ABSTRACT

EMPHASIS SPREAD IN NAJDI ARABIC

This thesis focuses on the directionality of emphasis spread in Najdi Arabic and on the restrictions that source and target consonants play in this spread. Five different emphatic consonants are examined: \([s^\text{ˤ}], [t^\text{ˤ}], [z^\text{ˤ}], [l^\text{ˤ}],\) and \([\delta^\text{ˤ}]\). Emphasis is found to spread rightward and leftward, but only within morphological roots; affixes are not affected by the spread of emphasis. Leftward spread from emphatic laterals is unrestricted while it is restricted for emphatic stops and fricatives. Emphatic fricatives spread emphasis leftward to other fricatives that share the same voicing feature, that is, voiceless to voiceless, and voiced to voiced. Emphatic stops, however, only spread emphasis to fricatives. Similarly, rightward emphasis spread from emphatic laterals is unrestricted, but it is restricted for stops and fricatives. Emphatic stops only spread their emphasis rightwards to other stops; fricatives spread emphasis only to stops and to other fricatives that share the same voicing feature.

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EMPHASIS SPREAD IN NAJDI ARABIC

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CHAPTER 1: INTRODUCTION

Emphasis, also known as pharyngealization, refers to secondary articulations involving constriction of the pharynx, for example, plain [t] vs. pharyngealized or emphatic [tˤ] (Almasri & Jongman 2004). To indicate emphasis, a superscript [ˤ] is placed after the emphatic consonant. There are many different definitions for emphasis in the literature. A detailed one is found in Lehn (1963):

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

Hoberman (1995) explains that emphasis is found in most Semitic languages including Arabic. He defines emphasis as a phonological feature that is realized sometimes as pharyngealization, glottalization, uvularization, or velarization.

Not all emphatic segments are necessarily pharyngealized. Watson (1999) indicates that most emphatics involve pharyngealization; however, there are some emphatics that are labialized. Only the pharyngealized realization of Emphasis will be considered in this paper.

Some linguists claim that emphasis and pharyngealization are two different terms for the same process while others argue that we cannot equate pharyngealization with emphasis. However, when considering the term
‘pharyngealization’ it is important to use the word ‘pharyngealized’ instead of ‘pharyngeal’ to describe consonants that have this feature. Although the two terms sound similar, they differ in the place of articulation associated with them.

‘Pharyngeal’ refers to consonants such as the voiced pharyngeal fricative [ʕ] and the voiceless pharyngeal fricative [h] where the primary articulation is the pharynx while the word ‘pharyngealized’ refers to consonants that are produced with the pharynx being a secondary articulation.

To acoustically distinguish between ‘pharyngeals’ and pharyngealized consonants, Ghazeli (1977) used cinefluorography in his study to compare the production of some pharyngeals to some pharyngealized consonants. His study showed that in producing pharyngeals such as [ʕ] and [h], the construction was below the epiglottis whereas in producing pharyngealized consonants such as [ðˤ] and [sˤ], the construction occurred in the upper pharynx.

Mccarthy (1994:38), on the other hand, discusses the difference between emphatics and pharyngealized consonants. He shows that both emphatics and pharyngealized consonants require a constriction in the upper pharynx, but unlike emphatics, pharyngealized consonants are affected by some back segments (uvulars, such as [q], [χ], and [ʕ]), and thus should be called uvularized.

The main focus of this study is on the effect of emphatics of Najdi dialect of Arabic on other coronal consonants. The purpose is to examine how features of the source consonant (the consonant from which emphasis spreads) affect spreading; and how the features of the target consonant (the consonant to which emphasis spreads) affect spreading. (See Archangeli & Pulleyblank 1994 for fuller discussion of the source/target distinction.)

Najdi Dialect is spoken in Riyadh, the capital of Saudi Arabia. There are different varieties of Najdi depending on the region where it is spoken. They are:
North Najdi, Central Najdi, and South Najdi, see map (Appendix A). Central Najdi spoken by Subaiee Najdi people residing in Riyadh is the focus of this paper.
CHAPTER 2: PREVIOUS RESEARCH ON EMPHASIS

Traditionally, Arabic has been known as *Lughat Al- dˤaad* (the language of dˤaad), which stands for the letter dˤaad, the voiced emphatic dento-alveolar stop. As early as the 8th century, the author of the first Arabic grammar book, Sibawayh, described emphasis using the term [itˤbaːq] which literally means ‘covering’. He explains that emphatic sounds are produced when the tongue is raised to touch the palate (Lehn 1963:29).

Ibn Sina also describes emphasis, but within a scientific background using the term [istiʕlaʔ], which literally means ‘elevation’. As reported in Card (1983:9), Ibn Sina explains the process of producing the emphatic coronal [tˤ] compared to the other plain coronals [t] and [d]. He shows that all three sounds share the same place of articulation and differ only in the way the air is restricted inside the mouth. For the sound [tˤ], the air is restricted by the tip and the two sides of the tongue forming a depression in the center of the tongue. For the sound [t] however, the air is only restricted by the tip of the tongue. As for the sound [d], there is no strongly detected air restriction as the palate is not covered.

Linguists agree that emphasis is distinctive in most dialects of Arabic (Newman 2002, Ladefoged & Maddieson 2008). The most common emphatics found in Semitic languages, including Arabic, are a set of alveolar obstruents. However, Ferguson (1956) reports in his study that in Cairene Arabic, emphasis involves laterals and rhotics. Emphasis in Najdi also involves the emphatic lateral [lˤ] as will be shown later in this study.

Emphatics occur in Arabic due to a constriction of the pharynx that has been represented in the literature as [+RTR] (Retracted Tongue Root). This feature
can spread in a word to affect neighboring sounds and sometimes the entire phonological word (Davis 1995, Watson 1999).

Generally speaking, the effect of emphasis on vowels has been described as raising of the values of the first formant F1, and lowering of the second formant F2 values in the vowel that follows the emphatic consonant, the following syllable, the preceding syllable, or the entire word. So, acoustically, emphasis on vowels is most consistently identified as a lowering of the second formant frequency F2 of the vowel following the emphatic consonant (Alosh 1987, Watson 1999, Almasri & Jongman 2004).

In his study, Norlin (1985) explains that when emphasis occurs, it can spread to adjacent sounds or syllables. He refers to such process as the *feature-spread effect* and concludes that this effect is mostly noticed on following and preceding vowels that are adjacent to the emphatic consonant. On the other hand, Almasri and Jongman (2004) study the effect of emphasis on Arabic vowels and they conclude that such effect does not spread to all vowels, instead it is mostly associated with the front vowel [a]. This is compatible with what has been found in Najdi when three vowels: [a],[i], and [u] were acoustically measured as will be shown later on in this study.

Moreover, Davis (1993) discusses emphasis spread and notes that when a word includes an emphatic phoneme, neighboring sounds get affected and become emphatic too. He further elaborates that dialects differ to which extent these neighboring sounds are affected. In his study, he examines Cairene Arabic, a dialect spoken in Egypt, and concludes that when an emphatic segment occurs, the entire phonological word is produced as completely emphatic.

Bukshaisha (1985:217 –219) discusses a similar study to the latter where she observes different dialects of Arabic, and finds that the spread of emphasis
differs from one dialect to another. For Cairene, emphasis spreads and affects the whole word while in Abha dialect (spoken in southern regions of Saudi Arabia), emphasis rarely spreads beyond the adjacent vowel. She also considers Qatari Arabic and concludes that for this particular dialect of Arabic, emphasis spread is bidirectional over the entire phonological word, and when a word starts with an emphatic sound, the spread might also go leftward across the word boundary to affect the adjacent word.

Lehn (1963:31) tackles a different issue on emphasis. He mentions that in Cairene Arabic, the degree of emphasis differs when speakers of different dialects are involved. He finds that the emphasis spread observed in males is not similar to that of females’ suggesting that men and women might have different degrees of emphasis, but he does not support his claim with any empirical experiments.

Later on, Kahn (1975) acoustically examines the emphasis of males and females in Cairene Arabic. She compares the F2 values of vowels that follow emphatic sounds vs. vowels that follow plain counterparts, for both genders. Her results show that the difference between F2 values in these two environments is greater for males than females, supporting the claim by Lehn (1963). This is an interesting issue that will not be covered in this study.

Other linguists are more concerned to investigate segments that might block the spread of emphasis. In his study, Lehn (1963) claims that emphasis cannot be the only feature of one segment; it must spread to affect other segments as well. He reports that the minimum domain in which emphasis can occur is of the sequence CV, but not VC. In monosyllabic words, the whole syllable is either plain or emphatic; however, in longer words, contrasts exist as both or neither syllables can be emphatic, or only the first or the second is emphatic. He supports this claim by providing minimal pairs such as [tˤːiːn] ‘mud’ vs. [tːiːn] ‘figs’, and
[zʰuːr] ‘perjury’ vs. [zuːr] ‘visit’. Lehn concludes that the vowels [i] and [u] always block the emphasis spread in a word. Other studies later on argue that long vowels are opaque to emphasis as they block its spread to neighboring sounds (e.g. Davis 1995, Watson 1999, Card 1983).

In contrast to what previous studies conclude regarding back vowels, Davis (1995:468) studies the emphasis spread in the northern and southern dialects of Palestinian Arabic within the Grounded Phonology’s perspective. He reports that both rightward and leftward spreads are found in Palestinian Arabic. His results show that leftward spread from emphatic sounds is unbounded while rightward spread is always blocked by [+high, -back] vowels. This finding excludes the vowel [u] from blocking the spread of emphasis, unlike what Lehn suggested in his study. Such findings show that different dialects can have different opaque segments that block emphasis spread. They also show that there are different directions of blocking.

Card (1983) also considers emphasis in the Palestinian dialect of Arabic. She compares the F2 values of segments in emphatic vs. plain environments, and finds that the former have lower values compared to the latter. She also measures F2 frequencies for segments that acquire emphasis from adjacent emphatics through emphasis spreading, in what she calls secondary emphatics. Her results show that F2 values for these kinds of segments are not as low as those of primary emphasis, and are not as high as F2 frequencies of plain segments. Card also studies the directionality of emphasis in this dialect and concludes that it is bidirectional within the phonological word, that is, both leftward and rightward.

Another study conducted by Zawaydeh (1999) focuses on Ammani Jordanian Arabic. Zawaydeh investigates emphasis spread and finds that emphasis spreads bidirectionally, but not to the same degree. She also measures the F2
frequencies of vowels in leftward vs. rightward spreading. She finds that for leftward spreading, F2 values of vowels are equally low whether they are adjacent to emphatics or further away. Rightward emphasis spreading, on the other hand, is gradient as F2 values of vowels that are adjacent to emphatics have low values compared to vowels that are further away.

None of the previous studies, at least to my knowledge, talks about the emphasis spread in coronal consonants precisely. Most of the studies observed conclude that emphasis either spread right of left, but they do not show the consonants that spread emphasis (sources) or consonants that are influenced by the spread (targets). This study aims to fill this gap by explaining the nature of spreading from coronal emphatics to other coronal consonants.
CHAPTER 3: INVENTORY

Consonants

There are twenty-nine consonants in Najdi, as shown in Table.1. Only five emphatic coronal consonants are found in Najdi: the voiceless pharyngealized alveolar fricative [sˤ], the voiced pharyngealized alveolar fricative [zˤ], the voiceless pharyngealized alveolar stop [tˤ], the voiced pharyngealized dental fricative [ðˤ], and the voiced lateral alveolar [lˤ].

Table 1. Najdi consonant inventory chart

<table>
<thead>
<tr>
<th></th>
<th>Bilabial</th>
<th>Labiodental</th>
<th>Dental</th>
<th>Alveolar</th>
<th>Post-</th>
<th>Palatal</th>
<th>Velar</th>
<th>Uvular</th>
<th>Pharyngeal</th>
<th>Glottal</th>
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<tr>
<td>Plosives</td>
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<td>k</td>
<td>g</td>
<td>q</td>
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<tr>
<td>Pharyngealized</td>
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<td>Nasal</td>
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<td>Fricative</td>
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<td>Pharyngealized</td>
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<td>ðˤ</td>
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<td>Approximant</td>
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<td>w</td>
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All five emphatic consonants [sˤ], [tˤ],[zˤ], [lˤ] and [ðˤ] are distinct phonemes as shown in 1. The lateral [l], however, can be both phonemic (see 1) and allophonic in certain environments that will not be covered in this paper.
(1) Minimal pairs

a. [sal] ‘tuberculosis’
   [sˤal] ‘pray’

b. [taraf] ‘luxury’
   [tˤaraf] ‘edge’

c. [ðal] ‘humiliated v.’
   [ðˤal] ‘lost’

d. [walla:h] ‘and God’
   [walla:h] ‘he appointed him’

Vowels

There are three vowels in Najdi: [a], [i] and [u], and their long counterparts [a:], [i:], and [u:]. The distinguishing factor between short and long vowels is their duration. Alghamdi (1998) conducts a study measuring the duration between short and long vowels in Arabic, and he concludes that long vowels are more than twice longer than their short counterparts.

Diphthongs are also found in Najdi. There are two diphthongs: [ɔi] and [ei], as shown in 2 and 3.

(2) [ɔi]
   [mɔijah] ‘water’
   [bɔijah] ‘paint’

(3) [ei]
   [ʔeɪn] ‘eye’
   [zɛn] ‘good’.
CHAPTER 4: EMPHASIS EFFECT ON NAJDI VOWELS

Monosyllabic and disyllabic words of the structure C\textsuperscript{ˤ}VC and CVC\textsuperscript{ˤ}VC were recorded and acoustically measured on Praat using a MacBook laptop. The purpose was to examine the effect of emphatic segments on adjacent vowels, vowels that both follow and precede emphatic segments. Values of F1 and F2 were also measured for better understanding. The sequence of measuring will start with monosyllabic minimal pairs first, followed by disyllabic words.

Emphasis Effect on \([a]\)

Words of the form C\textsuperscript{ˤ}aC and CaC\textsuperscript{ˤ}aC were recorded and acoustically measured to examine the effect of emphatic consonants on the adjacent low front vowel \([a]\). The effect of emphasis on this particular vowel was very much noticeable on the lowering of its F2 values as shown in Figure 1.

![Waveform](image)

Figure 1. The effect of plain and emphatic consonants \([s]\) vs. \([s^\text{ˤ}]\) on the low front vowel \([a]\) on monosyllabic C\textsuperscript{ˤ}VC words: \([sal]\) ‘tuberculosis’ vs. \([s^\text{ˤ}al]\) ‘pray’

Results show a clear lowering of F2 values when the emphatic consonant \([s^\text{ˤ}]\) precedes the vowel \([a]\) in C\textsuperscript{ˤ}aC and CaC\textsuperscript{ˤ}aC words, as shown in the second part of Figure 1 and 2. For more examples with monosyllabic words, see Figure 6 and
7 (Appendix A). The exact values of F1 and F2 for all vowels involved in this study are listed in Table 2 (see Appendix B).

Results support what other linguists conclude in their studies about the effect that emphatic consonants have on adjacent vowels, syllables or sometime the entire word (Alosh 1987, Davis 1993, Watson 1999, Almasri & Jongman 2004).

Figure 2 shows that in CaC罽aC, F2 values of both vowels preceding and following the low front [a] have dropped from 1763 Hz to 1264 Hz and 1308 Hz respectively changing the front vowel [a] to be back [a]. This also shows that emphasis spreads to affect both vowels that are adjacent to the emphatic segments even if they happen to fall on different syllables.

![Waveform and Spectrogram](image)

[nasab] | [nas罽ab]
---|---
Figure 2. The effect of plain and emphatic consonants [s] vs. [sˁ] on the low front vowel [a] in disyllabic CVC司法VC words: [nasab] ‘kinship’ vs. [nas罽ab] ‘put’

**Emphasis Effect on [i]**

Minimal pairs of the form CiC, [티:n] ‘fig’ and C罽iC [티:n] ‘mud’, were recorded and acoustically measured to examine the effect of emphatic consonants on the adjacent high front vowel [i]. Figure 3 shows that there was no noticeable effect of emphasis spread on the vowel [i] as the F2 values of the vowel following
the emphatic consonant [tˤ] and that of the vowel following a plain [t] were of the same range, 2633 and 2699 Hz respectively.

![Waveform Image](image)

**Figure 3.** The effect of plain and emphatic consonants [t] vs. [tˤ] on the high front vowel [i] in monosyllabic CᵢC words: [ti:n] ‘figs’ vs. [tˤi:n] ‘mud’

**Emphasis Effect on [u]**

Minimal pairs of the form CuC, [tu:b] ‘repent’ (imperative) and CᵢuC [tˤu:b] ‘brick’, and CuCuC, [futu:r] ‘vatigue’ and CuCᵢuC [futˤu:r] ‘breakfast’ were recorded and acoustically measured to examine the effect of emphatic consonants on the adjacent high back vowel [u]. Figure 4 shows that emphasis had no effect on the vowel [u] as both values of F2 reported are of the same range. F2 frequency of the vowel [u] following a plain [t] in CVC was 1050 Hz and F2 value of the vowel following an emphatic [tˤ] was about 1085 Hz.

Similarly, Figure 5 shows that in CuCᵢuC, F2 values of vowels following and preceding plain vs. emphatic consonants were of the same range and no noticeable drop was observed. For exact values of all vowels involved, see Table 2 (Appendix B).
Figure 4. The effect of plain and emphatic consonants [t] vs. [tˤ] on the high back vowel [u] in monosyllabic CuC/uC words: [tuːb] ‘repent’ vs. [tˤuːb] ‘brick’

Figure 5. The effect of plain and emphatic consonants [t] vs. [tˤ] on the high back vowel [u] in disyllabic CuC/uC words: [futuːr] ‘vatigue’ vs. [futˤuːr] ‘breakfast’
CHAPTER 5: THE STUDY

The current study looks into five coronal emphatics of Najdi and examines their effect on coronal consonants. Since monosyllabic words provide weak evidence for emphasis spread, longer words are needed to understand the nature of such spread. Disyllabic words help examine the effect of emphasis with different positions of emphatics: word-initially, word-medially, and word-finally. For word medial cases, both CVCˤ.CVC and CVC.CˤVC were examined to see if syllable-position (coda vs. onset) has any effect on spread.

Data and Discussion

A list of words of the forms CVCˤ and CˤVC was created to see the effect of emphatics on other coronal consonants. Most words of these two syllable structures are nonsense. They are only used to test the acceptability of such sound sequencing in Najdi. Every word below includes at least two coronal consonants that are possible emphatics, for example, [s] becomes [sˤ], [t] becomes [tˤ], etc. The purpose is to examine emphasis effect on other coronal consonants, and to determine its directionality. Actual words of Najdi are also provided where helpful.

Leftward Spread

The first pattern CVCˤ is used to test the leftward spread of emphasis as the underlying emphatic comes word-finally while the CˤVC pattern is used to test the rightward spread as the underlying emphatic is word-initially. All five coronals of Najdi [lˤ], [sˤ], [zˤ], [ðˤ], and [tˤ] are examined in CVCˤ syllable structure to test sound sequencing acceptability, and in other syllable structures, such as
CVC\textsuperscript{C}.CVC and CVC.C\textsuperscript{V} to see if syllable position has an effect on spread when emphatics are in coda vs. onset positions.

(4) Leftward spread from a lateral (l\textsuperscript{ʕ})

\begin{itemize}
  \item[a.] \texttt{t\textsuperscript{ʕ}al\textsuperscript{ʕ} s\textsuperscript{ʕ}al\textsuperscript{ʕ} z\textsuperscript{ʕ}al\textsuperscript{ʕ} \delta\textsuperscript{ʕ}al\textsuperscript{ʕ} l\textsuperscript{ʕ}al\textsuperscript{ʕ}}
  \item[b.] \texttt{*tal\textsuperscript{ʕ} *sal\textsuperscript{ʕ} *zal\textsuperscript{ʕ} *\delta al\textsuperscript{ʕ} *lal\textsuperscript{ʕ}}
\end{itemize}

It seems that when a word has an emphatic [l\textsuperscript{ʕ}] in CVC\textsuperscript{C} syllable structure, the emphasis automatically spreads leftward to affect other coronal consonants found in the same phonological word, as shown in 4a. Violations of this rule lead to unpronounceable forms as in 4b.

Here are some actual monosyllabic, disyllabic and trisyllabic Najdi words that include the emphatic [l\textsuperscript{ʕ}]:

(5) Spread

\begin{itemize}
  \item \texttt{[t\textsuperscript{ʕ}al\textsuperscript{ʕ}ab]} ‘request n.’
  \item \texttt{[t\textsuperscript{ʕ}al\textsuperscript{ʕ}fa\textsuperscript{ʕ}]} ‘he took something out’
  \item \texttt{[s\textsuperscript{ʕ}al\textsuperscript{ʕ}ah]} ‘he fixed’
  \item \texttt{[z\textsuperscript{ʕ}al\textsuperscript{ʕ}at\textsuperscript{ʕ}ah]} ‘salad’
  \item \texttt{[t\textsuperscript{ʕ}al\textsuperscript{ʕ}ag]} ‘he shot’
  \item \texttt{[\delta\textsuperscript{ʕ}al\textsuperscript{ʕ}a:m]} ‘darkness’
  \item \texttt{[s\textsuperscript{ʕ}al\textsuperscript{ʕ}ab]} ‘crucified’
\end{itemize}

Words in 5 show that whether the emphatic [l\textsuperscript{ʕ}] is in coda or onset position, all other leftward coronals must be emphatic due to emphasis spread.

The same words above are unpronounceable if they are produced with any plain coronal consonant preceding an emphatic [l\textsuperscript{ʕ}], that is, when an emphatic [l\textsuperscript{ʕ}] is around, all coronal consonants to its left must be emphatic, as shown in 6 below:
(6)  *[talˤab]*  
    *[tallˤaʃ]*  
    *[sallˤah]*  
    *[zalˤatˤah]*  
    *[talˤag]*  
    *[ðalˤaːm]*  
    *[salˤab]*  

    Other emphatic coronals at the same position as [lˤ], shown in 4 are also examined to check if this is always the case. Consider the following words for the voiceless alveolar fricative [sˤ].

(7) Leftward spread from a fricative (sˤ)

a.  \( \text{tas}^{\text{s}} \quad \text{s}^{\text{s}} \text{as}^{\text{s}} \quad *\text{z}^{\text{s}} \text{as}^{\text{s}} \quad *\text{ð}^{\text{s}} \text{as}^{\text{s}} \quad \text{las}^{\text{f}} \)  

b.  \( *\text{t}^{\text{s}} \text{as}^{\text{s}} \quad *\text{sas}^{\text{s}} \quad *\text{zas}^{\text{s}} \quad *\text{ðas}^{\text{s}} \quad *\text{l}^{\text{f}} \text{as}^{\text{s}} \)  

Looking at 7a,b, it seems that there are two general patterns. One pattern shows that emphasis spreads leftward from fricatives to other fricatives, but never from fricatives to stops or laterals. There is no emphasis spread from fricatives to laterals as shown in 7a where the plain lateral [l] is allowed to precede an emphatic coronal fricative [sˤ] in [lasˤ].

Another pattern shows that not all fricative-to-fricative emphasis spread is allowed in Najdi. Some sound sequencing forms in 7a where both coronal fricatives are emphatic are not acceptable. Emphasis then is allowed to spread from voiceless fricatives to other voiceless fricatives, but not to voiced ones like [zˤ] and [ðˤ]. This explains why it is possible to have [spraak] but not *[zpraak] or *[ðpraak] in Najdi.

As for spreading from fricatives to stops, the form [tasˤ] in 7a shows that there is no leftward spread from an emphatic fricative [sˤ] to a stop; plain [t] is
allowed to precede an emphatic voiceless fricative. Leftward spread in this situation is blocked, that is, [t] never turns to be [tˤ]. Other emphatic fricatives need to be tested to see if this is always the case with fricatives to stop spreading, or if it is just an exceptional one.

Actual monosyllabic, disyllabic and trisyllabic Najdi words that include the emphatic [sˤ] are shown below:

(8) Spread

\[
\begin{align*}
\text{[masˤasˤah]} & \quad \text{‘pacifier’} \\
\text{[masˤa:sˤ]} & \quad \text{‘straw’} \\
\text{[hisˤasˤ]} & \quad \text{‘shares’} \\
\text{[gisˤasˤ]} & \quad \text{‘stories’} \\
\text{[rsˤasˤ]} & \quad \text{‘Lead’}
\end{align*}
\]

Looking at the data in 8, it seems that whether the emphatic [sˤ] is in coda or onset position, emphasis spreads leftward from voiceless fricatives to other voiceless fricatives.

(9) No spread

\[
\begin{align*}
\text{[tasˤtˤir]} & \quad \text{‘hitting’} \\
\text{[tasˤfir]} & \quad \text{‘whistling’} \\
\text{[lasˤg]} & \quad \text{‘glue’} \\
\text{[lasˤsˤag]} & \quad \text{‘he glued’}
\end{align*}
\]

Words in 9 show that emphasis from fricative [sˤ] never spreads to affect preceding stops or laterals.
(10) Unpronounceable forms:
*[^tˤasˤtˤir]
*[^tˤasˤlih]

Forms in 10 show that it is unpronounceable to have emphatic stops preceding emphatic fricatives in Najdi.

The third emphatic coronal consonant is the voiced alveolar fricative [zˤ].

(11) Leftward spread from a fricative (zˤ)

a.  tazˤ  ?zˤazˤ  ?δˤazˤ  lazˤ
b.  *tˤazˤ  *zazˤ  *δazˤ  *lˤazˤ  *sˤazˤ

The patterns in 11a show that when a word has the emphatic [zˤ] in CVCˤ syllable structure, emphasis does not spread leftward to affect stops or laterals. Violations will lead to unpronounceable forms as in 11b. This explains why [tazˤ] is acceptable but *[^tˤazˤ] is not. Meaning, the voiceless stop [t] is immune to the leftward spread of emphasis when emphatic fricatives occur to its right. Moreover, emphasis does not spread from fricative [zˤ] to lateral [l] as the form [lazˤ] shows.

Some forms in 11a are marked as awkward [?], and that is when a word includes two emphatic voiced coronal fricatives. Although, there are no actual Najdi words of these two patterns, their sound sequencing is acceptable compared to producing them with plain fricatives preceding an emphatic [zˤ].

The following are some actual Najdi words that include the emphatic [zˤ]:

(12) No Spread
[tazˤbitˤ]  ‘making something well’
[taˤzbitˤah]  ‘making something well (feminine)’
[tazˤnitˤ]  ‘strangle’

Words in 12 show that emphasis does not spread leftward from fricative [zˤ] to stops as plain [t] is allowed to occur to its left.
The fourth emphatic coronal segment to be tested is the voiced dental fricative [ðˤ]. Consider the following:

(13) Leftward Spread from a fricative (ðˤ)

a. taðˤ tiðˤ ʔaðˤ ʔaðˤ laðˤ
b. *taðˤ *taðˤ *zaðˤ *zaðˤ *laðˤ *laðˤ *sˤaðˤ

Similar to [sˤ] and [zˤ], when the voiceless coronal stop [t] is involved, leftward spread is blocked, that is, [t] never turns to be [tˤ], as shown in the first pattern of 13a,b. Fricatives do not spread emphasis to laterals either, and this explains why the form [laðˤ] is allowed in Najdi as in 13a.

Emphasis spreading from fricatives to other fricatives is allowed as it spreads from the voiced fricative [ðˤ] to [ðˤ], as shown in 13a. It is ungrammatical and unpronounceable to allow plain fricatives to precede emphatic [ðˤ], as shown in 13b.

One of the patterns in 13a is marked as (?) and that is because no actual words of the same form are found in Najdi; however, its sound sequencing is acceptable.

The following are some actual disyllabic and trisyllabic Najdi words that include the emphatic [ðˤ]:

(14) No spread

[taðˤli] ‘making something darker’
[taðˤamun] ‘solidarity’
[laðˤa] ‘very hot’

Words in 14 show that emphasis from the emphatic [ðˤ] does not spread leftward to stops or laterals.
(15) Spread

[ʕaðˤːaðˤːah] ‘teething toy’

[maðˤːmaðˤːah] ‘rinsing’

Words in 15 show that whether the emphatic sound [ðˤ] is in coda or onset position, leftward voiced fricatives must be emphatic due to emphasis spread.

The last emphatic coronal segment considered for leftward spread is the voiceless stop [tˤ].

(16) Leftward Spread from a stop (tˤ)

a. tatˤ sˤatˤ zˤatˤ ðˤatˤ latˤ

b. *tˤatˤ *sˤatˤ *zˤatˤ *ðˤatˤ *lˤatˤ

Underlying emphatic stops do not spread emphasis leftward to affect other stops or laterals. This explains why plain coronals [t], and [l] are allowed to precede emphatic stops, as 16a shows. Words in 16b show that violations to this lead to unpronounceable forms.

The only case where emphasis must spread leftward is from stops to fricatives [sˤ],[zˤ] and [ðˤ]. It is unpronounceable to have plain fricatives preceding emphatic stops as the starred [*] forms show in 16b. Some forms, however, are marked as problematic (ʔ*) in 16b, and that is because few Najdi speakers would find it acceptable to produce the word with either plain or emphatic voiceless fricative [s]. This might be due to the fact that they are being influenced by Standard Arabic, where no leftward spreading from emphatic stops to fricatives takes place. This issue is not going to be covered in this paper because the number of such cases is too small for a definite claim.

Consider the following actual monosyllabic, disyllabic and trisyllabic Najdi words that include the emphatic [tˤ]:

(17) Spread

[ðˤatˤur] ‘gecko’
[zˤabˤ] ‘fixing’
[sˤatˤir] ‘line’
[sˤatˤurah] ‘chopper’

Words listed in 17 show that emphasis spreads leftward from stops to fricatives. They also show that whether the emphatic stop [tˤ] is in coda or onset position, leftward voiced coronal fricatives must be emphatic due to emphasis spread.

(18) No spread

[tatˤhir] ‘cleansing’
[tatˤbil] ‘drumming’
[latˤm] ‘hitting’
[laʃˤ] ‘noise’

Words listed in 18 show that emphasis of [tˤ] does not spread leftward to other stops or laterals that are found in the same phonological word.

In sum, leftward spread in Najdi is restricted. Only emphatic laterals automatically spread emphasis leftwards turning all other coronals to their left to be emphatic. This kind of spreading thus is unbounded. Emphatic fricatives on the other hand, only spread emphasis to other coronal fricatives to their left, but never to stops or laterals. Note however, that fricatives only spread emphasis to other fricatives that share the same voicing feature as that of the emphatic consonant, that is, voiced fricatives to other voiced fricatives, and voiceless fricatives to other voiceless fricatives. Emphatic stops spread emphasis leftward to fricatives only, but not to other stops, or laterals.
Rightward Spread

CVC pattern is used to test the rightward spread as the emphatic is word-initial. Examples below are shown in CVC\* syllable structure to test sound sequencing acceptability, and in other syllable structures, such as CVC\*.CVC and CVC.C\*V to see if syllable position has an effect on spreading when emphatics are in coda vs. onset positions. Examples provided below show the effect of rightward spread from emphatic laterals, fricatives and stops.

(19) Rightward Spread from a lateral

a. \( {\text{f} \text{a}^\text{t}} \)  \( {\text{f} \text{a}^\text{s}} \)  \( {\text{f} \text{a}^\text{z}} \)  \( {\text{f} \text{a}^\delta} \)  \( {\text{f} \text{a}^\text{t}} \)

b. \( {\text{f} \text{a}^\text{t}} \)  \( {\text{f} \text{a}^\text{s}} \)  \( {\text{f} \text{a}^\text{z}} \)  \( {\text{f} \text{a}^\delta} \)  \( {\text{f} \text{a}^\text{t}} \)

Emphasis spreads rightward from an emphatic lateral to all other coronals to its right as shown in 19a. Violation of this rule leads to incorrect or unpronounceable forms shown in 19b.

As for the pattern marked (!) in (b), \[ {\text{f} \text{a}^\text{t}} \], emphasis does not spread rightward to affect [t] only when (-t) is suffixed to the root to indicate the 3rd feminine singular forms, or when the suffix (–a:t) is added to indicate the feminine plural form. So, the underlying rule is that emphasis spreads from a lateral affecting all other coronal consonants to its right, except when these coronal consonants are not parts of the root. Meaning that rightward spread from laterals is root-bounded, as shown in 20.

(20) No spread

[ga\text{\textipa{t}}:] ‘she said’
[t\text{\textipa{t}}a\text{\textipa{t}}:] ‘she took a look’
[t\text{\textipa{t}}a\text{\textipa{t}}:] ‘she got taller’
[ma\text{\textipa{t}}a\text{\textipa{t}}:] ‘umbrellas’
[f\text{\textipa{t}}a\text{\textipa{t}}:] ‘things’
Consider the following actual words of Najdi:

(21) Spread

\[[l^\text{ˤ}at^\text{ˤ}i:f]\] ‘nice’

\[[\chi^\text{ˤ}al^\text{ˤ}l^\text{ˤ}as^\text{ˤ}]\] ‘finished’

\[[t^\text{ˤ}al^\text{ˤ}al^\text{ˤ}]\] ‘name of a person’

Words listed in 21 show that emphatic laterals spread emphasis to other rightward laterals, stops, and fricatives. They also show that whether the emphatic lateral \([l^\text{ˤ}]\) is in coda or onset position, emphasis spreads rightward to all coronal fricatives, laterals, and stops that are parts of the root.

(22) Unpronounceable forms

\*\[[l^\text{ˤ}at^\text{ˤ}i:f]\]

\*\[[\chi^\text{ˤ}al^\text{ˤ}l^\text{ˤ}as^\text{ˤ}]\]

\*\[[t^\text{ˤ}al^\text{ˤ}al^\text{ˤ}]\]

Data in 22 show that plain coronal obstruents and laterals are difficult to produce when they occur to the right of an emphatic lateral in Najdi. Note though that the occurrence of plain \([t]\) to the right of an emphatic lateral in the word \*\[[l^\text{ˤ}at^\text{ˤ}i:f]\] is unpronounceable because \([t]\), in this word, is part of the root, not a suffix.

(23) Rightward Spread from fricatives to laterals

a. \(\bar{s}^\text{ʕ}al\quad \bar{z}^\text{ʕ}al\quad \bar{\delta}^\text{ʕ}al\)

b. \*\(\bar{s}^\text{ʕ}al^\text{ʕ}\quad \bar{z}^\text{ʕ}al^\text{ʕ}\quad \bar{\delta}^\text{ʕ}al^\text{ʕ}\)

The data in 23a,b show that emphasis does not spread from fricatives to laterals as plain laterals are allowed to occur to the right of emphatic fricatives.

Actual words of Najdi are listed in 24:
(24) No spread

[ðˤa:lim] ‘unfair’
[sˤalih] ‘good’
[ðˤlal] ‘shadow’
[tfaðˤal] ‘please’

(25) Unpronounceable forms

*[ðˤa:lˤim]
*[sˤalˤih]
*[ðˤlˤal]
*[tfaðˤal]

The data in 24 show that there is no rightward spread from fricatives to laterals. Words shown in 25, on the other hand, show that spreading emphasis from fricatives to laterals is unacceptable.

(26) Rightward Spread from fricatives to stops

a. sˤatˤ zˤatˤ ðˤatˤ
b. !sˤat !zˤat !ðˤat

Spreading from emphatic fricatives to stops is root-bounded, meaning that emphasis must spread to coronal stops found to the right of an emphatic fricative. However, when the suffix (-a:t) ‘fem. pl’ or the suffix (-t) ‘3rd singular fem.’ is added to a root, no emphasis spread takes place. Examples of these cases are shown in 27.
(27) No spread

[mumariðˤ-ʔa:t] ‘nurses’
[mraðˤa-t] ‘she got sick’
[manasˤ-ʔa:t] ‘stages’

(28) Spread

[musˤtˤafa] ‘chosen’
[iðˤirab] ‘confusion’

Words in 27 show that when suffixes are present, emphasis does not spread to stops; however, when coronal stops are parts of the root, emphasis from fricatives must spread rightward, as seen in 28.

(29) Rightward Spread from fricatives to other fricatives

a. sˤasˤ ðˤaðˤ ðˤazˤ
b. *sˤaðˤ *ðˤað *ðˤaz *ðˤas *sˤaz *ðˤas

The data in 29a show that rightward spreading from fricatives to other fricatives is restricted to consonants that share the same voicing feature, that is, from voiceless to other voiceless, or voiced to other voiced fricatives, but never from voiced to voiceless fricatives or vice versa, as shown in 29b. One of the patterns in 29a is marked as (?) and that is because no actual words of the same form are found in Najdi; however, its sound sequencing is acceptable. Actual words of other patterns are shown in 30.

(30) Spread

[masˤasˤah] ‘pacifier’
[ʔaðˤðˤaðˤah] ‘teething toy’
Moreover, the data in 29c show that plain coronal [s] can never exist to the right of emphatic fricatives unless if it is not part of the root. The suffix (-s) is used in Najdi to address feminine subjects, as the data in 31 show:

(31) No spread

[ʕaððʕa-s] ‘he bit you (f)’
[gasʕsʕa-s] ‘he cut your(f) hair’

(32) Rightward Spread from stops to laterals

a. ʕal
b. *ʕalʕ

Words shown in 32a,b clearly show that emphasis does not spread rightward from stops to laterals, as plain laterals are allowed to follow emphatic stops.

(33) No spread

[tʕal] ‘took a look’
[tʕalaʕ] ‘he went out’
[tʕalasim] ‘nonsense words’

(34) Rightward Spread from stops to fricatives

a. ʕas ʕaz ʕað
b. *ʕasʕ *ʕazʕ *ʕaðʕ

Emphasis does not spread rightward from stops to fricatives, that is, only plain fricatives are allowed to occur to the right of an emphatic stop, as shown in 34a. Violations lead to unpronounceable forms as in 34b. Actual words of Najdi are seen in 35:
(35) No Spread

\[
\text{[ʕatˤas]} \quad \text{‘he sneezed’} \\
\text{[ʁatˤas]} \quad \text{‘he dove’} \\
\text{[tˤa:sah]} \quad \text{‘bowel’} \\
\text{[tˤazah]} \quad \text{‘fresh’}
\]

(36) Rightward Spread from stops to other stops

a. \text{tˤatˤ} \\
b. \text{tˤat}

Emphasis spreads rightward from emphatic stops to other stops as shown in 36a. Consider the following example:

(37) Spread

\[
\text{[ʃartˤun]} \quad \text{‘tape’} \\
\text{[matˤatˤ]} \quad \text{‘rubber’} \\
\text{[χatˤatˤ]} \quad \text{‘writer’}
\]

It seems that whether the emphatic stop [tˤ] is in coda or onset position, emphasis spreads rightward to other coronal stops to its right. However, this kind of spreading is root-bounded, that is, emphasis does not spread to suffixes that are attached to the root to indicate the 3rd singular feminine forms (-t), or to indicate the feminine plural form (-a:t), as shown in 38.

(38) Non-spread

\[
\text{[mahatˤ-a:t]} \quad \text{‘stations’ (feminine.pl)} \\
\text{[hatˤa-t]} \quad \text{‘she put’} \\
\text{[rbatˤa-t]} \quad \text{‘she tied’}
\]

In sum, examples of rightward spread show that rightward spreading of emphasis is root-bounded. Obstruents do not spread emphasis to a lateral. On the
other hand, emphatic laterals must spread emphasis rightward to all other coronals, but suffixed coronals are immune.

Emphatic stops must spread emphasis rightward to other stops, but not to laterals or fricatives; emphatic fricatives spread emphasis rightward to stops and to other fricatives that share the same voicing feature, that is, voiced to voiced and voiceless to voiceless fricatives.
CHAPTER 6: CONCLUSION

Five coronal emphatics [sˤ],[tˤ],[ðˤ],[zˤ], and [lˤ] are tested to examine the emphasis spread in Najdi Arabic and to highlight the restrictions that source and target consonants play in this spread. Emphasis is found to spread rightward and leftward, but only within morphological roots, that is, affixes are not affected by the spread. Leftward spread from emphatic laterals is unrestricted while it is restricted for emphatic stops and fricatives. Emphatic stops spread their emphasis to fricatives only, and emphatic fricatives restrict their emphasis to other fricatives of the same voicing status. Similarly, rightward emphasis spread from emphatic laterals is unrestricted, but it is restricted for stops and fricatives. Emphatic stops only spread their emphasis rightwards to other stops; fricatives spread emphasis only to stops and to other fricatives that share the same voicing feature.

Segments that might block emphasis from spreading to coronals are not examined in this study, but would be interesting to observe for future investigation.
REFERENCES


ALOSH, MUHAMMAD MAHDI. 1987. The Perception and Acquisition of Pharyngealized Fricatives by American Learners of Arabic and Implications for Teaching Arabic Phonology. Unpublished doctoral dissertation, the Ohio State University, Columbus, Ohio.


GHAZALI, S. 1977, Back consonants and backing co-articulation in Arabic, PhD dissertation, University of Texas, Austin.


APPENDIX A: FIGURES
Figure 6. The effect of plain and emphatic consonants [ð] vs. [ðˤ] on the low front vowel [a] on the monosyllabic C'VC words: [ðal] ‘humiliated’ and [ðˤal] ‘lost’

Figure 7. The effect of plain and emphatic consonants [t] vs. [tˤ] on the low front vowel [a] on the monosyllabic C'VC words: [tal] ‘hill’ and [tˤal] ‘took a look’
Figure 8. Map of Saudi Arabia
APPENDIX B: TABLE 2
Table 2. F1 and F2 values of both monosyllabic and disyllabic words of Najdi

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<th>Monosyllabic words</th>
<th>F1 (Hz)</th>
<th>F2 (Hz)</th>
<th>Disyllabic words</th>
<th>F1 (V1)</th>
<th>F2 (Hz)</th>
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