. Yet, since Arabic emphasis is realized differently in different Arabic dialects (e.g., pharyngealization in JA versus uvularization in Qatari Arabic), it is not unexpected that its exponents vary from one variety to another.

5.2. Phonetically-driven Interactions

The current study is initiated to verify the potential interaction effects between emphasis, on the one hand, and manner, PTC, VQ, and VL, on the other hand. Hence, the following subsections discuss the findings of these interactions in relation to those of previous studies where applicable.

5.2.1. Temporal Cues

The analysis shows that the interaction between emphasis, VQ, and VL was statistically significant on SC, where participants exhibited longer SC intervals in an emphatic environment as compared to those in a plain environment across the different VL pairs. Yet, the pattern of change was not uniform, as participants showed a great deal of overlap in terms of SC. In other words, the emphatic-plain contrast in terms of SC was largest in the environment of /ʊ/ (17.636 ms) and smallest in the environment of /ɪ/ (1.033). Figure 59 below displays these differences.

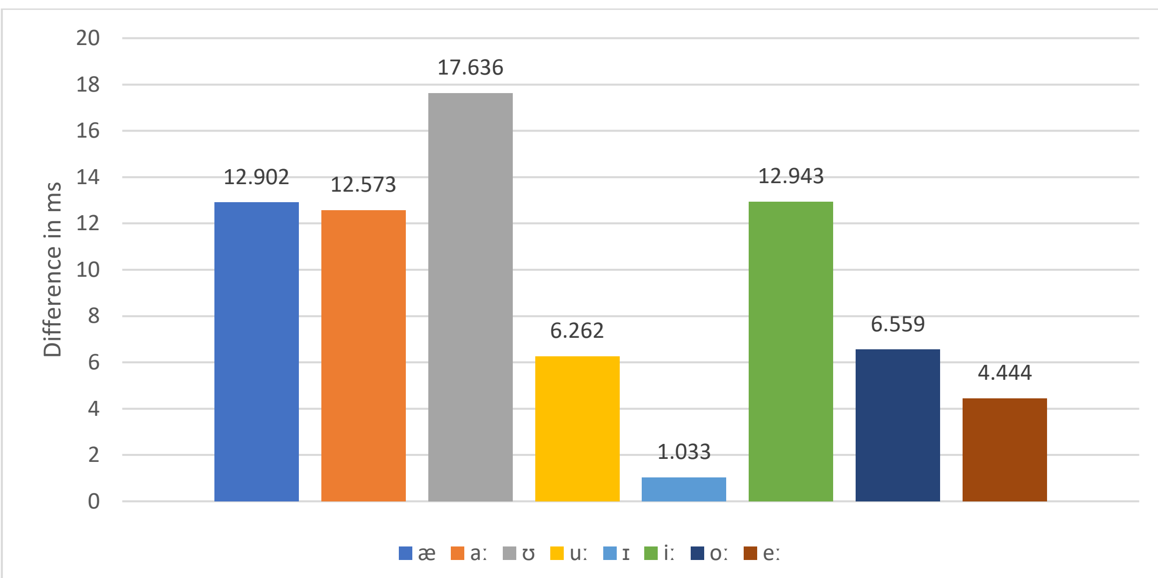


Figure 59. Emphatic-plain contrast in terms of SC across different vowels.

By examining the table above, it is apparent that the emphatic-plain contrast in terms of SC varies across different vowel qualities and is thus reliant on VL[106]. Except for the low vowels /æ/ and /aː/[107], there seems to be a great deal of overlap between the short and long variants in the other two VL pairs, where the short variants, especially /ɪ/, show a marginal difference. Besides, since the mid-front and mid-back vowels /eː/ and /oː/ do not have short contrasting counterparts, it is impossible to integrate them with other VL pairs as far as both VQ and VL are concerned.

It is noteworthy that this study is, to the best of my knowledge, the first to explore the coupled effects of VQ and VL on emphasis production in a tripartite design. However, this finding partially confirms those proposed by the majority of previous studies (Card, 1983; Zawaydeh, 1998; Khattab et al. 2006; Alarifi, 2010; Kalaldeh and Al-Shdaifat, 2019; Alahmari, 2020; Kulikov et al., 2020; Al-Ansari and Kulikov, 2022-2023, among others), which point to the salience of the emphatic-plain contrast in the environment of the low vowels.

Besides, the study shows that the interaction between emphasis and VL was statistically significant on VOT, where the emphatic-plain contrast in terms of VOT was significantly greater in the environment of a long vowel than in that of a short vowel. This finding, though not tackled in prior research, points counter to those who claimed that emphasis is more acoustically pronounced in the vicinity of a short vowel than in that of a long vowel (Al-Masri, 2009; Jongman et al., 2011; Kalaldeh and Al-Shdaifat, 2019).

Similar to SC, the analysis demonstrates that the interaction between emphasis, VQ, and VL was statistically significant on VOT, where the emphatic-plain contrast in terms of

[106] Further two Univariate ANOVAs were conducted to verify whether the emphasis by VQ or VL interactions were significant on SC, where none of them revealed significance.
[107] This finding probably predicts the invariable status of the low vowels in detecting emphasis.

VOT was largest in the environment of /iː/ and smallest in that of /ɪ/. Figure 60 below displays these differences.

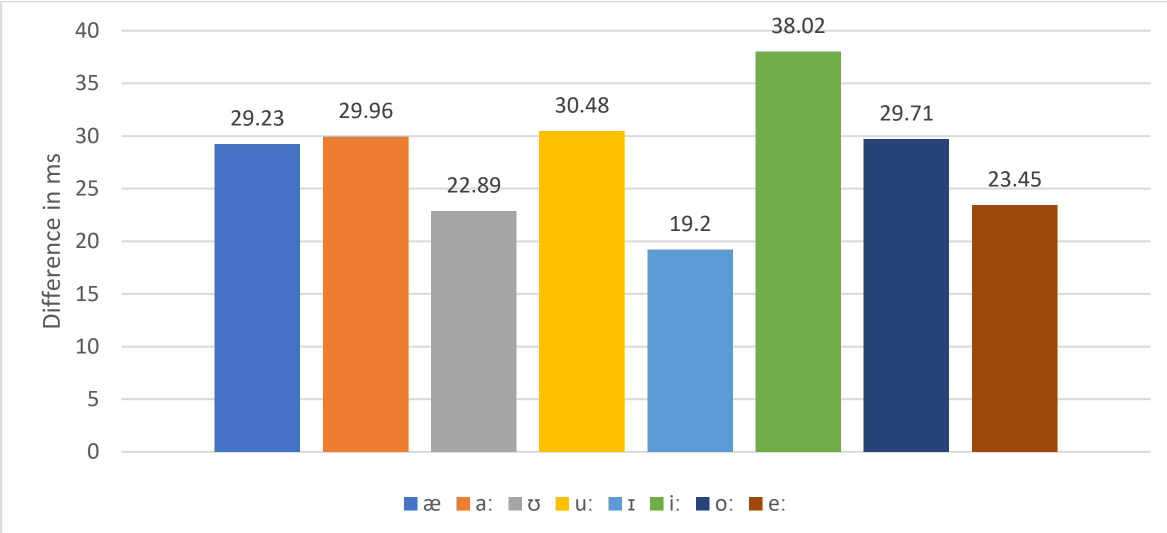


Figure 60. Emphatic-plain contrast in terms of VOT across different vowels.

What these differences suggest is that the effect of emphasis is contingent on both VQ and VL. That is, the amount of VOT shortening between emphatic and plain environments varies across the different VL pairs, thus suggesting a directional asymmetry favoring long and high vowels (i.e., /iː/). For instance, while the long high front vowel /iː/ manifested the greatest emphatic-plain contrast, its short counterpart showed the smallest emphatic-plain contrast. Back vowels, on the other hand, showed less variation, with low vowels being virtually unaffected by VL. This latter finding suggests that low vowels are unfailing in detecting emphasis, which is attested by the bulk of earlier research (Card, 1983; Zawaydeh, 1998; Khattab et al. 2006; Alarifi, 2010; Kalaldeh and Al-Shdaifat, 2019; Alahmari, 2020; Kulikov et al., 2020; Al-Ansari and Kulikov, 2022-2023, inter alia). As for /oː/ and /eː/, both showed similar degrees of contrast in terms of VOT between emphatic and plain environments; therefore, they do not have short contrasting counterparts.

5.2.2. Spectral Cues

5.2.2.1. First Formant Frequency (F1)

The study shows that the interaction between emphasis and PTC was statistically significant at the onset and offset positions. At the onset, the emphatic-plain contrast was significantly greater in the environment of a word-initial emphatic consonant than in that of a word-final emphatic consonant. The offset, on the other hand, showed the opposite, where the emphatic-plain contrast was significantly greater in the environment of a word-final emphatic consonant than in that of a word-initial emphatic consonant. What this interaction effect signifies is that the farther the portion of the vowel from the emphatic consonant is, the less affected it becomes. This conclusion runs in tandem with Zawaydeh (1998), Jongman et al., (2007), Al-Masri (2009), Alarifi (2010), and Alsuhaibani (2022) while simultaneously opposing that of Jongman et al. (2011), who argued that emphasis spread is evident throughout the vowel in CVC constructions. Additionally, our finding on F1 does not lend support to Alzoubi (2017), who found that the emphatic-plain contrast in terms of F1 was substantial from a word-final, but not word-initial, emphatic consonant. Besides, the absence of effect on F1 at the midpoint of the vowel is attested by Al-Ansari and Kulikov (2022-2023), who found that F1 raising was substantial only at the onset of the vowel.

In addition, the study demonstrates that the interaction between emphasis and VL was statistically significant on F1 at the midpoint and offset position, where the emphatic-plain contrast was consistently greater for short than for long vowels. Minimally aligning with this finding is Jongman et al.'s (2011), where they found that in the vicinity of a word-final emphatic consonant, the emphatic-plain contrast in terms of F1 at the onset and midpoint was consistently greater for short than long vowels. Notwithstanding, they argued that the only legitimate temporal point for comparing short and long vowels in this environment is the vowel offset, which did not show any significance. Thus, this interaction effect is dubbed unimportant.

Besides, the analysis shows that the interaction between emphasis, manner, and PTC was, though less consistent, statistically significant on F1 only at the onset position. To clarify, while the emphatic-plain contrast in terms of F1 was greater for word-initial stops than word-initial fricatives, it was comparable for both word-final stops and fricatives. Figure 61 below displays these differences.

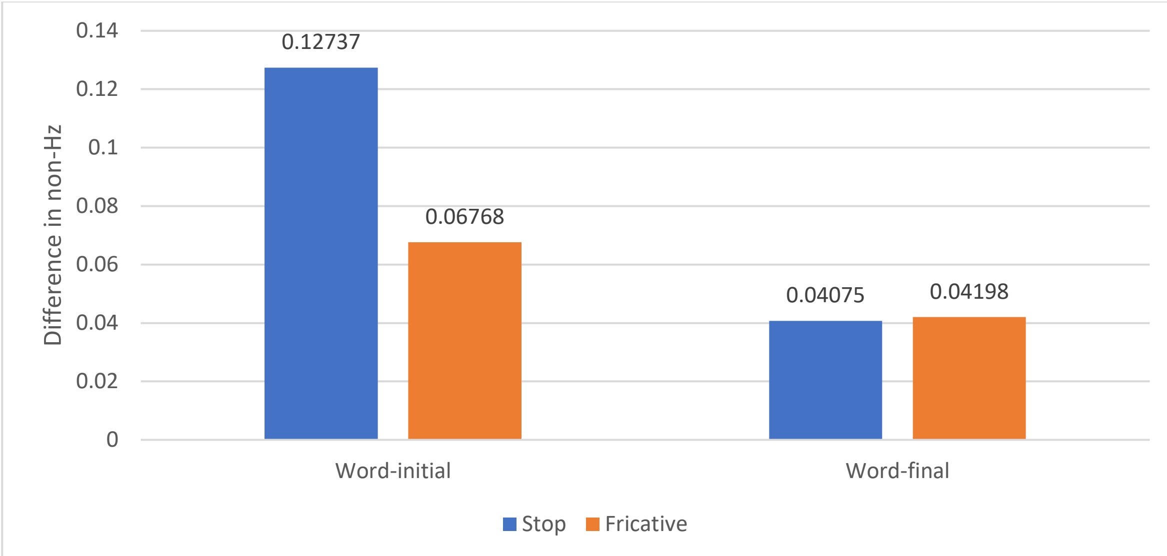


Figure 61. Emphatic-plain contrast in terms of F1 in different environments.

Although the interaction in terms of F1 shows salience of the emphatic-plain contrast in the environment of a word-final fricative than in that of a word-final stop, the difference is not substantial. Though insignificant across the other two measurement points (i.e., midpoint and offset), this interaction effect on F1 might be an indicator of contrast neutralization or overlap effect between word-final stops and fricatives.

Moreover, the study indicates that the interaction between emphasis, VQ, and VL on F1 at the midpoint of the vowel was statistically significant, where the effect of VQ was contingent upon that of VL. To clarify, the emphatic-plain contrast in terms of F1 was consistently greater in the environment of a short vowel than in that of a long vowel, thus confirming our earlier finding on the interaction between emphasis and VL. Besides, the emphatic-plain contrast in terms of F1 was, though less consistently, greater in the environment of a front vowel than in that of a back vowel. These findings are partially in line with Jongman et al. (2007), Al-Masri (2009), Alarifi (2010), Jongman et al. (2011), and Kalaldeh and Al-Shdaifat (2019), who found that emphasis is significantly affected by VQ.

5.2.2.2. Second Formant Frequency (F2)

The study reveals several consistent interaction effects between emphasis and the other linguistic variables in terms of F2. The interaction between emphasis and manner on F2 was statistically significant at the onset. However, the emphatic-plain contrast was slightly greater in the vicinity of a stop than in that of a fricative. This is in line with Jongman et al. (2011) and Omari and Jaber (2020), who found that F2 was lower following an emphatic stop than following an emphatic fricative. Similar to that on F1, the interaction between emphasis and PTC on F2 was statistically significant at both the onset and offset positions. At the onset, the emphatic-plain contrast in terms of F2 was significantly greater in the vicinity of a word-initial emphatic consonant than in that of a word-final emphatic consonant. However, this pattern of change was reversed at the offset position, where the emphatic-plain contrast was significantly greater in the vicinity of a word-final emphatic consonant as compared to that of a word-initial emphatic consonant. This finding lends support to those who found that emphasis spread is proportional to the proximity of the vowel portion to the emphatic segment (i.e., gradient spread) (Zawaydeh, 1998; Jongman et al., 2007; Al-Masri, 2009; Alarifi, 2010; Alsuhaibani, 2022). Nevertheless, our finding on F2 runs counter to that of Jongman et al. (2011), who pinpointed that F2 was consistently lower in an emphatic environment than in a plain environment throughout the vowel in the vicinity of both word-initial and word-final emphatic consonants.

The study also indicates a significant interaction effect between emphasis and VQ at the onset, midpoint, and offset of the vowel. On the whole, the emphatic-plain contrast in terms of F2 was consistently greatest in the context of /a/, followed by /i/, /e/, /u/, and /o/, except for the midpoint, where /e/ overlapped with /o/. It is now apparent that emphasis is more acoustically salient on low vowels than on front vowels, which in turn show greater emphatic-plain contrast than back vowels. This finding suggests that the degree to which emphasis affects neighboring segments is contingent upon VQ, which is corroborated by the bulk of previous studies on emphasis (Al-Masri, 2009; Alarifi, 2010; Jongman et al., 2011; Alzoubi, 2017; Kalaldeh and Al-Shdaifat, 2019). However, our finding on F2 opposes that of Almbark (2008), who found that the emphatic-plain contrast in terms of F2 was maintained regardless of the vowel environment, especially in the vicinity of a fricative.

Similar to that on F1, the study demonstrates a significant interaction between emphasis and VL on F2 only at the offset position, where the emphatic-plain contrast was significantly greater for short than long vowels. This finding is in line with Al-Masri (2009), Jongman et al. (2011), and Kalaldeh and Al-Shdaifat (2019), who proposed that emphasis was more acoustically pronounced for short than for long vowels. Despite these statistically significant differences and in line with Jongman et al. (2011), it would be inaccurate to generalize this finding without taking into consideration other underlying factors, such as the difference in the proximity of the portion of the vowel to the emphatic consonant between short and long vowels. Therefore, the researcher considers this finding more suggestive than normative.

The study reveals further noteworthy interactions between emphasis and additional linguistic factors in a tripartite framework. Initially, the interaction between emphasis, manner, and PTC showed a statistically significant effect on F2 only at the offset. The emphatic-plain contrast in terms of F2 was significantly higher for stops than for fricatives in the vicinity of a word-final emphatic consonant than in that of a word-final emphatic fricative, a finding that substantiates our earlier finding on manner. On the other hand, the interaction shows a reversed image for F2 in the vicinity of a word-initial emphatic consonant, where the emphatic-plain contrast was higher for fricatives than stops. Notwithstanding, the degree of difference between stops and fricatives was not so high as to conclude that fricatives spearheaded stops in F2 lowering.

Additionally, the interaction between emphasis, PTC, and VQ demonstrated statistical significance on F2 at both the onset and offset positions. Specifically, the contrast between emphatic and plain consonants was substantially more pronounced from a word-initial emphatic consonant than from a word-final emphatic consonant across the different vowel qualities at the onset, whereas the reverse was observed at the offset. This finding replicates the previously reported interaction effects between emphasis and PTC, that is, the gradient manner of emphasis spread. More importantly, this interaction indicates that the magnitude of the emphatic–plain contrast was systematically greater in the environment of a low vowel than in the environments of a high front vowel or a back vowel, irrespective of PTC, thus confirming our earlier findings on the interaction between emphasis and VQ. This finding is in line with Jongman et al.'s (2011), where they found that F2 of emphaticized /a/ was consistently lower throughout the vowel, regardless of PTC. The researchers pinpointed that while /i/, similar to our finding, showed a decreasing effect, /u/ was virtually unaffected by a word-final emphatic consonant.

Verifying the previous findings on the effects of VQ and VL, the analysis shows that the interaction between emphasis, VQ, and VL was statistically significant on F2 at the midpoint and offset positions, where short vowels generally exhibited a higher emphatic-plain contrast in terms of F2 across the different vowel qualities, except for the low vowels, which were comparable. It is noteworthy that the midpoint of short vowels is closer to the source of emphasis. Figure 62 below displays these differences.

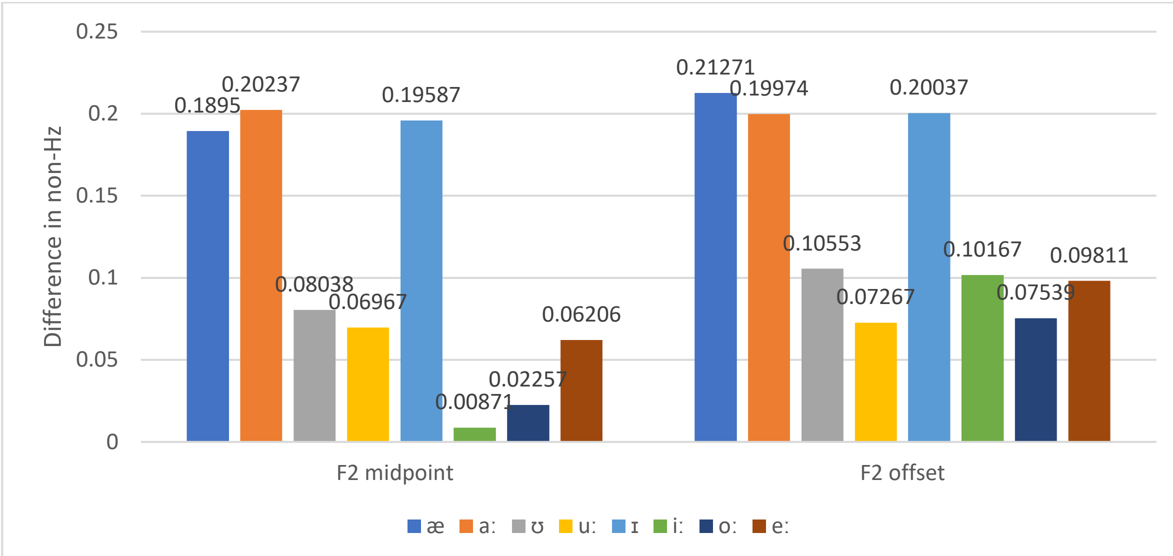


Figure 62. Emphatic-plain contrast in terms of F2 in different vowel environments.

It can be deduced from the figure above that short vowels, compared to their long cognates, consistently show a higher proportion of F2 lowering. Yet, this finding, as noted earlier, should not be taken in isolation from other underlying effects such as those originating from the proximity of the vowel portion to the target segment. It is noteworthy that none of the previous studies tackled this interaction effect in this manner (i.e., emphasis x VQ x VL).

Corroborating our suggestive finding on the salience of short vowels in carrying a greater magnitude of change in the direction of emphasis, the study indicates that the interaction between emphasis, PTC, and VL was statistically significant on F2 only at the offset position. The emphatic-plain contrast in terms of F2 was significantly higher for short than long vowels only in the vicinity of word-initial consonants. The difference in terms of F2 in the vicinity of word-final consonants was almost the same. This finding aligns with Al-Masri (2009), Jongman et al. (2011), and Kalaldeh and Al-Shdaifat (2019), who found that the emphatic-plain contrast in terms of F2 was significantly greater for short than long vowels. Yet, a careful examination of the magnitude of difference between short and long emphaticized vowels in terms of F2 in the vicinity of a word-final emphatic consonant, as compared to that in the vicinity of a word-initial emphatic consonant, underpins Jongman et al.'s (2011: 89) interpretation, which points to the effect of the relative distance between the emphatic consonant and the measurement point. Consequently, this finding on VL is dubbed unimportant.

Finally, the analysis also shows a statistically significant interaction effect between emphasis, manner, PTC, and VQ on F2 at the offset. The emphatic-plain contrast was consistently higher for front than back vowels in the vicinity of a stop, primarily word-final, than in that of a fricative (see Figure 57). These findings corroborate our earlier findings and those of others on the salience of stops and (low) front vowels over fricatives and back vowels in detecting emphasis, with a positive correlation when the target consonant is closer to the measurement point.

5.3. Sociophonetics of Emphasis

The foremost objective of this study was to examine how social factors such as gender, age, and parental education influence emphasis production among children and adolescents in AJA. The following subsections discuss our findings on the temporal and spectral cues in light of the previous studies on the sociophonetics of emphasis.

5.3.1. Temporal Cues

The study indicates that variables such as gender, age, and parental education did not produce any statistically significant effects on FD. Thus, the findings demonstrate that participants exhibited similar FDs in both emphatic and non-emphatic contexts, irrespective of their gender, age group (children or adolescents), or the educational background of their parents. This finding runs in tandem with that of Almbark (2008), positing that neither gender nor region had any salient effects on FD. This finding also corroborates that of Abudalbuh (2010), who argued that males and females exhibited almost identical values of FD between emphatic and plain environments. Similarly, our finding lends support to that of Omari and Jaber (2019), who found that neither gender nor social class had any significant effects on FD. In the same way, the analysis indicates that none of the social variables had any significant effects on SC. This finding was not, to the best of my knowledge, tackled in previous studies, and thus it cannot be discussed further.

As for VOT, a similar finding with no statistically significant bearings from any of the social variables was obtained. This finding corroborates Abudalbuh's (2010) and Omari and Jaber's (2019) findings, where they found that gender did not have any considerable effects on the VOT of voiceless stops. Further supporting our finding are Omari and Jaber's (2019) findings regarding the interactions between emphasis and social class, on the one hand, and emphasis, gender, and social class, on VOT, on the other hand. The researchers maintained that neither the former nor the latter yielded any notable differences in terms of VOT.

However, our finding runs counter to those of Almbark (2008), Al Malwi (2017), Almomany (2023a), and Salem and Sebane (2023), who found that the emphatic-plain contrast in terms of VOT was greater for females than males. Running counter to our finding is Al Malwi's (2017) finding that age (children versus adults) had a salient effect on VOT of /tˤ/, where children showed comparable, but not identical, VOT values to those of adults.

Though pointing to a different direction of change, Alzoubi's (2017) findings regarding the bearings of gender and speaker's origin on VOT are in opposition to ours. To clarify, he found that, relative to gender, males exhibited a higher emphatic-plain contrast in terms of VOT than females. Therefore, he argued that the emphatic-plain contrast in terms of VOT was greater for speakers from rural Palestinian origin than those from rural Jordanian and urban Palestinian origins, respectively. Likewise, our finding on VOT is not in line with that of Almomany (2023b), who found that, relative to age, the emphatic-plain contrast in terms of VOT was greater for speakers of the second age group (36-50), followed by those of the third (51 and above) and first (18-35) age groups. Additionally, Almomany's (2024) finding, where females exhibited a higher emphatic-plain contrast in terms of VOT as compared to their male peers across the different age groups, contradicts ours.

Moreover, the present study illustrates that gender, age, and educational background did not exhibit significant effects on VD. Concisely, the durational values of emphaticized and plain vowels were similar, irrespective of the speaker's gender, age, and/or the educational background of their parents. This finding is in line with Almbark (2008), Al-Masri (2009), Abudalbuh (2010), Omari and Jaber (2019), and Salem and Sebane (2023), who found that social variables by no means affect VD. The findings of Omari and Jaber (2019) partly contradict the current study's conclusion concerning the influence of social variables on VD. Their research suggests that the influence of social class manifests in the observation that individuals from the lower-middle class exhibited prolonged durations for emphaticized vowels compared to plain vowels, whereas individuals from the upper class demonstrated comparable durations for both vowel types.

5.3.2. Spectral Cues

5.3.2.1. First Formant Frequency (F1)

The study reveals a significant interaction effect between emphasis and gender on F1 throughout the vowel. The interaction shows that males consistently exhibited a higher emphatic-plain contrast in terms of F1 than females. This finding aligns with the bulk of previous studies on the sociophonetics of emphasis (Abudalbuh, 2010; Alzoubi, 2017; Omari and Jaber, 2019; Omari and Jaber, 2020) while simultaneously opposing that of Almbark (2008), who did not find any significant effects of gender in terms of F1. In the same manner, Alfraikh (2015) pinpoints that females' F1 in emphatic environment, unlike that of their male peers which was lowered than raised, was occasionally higher as compared to their in plain environment. Besides, Almomany (2023a) also argue that gender did not affect F1, thus opposing our finding which show the opposite. Similar to Almomany (2023a), Salem and Sebane (2023) propose that F1 was by no means affected by gender, thus running contrary to our finding.

In a nutshell, studies on the sociophonetics of emphasis in JA, except for Almomany (2023a) support our finding that males exhibited a higher emphatic-plain contrast in terms of F1. The discrepancy between Almomany's (2023a) finding and ours is likely because he drew his findings based on a small number of participants. On the other hand, studies on emphasis in other varieties of Arabic (e.g., Almbark, 2008, for Syrian Arabic) were in opposition to our finding on F1, which could be attributed to methodological shortcomings. For instance, Alfraikh (2015) arrived on his conclusions based on a very limited number of participants (four speakers), not to mention that he did not normalize the raw formant frequencies against physiological differences.

More importantly, since this study was designed to investigate the production of emphasis in the speech of two age groups, namely children and adolescents, the study indicates a statistically significant interaction effect between emphasis and age on F1 at the midpoint and offset of the vowel. Put plainly, adolescents consistently exhibited a higher emphatic-plain contrast in terms of F1 than children. This finding would be best discussed in light of studies with similar target age groups, yet this is not possible due to the lack of such studies. However, Al Malwi's (2017) conclusion that children's VOTs significantly diverged from those of adults partially corroborates our finding. Besides, our finding runs counter to Mashaqba et al.'s (2022) finding, where they found that children produced the emphatic sounds in an adult-like manner at the age of six word-initially and word-medially, and at the age of seven word-finally. In opposition to our finding is Almomany's (2023b) finding, where he claimed that age did not exert any significant effects on F1, a finding that probably resulted from the unnormalized formant frequencies. Although our findings do not align with those of Almomany (2024), his conclusion suggests that the interplay between age and gender presents a more comprehensive understanding of the interaction effects. He argued that females within the third age group demonstrated a leading role in emphasis production compared to their male counterparts.

In addition, the analysis indicates a statistically significant interaction effect between emphasis, gender, age, and VQ on F1 at the midpoint. The emphatic-plain contrast in terms of F1 was, on average, significantly higher for adolescents than for children. Moreover, male speakers, especially male adolescents, exhibit a higher emphatic-plain contrast in terms of F1 than females. Although there were significant patterns of change both among males and females and among children and adolescents, VQ seems to affect these differences. In sum, female children show a greater degree of overlap (i.e., negative shifts) than male children, whose negative shift was confined to /o/. A closer examination of the overall effects reveals robust conclusions. Foremost, while male and female adolescents show salient emphatic-plain contrast in terms of F1 in the environment of the front vowels /e/ and /i/, male and female children show inconsistent patterns. Therefore, it could be argued that children are still at a developmental stage in acquiring emphatic sounds, which is proportional to age (i.e., the older the speaker is, the more emphatic and thus more consistent their speech becomes).

Despite the lack of acoustic studies on the speech of children and adolescents, the current study's findings lend support to the bulk of previous studies on the sociophonetics of emphasis on JA (Abudalbuh, 2010; Alzoubi, 2017; Omari and Jaber, 2019; Omari and Jaber, 2020; Almomany, 2024, among others). However, our finding is in opposition to those of Almomany (2023a) and Almomany (2023b), who found that gender did not have any statistically significant effect on F1. Therefore, our finding is in opposition to those of Almbark (2008) and Salem and Sebane (2023), who found no significant effect of gender on F1, thus claiming that females' speech is more emphatic than that of males through F2. Similarly, our finding runs counter to that of Alfraikh (2015), arguing that females, unlike males whose F1 was lowered than raised, inconsistently maintained the emphatic-plain contrast in terms of F1.

Furthermore, the analysis demonstrates a statistically significant interaction between emphasis, gender, age, and parental education on F1 only at the offset position. The emphatic-plain contrast between males and females was maintained, with males leading females. Moreover, adolescents generally maintained, especially males whose parents had received tertiary education, a higher emphatic-plain contrast than children. On the other hand, education-graded effects show more overlap, particularly for females. That is, while males whose parents had received tertiary education showed, except for male children, a higher emphatic-plain contrast, females showed more overlapped findings, as shown in Figure 63 below.

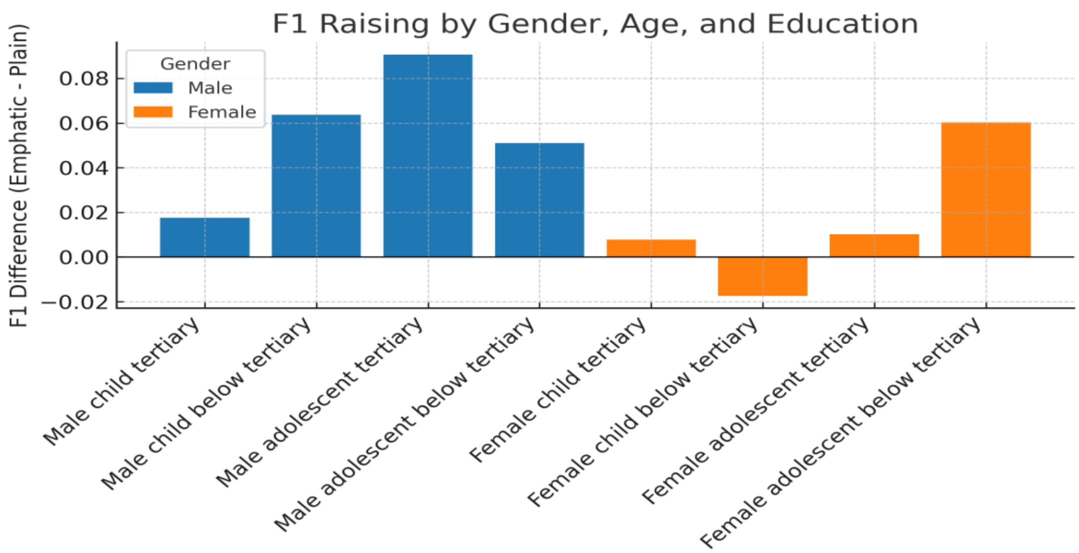


Figure 63. Emphatic-plain contrast in terms of F1 for different gender, age, and parental education groups.

What these findings suggest is that the potential effects of parental education are contingent upon those of gender and age, where we see that children show more overlap than adolescents, pointing to their inadequate acquisition of emphatic sounds at least socially. Therefore, a meticulous examination of the figure reveals that education-related effects are best observed among adolescents. That is, while female adolescents whose parents had received tertiary education show a tiny emphatic-plain contrast, suggesting a departure from sounding more emphatic, their female peers whose parents had received below-tertiary education did the opposite. Additionally, adolescent males whose parents had received tertiary education exhibit a higher emphatic-plain contrast than their peers whose parents had received below tertiary education, probably suggesting their less self-monitored speech.

5.3.2.2. Second Formant Frequency (F2)

The study shows some significant interaction effects between emphasis and the other social and linguistic variables. The analysis indicates a statistically significant interaction effect between emphasis and gender on F2 at the midpoint and offset of the vowel. The emphatic-plain contrast was consistently higher, though only slightly at the midpoint, for males than for females. Figure 64 displays these differences.

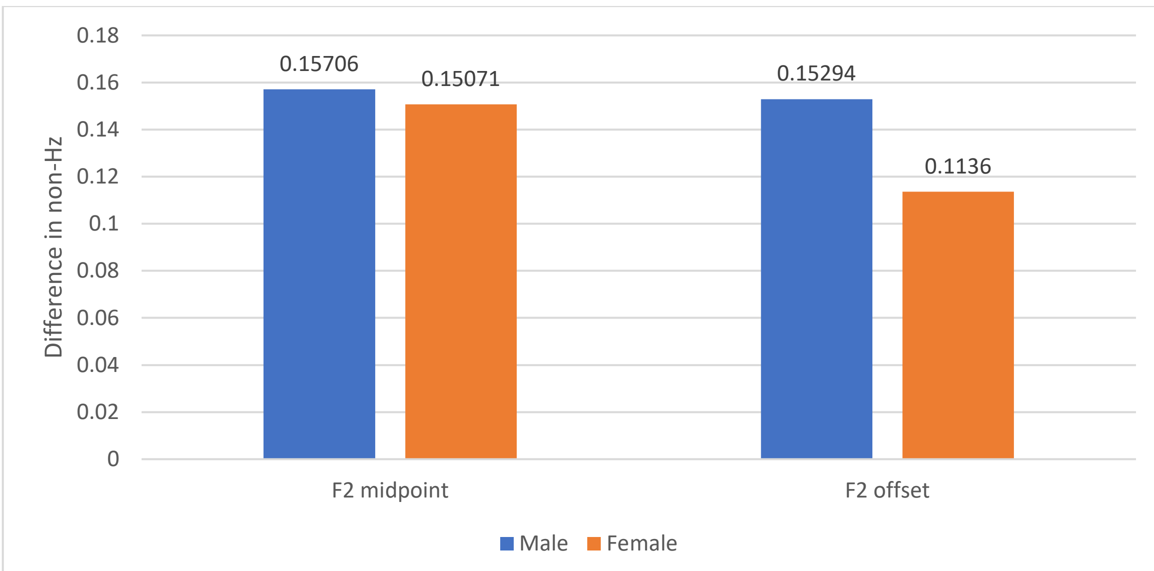


Figure 64. Emphatic-plain contrast in terms of F2 for males and females at the midpoint and offset positions.

By looking at the figure above, it becomes clear that while males and females maintain comparable emphatic-plain contrasts at the onset, males outrank females in carrying a larger emphatic-plain contrast at the offset. While the former finding corroborates those of Omari and Jaber (2020), Almomany (2023a), Salem and Sebane (2023), and Almomany (2024), who found no significant bearings of gender on F2, the latter finding is in line with those of Abudalbuh (2010), Alfraikh (2015), Alzoubi (2017), and Omari and Jaber (2019), who pinpointed that males manifested a greater emphatic-plain contrast in terms of F2 than females. Yet, the latter finding runs counter to that of Almbark (2008), who found that females maintained a higher emphatic-plain contrast in terms of F2 than males. The present study's findings suggest that females show, compared to males, more overlap in the degree of F2 lowering, probably pointing to a less pronounced effect of emphasis.

Conversely, the study demonstrates that the interaction between emphasis and age was not statistically significant in terms of F2, thus opposing our earlier finding on F1. This finding in tandem with Almomany's (2023b) finding, where age did not yield any significance in terms of F2. On the other hand, our finding runs counter to Al Malwi's (2017) finding, where he argued that children's VOTs were distinct from those of their adult peers. Similarly, our finding opposes that of Mashaqba et al.'s (2022), where they claimed that children produced the emphatic consonants just like adults at the ages of six and seven. Although our finding is not in tandem with those of Almomany (2024), his conclusion that the interaction between age and gender yields a more insightful picture of the potential effects. In simple terms, the researcher maintained that females within the third age group demonstrated a leading role in emphasis production compared to their male peers.

As far as parental education is concerned, the study reveals that participants, irrespective of their parents' educational background (i.e., tertiary vs. below tertiary), maintained slightly different F2 lowering between emphatic and plain environments. That is, participants whose parents had a higher educational attainment showed a relatively higher emphatic-plain contrast in terms of F2 than those whose parents had a lower educational attainment. Although the effect of education was not, to the best of the researcher's knowledge, examined in previous sociophonetic accounts of emphasis, at least in JA, this finding probably suggests that parental education does not seem to play a significant role as that of either gender or age in the production of emphasis among those children and adolescents. This finding is likely due to the mono-stratified (i.e., homogeneous) Ajlouni speech community, where almost all speakers belong to the same and only social stratum, namely the lower-middle class.

The analysis also indicates a statistically significant interaction effect between emphasis, gender, and age on F2 only at the onset of the vowel. The emphatic-plain contrast was greater for male than female children and, though less sharp, greater for female than male adolescents. Figure 65 displays these differences.

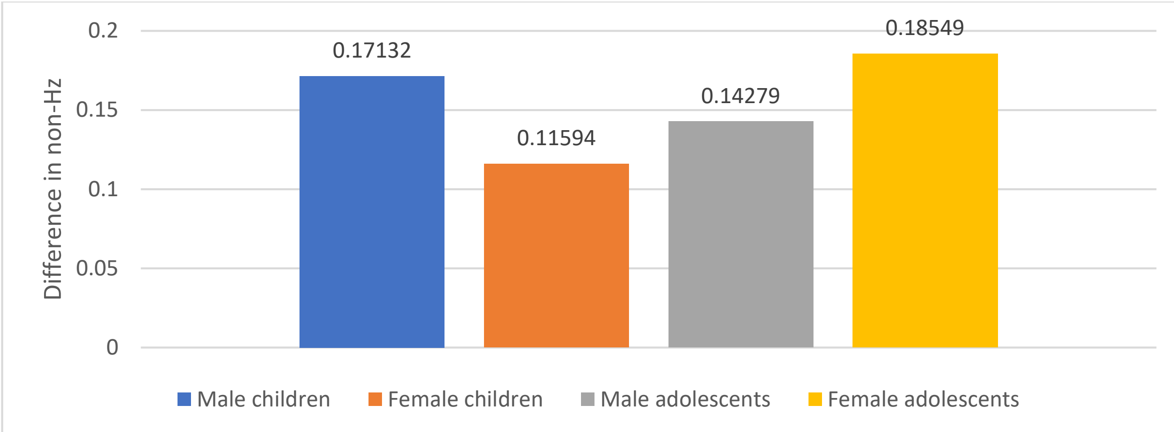


Figure 65. Emphatic-plain contrast in terms of F2 for different genders and age groups.

It is noteworthy in the figure above that neither the age-related differences nor the gender-related differences exhibit a consistent pattern, indicating greater variability and reduced stability in this interaction effect. Consequently, this interaction is interpreted as suggestive rather than normative.

Finally, the study indicates a statistically significant interaction effect between emphasis, gender, and VQ on F2 only at the offset of the vowel. The emphatic-plain contrast was significantly higher for males than for females across the different vowel environments, except for that of /u/, in which females showed a slightly higher emphatic-plain contrast than males (see Figure 52). A closer examination of the figure shows that all speakers maintained a higher emphatic-plain contrast in the environment of /a/ than in those of /i/, /e/, /o/, and /u/, respectively, except for females who showed an overlap between /u/, /o/, and /e/. This finding aligns with those of Abudalbuh (2010), Alzoubi (2017), and Omari and Jaber (2019), who argued that males show a greater emphatic-plain contrast than females in terms of F2. Besides, our finding runs in tandem with that of Alfraikh (2015), who argued that while males' F2 was consistently and notably lower in emphatic environments, mainly for /ɪ, iː/, females' F2 showed overlap between emphatic and plain environments. On the contrary, our finding does not line up with those of Almbark (2008), who claimed that females maintained a higher-emphatic contrast in terms of F2 than males. Therefore, our finding opposes those of Omari and Jaber (2020), Almomany (2023a), and Salem and Sebane (2023), who contended that gender had no effect in terms of F2.

In short, our findings manifest their accordance with Labov's (1966) theory, Variationist Sociolinguistics, which posits that variability is inherent, and thus it is governed by linguistic and non-linguistic variables. We observe an appreciable difference between males and females in producing emphasis, where males are socially expected to sound more masculine (i.e., more emphatic) than females, who in turn are socially expected to sound more feminine (Trudgill, 1972; Meyerhoff, 2006; Holmes, 2013). In terms of prestige, our findings are best viewed through Ibrahim's (1986) reformulated model of Labov's (1966) standard and prestige, a milestone contribution to a sound understanding of the notion of standard versus prestige in Arabic-speaking communities. We note that females attenuate their speech so that they sound less emphatic, and hence more prestigious, than their male peers, who, on the other hand, sound more emphatic (i.e., less prestigious). This is also in line with Trudgill's (1972) finding that women generally favor socially prestigious forms more than men, thus suggesting their social awareness of social standing in society.

Our findings on age-graded are also in concord with those of Meyerhoff (2006) and Holmes (2013), who suggest that variation is not only gender-graded but also age-graded. That is, the frequency of use of the standard (i.e., prestigious) forms is infrequent in childhood, but gradually increases at adolescence, with a sharper rise at middle age, a period when societal pressure peaks. Nevertheless, this frequency of usage declines again later at a senior age, a period with reduced societal pressure. This successive manner of development is observed, especially when children are compared to adolescents, a pattern where adolescents exhibit a higher emphatic-plain contrast.

Nevertheless, our findings on parental education do not seem to be as consistent as those of gender and age, respectively, given that parental education shows an effect only in the combination of emphasis, gender, age, and parental education exclusively on F1 at the offset position. Yet, this interaction suggests that female adolescents, but not female children, show an education-graded effect, where those whose parents are less educated exert a higher emphatic-plain contrast than those whose parents are more educated. This finding is in line with Labov's (2001) Principle 2, where women's utilization of the prestigious forms is more frequent than that of men. Therefore, this finding partially lines up with Trudgill's (1972), Meyerhoff's (2006), and Holmes' (2013) observations, where the more educated the speaker is, the less frequent their use of the non-prestigious forms is.

Chapter 6: Conclusions, Shortcomings, and Recommendations

This chapter summarizes the conclusions of the present study in Section 6.1. and gives insights into the shortcomings and recommendations in Section 6.2.

6.1. Conclusion

The study is designed to tackle three main observations: the main effect of emphasis on the acoustic cues; the interaction effects between emphasis and manner of articulation, PTC, VQ, and VL on the acoustic cues; the interaction effects between emphasis, on the one hand, and gender, age, and parental education, along with any other linguistic variables, on the acoustic cues, on the other hand.

The first experiment reveals a significant main effect of emphasis only on SC, VOT, F1, F2, and F3. SC of emphatic stops was significantly longer than that of plain stops. Similarly, emphatic VOTs were significantly shorter than their plain counterparts. Moreover, F1 of emphaticized vowels was significantly higher than that of plain vowels throughout the vowel. Similar to F1, F2 of emphaticized vowels was significantly lower than that of plain vowels throughout the vowel. However, although emphasis had a statistically significant main effect on F3 only at the onset of the vowel, this interaction effect was not in the direction of emphasis, where emphaticized vowels showed lower than raised F3. In summary, these findings partly confirm our hypothesis that emphasis is mainly characterized by a shorter VOT, higher F1, lower F2, and higher F3, while simultaneously pinpointing that a longer interval of SC is a reliable acoustic cue as far as emphasis is concerned.

Relative to the second experiment, several significant interaction effects were observed between emphasis and the other linguistic variables on both the temporal and spectral cues. The study confirms the consistency of the low vowels /æ, aː/ in detecting emphasis in terms of both SC and VOT. Regarding the spectral cues, the study highlights the salience of stops in carrying a greater magnitude of change in the direction of emphasis through F1 and F2 onsets. In addition, the study underlines the significant effect of PTC on emphasis production, where closer portions of the vowel to the emphatic consonant show greater emphatic-plain contrast in terms of F1 and F2 at the onset and offset positions. Besides, the study indicates that emphasis is more acoustically pronounced on low than high front and back vowels, relying on F1 midpoint and F2 throughout the vowel. Furthermore, the study demonstrates that emphasis is more acoustically pronounced on short than on long vowels, as evinced by the F2 offset. In a nutshell, our findings substantially validate our hypothesis that emphasis significantly interacts with PTC, VQ, and VL, put alone that it also significantly interacts with manner.

More significantly, the study reveals several milestone findings regarding the bearings of the social variables on emphasis production as manifested by the spectral cues. Initially, the study demonstrates that gender has a striking effect on the emphasis, where males consistently maintained a higher emphatic-plain contrast than females in terms of F1 throughout the vowel and F2 at the midpoint and, though only slightly, offset. The study also demonstrates that, though less consistently, adolescents consistently maintained a higher emphatic-plain contrast than children in terms of F1 midpoint and offset, and, though with overlap in terms of gender, F2 onset. As for the education-graded effects, the study indicates that participants whose parents had a higher educational attainment showed, though only marginally, a greater emphatic-plain contrast than those whose parents had a lower educational attainment. However, the interaction between emphasis, gender, age, and education shows a different pattern of change, primarily in the adolescents' data, where only female adolescents showed sensitivity to parental education. In other words, parental education seems to influence females' degree of emphaticness, where those whose parents had a higher educational attainment showed a milder emphatic-plain contrast than those whose parents had a lower educational attainment. However, this pattern of change was reversed among male adolescents, probably suggesting that they pay less attention to their speech.

The study also underscores the intersection between emphasis, gender, age, and VQ, where only adolescents, with males leading females, exhibited a consistent pattern of change, unlike children, who showed inconsistency and overlap between emphatic and plain environments across the different vowel contexts. This finding is considered essential since it highlights the developmental stage at which children are. Moreover, the study emphasizes the interaction between emphasis, gender, and VQ on F2 at the offset, where males maintained a higher emphatic-plain contrast than females across the different vowel environments, except for /u/, which emerged as an outlier in the pattern. Therefore, this finding lends support to the salience of low over high front and back vowels in detecting emphasis, especially for males.

The present study's findings on the sociophonetics of emphasis lend credit to our hypotheses while simultaneously refuting some. Our findings support the salience of males in carrying a greater magnitude of change in the direction of emphasis than females. Besides, our findings validate our hypothesis that, though less consistently than gender, emphasis is more acoustically prominent in adolescents' speech than in children's. However, our findings do not fully support our hypothesis that participants whose parents are less educated sound more emphatic than those whose parents are more educated, except for female adolescents, who show more sensitivity to parental education than their male peers. Yet, the effect of parental education is observable only in the two-way interaction between emphasis and parental education and the four-way interaction between emphasis, gender, age, and parental education, thus indicating its suggestive rather than normative status. Similarly, our hypothesis that gender is the strongest controlling variable compared to age and parental education is therefore substantiated, where males consistently exhibited a greater emphatic-plain contrast than females, except for the slight overlap between male and female adolescents in the interaction between emphasis, gender, and age on F2 onset.

6.2. Shortcomings and Recommendations

The current study undoubtedly suffers from some limitations that are rather methodological than technical. The population sample of the present study lacks data on adults' speech, which would give us more space for comparability among children, adolescents, and adults. In addition, the meticulous control of the population sample in the current study made it difficult to include speakers from other social classes (e.g., upper-class), since the main focus of regional dialectology is AJA. Besides, the stimulus materials, all monosyllabic, made it impossible for the researcher to thoroughly investigate emphasis spread and its directionality.

Previous accounts of the sociophonetics of emphasis focused on the speech of adults, leaving out that of children and adolescents. This study is considered a starting point and is hoped to maintain sustained research on the sociophonetics of emphasis that tackles the speech of not only children and adolescents but also that of other age groups (e.g., young, middle-aged, old). It is therefore anticipated that this study would foster the implementation of acoustics when probing children's acquisition of phonemic contrasts. Finally, it is expected that this study would also trigger researchers' interest in examining other social factors such as social class and intermarriage in the speech of children and adolescents.

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Appendices

Appendix A: Stimuli production lists in the Arabic language

جدول (أ)

التكرار	PT	الجملة	التكرار	PT	الجملة	
3	ʃo:tˤ	إحكي **شوط** كمان مرّه	3	ta:b	إحكي **تاب** كمان مرّه	1
3	bi:tˤ	إحكي **بِيطْ** كمان مرّه	3	ba:t	إحكي **بات** كمان مرّه	2
3	ba:tˤ	إحكي **باط** كمان مرّه	3	tæl	إحكي **تَلْ** كمان مرّه	3
3	tˤu:b	إحكي **طُوبْ** كمان مرّه	3	fæt	إحكي **فَتْ** كمان مرّه	4
3	tˤo:r	إحكي **طور** كمان مرّه	3	ti:n	إحكي **تِين** كمان مرّه	5
3	zɪtˤ	إحكي **زِطْ** كمان مرّه	3	bi:t	إحكي **بِيتْ** كمان مرّه	6
3	tˤa:b	إحكي **طاب** كمان مرّه	3	tɪf	إحكي **تِفْ** كمان مرّه	7
3	tˤi:n	إحكي **طِين** كمان مرّه	3	zɪt	إحكي **زِتْ** كمان مرّه	8
3	fu:tˤ	إحكي **فُوطْ** كمان مرّه	3	tu:b	إحكي **تُوبْ** كمان مرّه	9
3	tˤɪf	إحكي **طِفْ** كمان مرّه	3	fu:t	إحكي **فُوتْ** كمان مرّه	10
3	tˤe:f	إحكي **طيف** كمان مرّه	3	tʊb	إحكي **تُبْ** كمان مرّه	11
3	tˤæl	إحكي **طَلْ** كمان مرّه	3	fʊt	إحكي **فُتْ** كمان مرّه	12
3	he:tˤ	إحكي **حيط** كمان مرّه	3	te:f	إحكي **تيف** كمان مرّه	13
3	tˤʊb	إحكي **طُبْ** كمان مرّه	3	he:t	إحكي **حيت** كمان مرّه	14
3	fʊtˤ	إحكي **فُطْ** كمان مرّه	3	to:r	إحكي **تور** كمان مرّه	15
3	fætˤ	إحكي **فَطْ** كمان مرّه	3	ʃo:t	إحكي **شوت** كمان مرّه	16

جدول (ب)

	الجملة	PT	التكرار	الجملة	PT	التكرار
1	إحكي **ساب** كمان مرّه	sa:b	3	إحكي **صيفْ** كمان مرّه	sˤe:f	3
2	إحكي **باس** كمان مرّه	ba:s	3	إحكي **صوتْ** كمان مرّه	sˤo:t	3
3	إحكي **سَبْ** كمان مرّه	sæb	3	إحكي **صُبْ** كمان مرّه	sˤʊb	3
4	إحكي **بَسْ** كمان مرّه	bæs	3	إحكي **صِدْ** كمان مرّه	sˤɪd	3
5	إحكي **سِيْبْ** كمان مرّه	si:b	3	إحكي **صاب** كمان مرّه	sˤa:b	3
6	إحكي **نِيسْ** كمان مرّه	ni:s	3	إحكي **صَبْ** كمان مرّه	sˤæb	3
7	إحكي **سِدْ** كمان مرّه	sɪd	3	إحكي **بِصْ** كمان مرّه	bɪsˤ	3
8	إحكي **بِسْ** كمان مرّه	bɪs	3	إحكي **بوصْ** كمان مرّه	bo:sˤ	3
9	إحكي **سُوفْ** كمان مرّه	su:f	3	إحكي **هُصْ** كمان مرّه	hʊsˤ	3
10	إحكي **بُوسْ** كمان مرّه	bu:s	3	إحكي **نِيْصْ** كمان مرّه	ni:sˤ	3
11	إحكي **سُبْ** كمان مرّه	sʊb	3	إحكي **صِيْبْ** كمان مرّه	sˤi:b	3
12	إحكي **هُسْ** كمان مرّه	hʊs	3	إحكي **بَصْ** كمان مرّه	bæsˤ	3
13	إحكي **سيفْ** كمان مرّه	se:f	3	إحكي **تيصْ** كمان مرّه	te:sˤ	3
14	إحكي **تيسْ** كمان مرّه	te:s	3	إحكي **بُوصْ** كمان مرّه	bu:sˤ	3
15	إحكي **سوتْ** كمان مرّه	so:t	3	إحكي **باص** كمان مرّه	ba:sˤ	3
16	إحكي **بوسْ** كمان مرّه	bo:s	3	إحكي **صُوفْ** كمان مرّه	sˤu:f	3

جدول (ج)

	الجملة	PT	التكرار	الجملة	PT	التكرار
1	إحكي **ذَابْ** كمان مرّه	ða:b	3	إحكي **ظِلْ** كمان مرّه	ðˤɪl	3
2	إحكي **فَاذْ** كمان مرّه	fa:ð	3	إحكي **خُظْ** كمان مرّه	xʊðˤ	3
3	إحكي **ذَلْ** كمان مرّه	ðæl	3	إحكي **جَظْ** كمان مرّه	ʤæðˤ	3
4	إحكي **جَذْ** كمان مرّه	ʤæð	3	إحكي **فَاظْ** كمان مرّه	fa:ðˤ	3
5	إحكي **ذِيمْ** كمان مرّه	ði:m	3	إحكي **ظَابْ** كمان مرّه	ðˤa:b	3
6	إحكي **بِيذْ** كمان مرّه	bi:ð	3	إحكي **بيظ** كمان مرّه	be:ðˤ	3
7	إحكي **ذِلْ** كمان مرّه	ðɪl	3	إحكي **ظَلْ** كمان مرّه	ðˤæl	3
8	إحكي **جِذْ** كمان مرّه	ʤɪð	3	إحكي **بِيظْ** كمان مرّه	bi:ðˤ	3
9	إحكي **ذُوقْ** كمان مرّه	ðu:g	3	إحكي **ظوْق** كمان مرّه	ðˤo:g	3
10	إحكي **تُوذْ** كمان مرّه	tu:ð	3	إحكي **ظُبْ** كمان مرّه	ðˤʊb	3
11	إحكي **ذُبْ** كمان مرّه	ðʊb	3	إحكي **جِظْ** كمان مرّه	ʤɪðˤ	3
12	إحكي **خُذْ** كمان مرّه	xʊð	3	إحكي **تُوظْ** كمان مرّه	tu:ðˤ	3
13	إحكي **ذيْفْ** كمان مرّه	ðe:f	3	إحكي **حوظ** كمان مرّه	ho:ðˤ	3
14	إحكي **بيْذْ** كمان مرّه	be:ð	3	إحكي **ظِيمْ** كمان مرّه	ðˤi:m	3
15	إحكي **ذوْق** كمان مرّه	ðo:g	3	إحكي **ظيفْ** كمان مرّه	ðˤe:f	3
16	إحكي **حوذ** كمان مرّه	ho:ð	3	إحكي **ظُوقْ** كمان مرّه	ðˤu:g	3

Appendix B: Authorization letter obtained from Ajloun Directorate of Education

وزارة التربية والتعليم

مديرية التربية والتعليم لمحافظة عجلون

الرقم ل/٧/١٣/ ٦٩٨٤
التاريخ ٢٠ صفر ١٤٤٥
الموافق ٢٠٢٣/٠٩/٠٦

مديري ومديرات المدارس الحكومية

الموضوع: البحث التربوي

السلام عليكم ورحمة الله وبركاته،،،،

أرفق طياً كتاب جامعة سيجد (المجر) رقم بلا تاريخ 2023/8/30 ، راجياً تسهيل مهمة الطالب ابراهيم شلاش عوده المومني وتقديم المساعدة الممكنة له . وعلى أن لا تستخدم البيانات المتحصلة إلا لأغراض البحث العلمي .

وتفضلوا بقبول فائق الاحترام

م/مدير التربية والتعليم

مدير الشؤون الإدارية والمالية
صبحه أحمد المومني

نسخة السيد مدير الشؤون التعليمية .

نسخة السيد ر.ق الإشراف التربوي.

هاتف ٠٦٢٠٧١٨١ ٦ ٩٦٢+ فاكس ٠٢٦٦٦٠١٩٠ ٦ ٩٦٢+ ص.ب ١٦٤٦ عمان ١١١١٨ الأردن الموقع الإلكتروني www.moe.gov.jo

Appendix C: Consent form in the Arabic language

تحية طيبة وبعد،

أرجو التكرم بالموافقة لي بجمع البيانات من ابنكم/ ابنتكم في الصف .... وذلك لعمل دراسة صوتية اجتماعية لغايات البحث العلمي، علماً بأنه سيتم التعامل مع تلك البيانات بسرية تامة في حال تمت الموافقة.

أنا ولي أمر الطالب/ة .... من الصف ....، أوافق على جمع البيانات من ابني/ابنتي للغايات المذكورة أعلاه وعليه أوقع.

ولي أمر الطالب/ة: ________________________________