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Phonological Assimilation in Urban Jordanian Arabic

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Abstract

This study reports patterns of phonological assimilation in consonant clusters in Urban Jordanian Arabic (UJA). We examine all possible C_1C_2 combinations across a word boundary as well as the concatenations of consonant-final prefixes /ʔin/ and /ʔil/ and consonant-initial stems. The data show that place assimilation in UJA is regressive, and it can occur both across major articulators and within the same articulator (for coronals). UJA also exhibits voicing assimilation and emphasis assimilation. The main theoretical interest of the work lies in the observation that phonological assimilation in UJA is sometimes conditioned by the similarity between the two adjacent consonants. This is reflected in three patterns of assimilation. First, coronal consonants with a minor place difference (e.g., alveolar vs. palatoalveolar) may assimilate to each other only if the sonorancy of the consonants already matches. Second, coronal obstruents may undergo place assimilation when followed by a coronal obstruent, but not a velar obstruent. Third, voicing and emphasis assimilations occur only if the places of the adjacent consonants are identical underlyingly or as a result of place assimilation. These results are discussed briefly in the light of recent works by MacEachern (1999), Hansson (2001), Zuraw (2002), Rose and Walker (2004), and Steriade (to appear). The UJA place assimilation patterns are also compared to the implicational hierarchies established by Mohanan (1993)'s and Jun (1995)'s crosslinguistic typologies.

1. Introduction

1.1. Place assimilation and the phonetics-phonology relation

Many phonological processes can be seen as the result of compromise between articulatory and perceptual demands in speech. Place assimilation, for instance, has been considered as not only an articulatorily motivated process, but also an adaptation to the listener's needs (Kohler 1991, 1992, Mohanan 1993, Jun 1995, 2005).

Typological works by Mohanan (1993) and Jun (1995, 2005) have established a number of implicational statements on place assimilation. Jun's statements are summarized in (1)-(5). Mohanan's results are similar.

(1) Target manner:

a. If fricatives or nonnasal sonorants are targets of place assimilation, so are stops.

b. If stops are targets of place assimilation, so are nasals.

(2) Target place:

a. If velars are targets of place assimilation, so are labials.

b. If labials are targets of place assimilation, so are coronals.

(3) Trigger manner:

a. If nonnasal sonorants trigger place assimilation, so do nasals and fricatives.

b. If nasals or fricatives trigger place assimilation, so do stops.

(4) Trigger place:

If coronals trigger place assimilation, so do noncoronals.

(5) Position of target:

In C_1C_2 cluster, if C_2 is a target of place assimilation, so is C_1.

Jun accounts for these implicational observations by incorporating constraints with perceptual bases in the grammar. The core of the theory is the Production Hypothesis, as stated in (6).

(6) Production Hypothesis:

Speakers make more effort to preserve the articulation of speech sounds with relatively more powerful acoustic cues. (Jun 2005: 73)

The Production Hypothesis informs the faithfulness constraints of their rankings based on the perceptual cues of the features that the faithfulness constraints aim to protect—the stronger the cues, the higher ranked the faithfulness constraints. This is formalized by Jun as in (7).

(7) PRES(X(Y)): Preserve perceptual cues for X (place or manner of articulation) of Y (a segmental class).

Universal ranking: PRES(M(N)) » PRES(M(R)), where N's perceptual cues for M are stronger than R's cues for M. (Jun 2005: 73)

For instance, this general schema accounts for the implicational observations in (2) because of the universal ranking PRES(pl(dor̃)) » PRES(pl(lab̃)) » PRES(pl(cor̃)) projected from the phonetics of dorsal, labial, and coronal sounds—dorsal sounds involve the slowest articulatory gestures, which provide the strongest transitional cues for their

perception; labial sounds benefit from weaker transitional cues; coronal sounds have the weakest transitional cues due to the agility of the tongue tip.

We investigate consonant place assimilation together with voicing and emphasis assimilations in Urban Jordanian Arabic (UJA) in this paper. The main goal of the paper is to present a comprehensive data source for the assimilation behavior in the language. The data, however, lead to two points of theoretical interest. First, we test whether the implicational hierarchies established by Mohanan and Jun are observed in a language with a rather complicated place assimilation pattern. To preview the result, we show that the predictions of the implicational hierarchies are generally borne out. Two patterns not predicted by, but also not in conflict with, the existing implicational statements are that nasals are better triggers of place assimilation than fricatives, and that labials are better triggers of place assimilation than velars. Second, we show that phonological assimilation in UJA is sometimes conditioned by the similarity between the two adjacent consonants. This is reflected in three patterns of assimilation: (a) coronal consonants with a minor place difference (e.g., alveolar vs. palatoalveolar) may assimilate to each other only if the sonorancy of the consonants already matches; (b) coronal stops may undergo place assimilation when followed by a coronal obstruent, but not a velar obstruent; and (c) voicing and emphasis assimilations occur only if the places of the adjacent consonants are identical underlyingly or as a result of place assimilation. These results are discussed briefly in the light of recent works by MacEachern (1999), Hansson (2001), Zuraw (2002), Rose and Walker (2004), and Steriade (to appear). This complements Mohanan's and Jun's results in providing a comprehensive picture of consonant assimilation.

1.2. The Arabic language and the Urban Jordanian dialect

Arabic is a Semitic language with various dialects spoken in Arab countries in the Middle East and North Africa. Modern Standard Arabic (MSA), which descends from the language of ancient poetry, literature, and the Quran, is considered the official language in these countries. Accordingly, most Arabic speakers employ at least two diverse linguistic forms: the regional dialect, which is naturally acquired as a first language, and MSA, which is learned during the course of education in a classroom setting. In other words, Arabic communities are diglossic. MSA is used in formal situations, such as public speeches, news announcements, and religious services, while the regional dialects are spoken locally in day-to-day communications.

Major Arabic dialects are Iraqi, Egyptian, Levantine, Gulf, Northwest African, and Yemeni. Palestinians, Lebanese, Syrians, and Jordanians speak the Levantine dialect with some phonological and lexical differences. Jordanian Arabic consists of four sub-dialects: Urban, Rural, Bedouin, and Ghorani.[1] One phonetic feature common to all Arabic dialects is the presence of the so-called emphatic consonants, written here as [C^{ς}]. These consonants are produced with a secondary constriction in the posterior vocal tract (Lehn 1963, Al-Ani 1970, Card 1983, Davis 1995, Zawaydeh 1999, among others). The consonantal inventory of Urban Jordanian Arabic (UJA) is similar to that of MSA, with the following two differences. First, the uvular plosive /q/ in MSA equates the Jordanian

[1] The Ghorani sub-dialect, in particular, is spoken by black Jordanian farmers living across the Jordan Valley.

velar /g/. Second, emphatics /dˤ/ and /ðˤ/ are contrastive in MSA, but speakers of UJA produce them interchangeably. The consonant inventory of UJA is summarized in (8).

(8) Consonantal inventory of UJA:

	Labial	Labio-dental	Inter-dental	Alveolar	Palato-alveolar	Palatal	Velar	Pharyn-geal	Glottal
Plosive	b			t d tˤ dˤ			k g		ʔ
Nasal	m			n					
Trill				r					
Fric.		f	θ ð ðˤ	s z sˤ	ʃ		x[2] ɣ	ħ ʕ	h
Affric.					dʒ				
Approx.				l					
Glide	w					j			

2. Data collection

To systematically investigate the patterns of consonant assimilation in UJA, we create phrases that represent all C_1C_2 combinations ($C_1 \neq C_2$) across a word boundary. Given that UJA has 28 consonants, and [j] and [w] do not occur in word-final position, there are a total of (28-2)(28-1)=702 phrases. All C_1C_2 clusters are intervocalic.

To examine the behavior of prefixes ending with consonants in UJA, we create words that are preceded by two of the prefixes: the definite article /ʔil/ and the passive

[2] Some UJA speakers pronounce the velar fricatives /x, ɣ/ as uvulars /χ, ʁ/.

prefix /ʔin/. These are the only prefixes that end in a consonant in UJA. Fifty-four ((28-1)×2) such examples were generated.

All phrases under investigation are produced by a female native speaker of UJA and recorded. The judgment of whether assimilation has occurred is made by the first author. Spectrographic analyses are used for ambiguous cases. But in general, the judgments are clear and relatively easy to make.

The assimilation behavior does not depend on lexical stress, and phrasal stress is identical on both words in the same phrase.

In the following two sections, we report the results for stem-stem and prefix-stem assimilations respectively.

3. Assimilation in stem-stem combinations

3.1. C_1=noncoronal and C_2=coronal

3.1.1. Place assimilation

Labials and dorsals are never targeted by coronals for place assimilation, as shown by the following examples.

D1.	/kalaam naagisˤ/	[kalaam naagisˤ]	‘incomplete speech’
D2.	/kalaam raagi/	[kalaam raagi]	‘elegant speech’
D3.	/kalaam taariixi/	[kalaam taariixi]	‘historic speech’
D4.	/kalaam safiih/	[kalaam safiih]	‘trivial speech’
D5.	/ʕalaf naadʒiħ/	[ʕalaf naadʒiħ]	‘a successful fertilizer’
D6.	/ʕalaf naaʕim/	[ʕalaf naaʕim]	‘a soft fertilizer’

D7.	/ʕalaf tidʒaari/	[ʕalaf tidʒaari]	‘a commercial fertilizer’
D8.	/ʕalaf saaxin/	[ʕalaf saaxin]	‘a warm fertilizer’
D9.	/galb daafi/	[galb daafi]	‘a warm heart’
D10.	/selek taalef/	[selek taalef]	‘a torn wire’
D11.	/malik daahje/	[malik daahje]	‘a shrewd king’
D12.	/farg ʃaasiʕ/	[farg ʃaasiʕ]	‘a big difference’
D13.	/ħarb sahle/	[ħarb sahle]	‘an easy war’

3.1.2. Voicing assimilation

Labials and dorsals are never targeted by coronals for voicing assimilation, as illustrated by examples D3-D6 and D11-D13.

3.1.3. Emphasis assimilation

Unsurprisingly, labials and dorsals are never targeted by coronals for emphasis assimilation, as emphatic labials and dorsals are not part of UJA’s consonant inventory. This is shown in D14-D15.

D14.	/kalaam sˁabi /	[kalaam sˁabi]	‘a boy’s speech’
D15.	/sarag sˁabi /	[sarag sˁabi]	‘he rubbed a boy’

3.2. C_1 and C_2=noncoronals

3.2.1. Place assimilation

Place assimilation does not occur if the two adjacent consonants are both noncoronals. This is shown in D16-D21.

D16.	/ħag ɣaname/	[ħag ɣaname]	'the price of a goat'
D17.	/galb gaasi/	[galb gaasi]	'a ruthless heart'
D18.	/faraaɣ kulli/	[faraaɣ kulli]	'a full blankness'
D19.	/ħub faani/	[ħub faani]	'a fading love'
D20.	/raf baali/	[raf baali]	'a torn shelf'
D21.	/selek baali/	[selek baali]	'a smashed wire'

3.2.2. Voicing assimilation

If two adjacent noncoronal sounds differ only in voicing, they undergo voicing assimilation. But when they differ in any other features, then voicing assimilation is blocked. The non-application of voicing assimilation is illustrated by examples D18-D21. Voicing assimilation is shown in D22-D23.

D22.	/ħag kaamil/	[ħak kaamil]	'a complete right'
D23.	/tˁax ɣaname/	[tˁaɣ ɣaname]	'he shot a goat'

3.2.3. Emphasis assimilation

Given that emphatic labials and dorsals are not part of UJA's consonant inventory, emphasis assimilation is not relevant here.

3.3. C_1=coronal and C_2=noncoronal

3.3.1. Place assimilation

When C_1 is a coronal nasal /n/, it assimilates in place to a following labial or velar stop (oral or nasal), a shown in examples D24-D27.

D24.	/tiin baladi/	[tiim baladi]	'local fig'
D25.	/den majjit/	[dem majjit]	'a dead loan'
D26.	/laban kaθiir/	[labaŋ kaθiir]	'a lot of yogurt'
D27.	/dʒibin gaasi/	[dʒibiŋ gaasi]	'hard cheese'

A coronal nasal /n/ does not assimilate in place to a following fricative, as shown in D28-D29.

D28.	/laban fawwaar/	[laban fawwaar]	'a boiling yogurt'
D29.	/den xasraan/	[den xasraan]	'a misplaced loan'

Unsurprisingly, /n/ does not assimilate in place to a following pharyngeal /ħ/ or /ʕ/, as a pharyngeal nasal is articulatorily impossible. This is shown in D30-D31.

D30.	/laban ħaami/	[laban ħaami]	'a very hot yogurt'
D31.	/laban ʕaadi/	[laban ʕaadi]	'a plain yogurt'

Coronal plosives /t, d, tˤ, dˤ/ assimilate in place to a following labial plosive, but not to a velar plosive, as in D32-D39. And as we can see in D33-D35, voicing and emphasis assimilations also occur concomitantly when place assimilation occurs.

D32.	/samaad baladi/	[samaab baladi]	‘national fertilizer’
D33.	/bet baladi/	[beb baladi]	‘a traditional house’
D34.	/matˤaatˤ baladi/	[matˤaab baladi]	‘national rubber’
D35.	/bedˤ baladi/	[beb baladi]	‘non-commercial eggs’
D36.	/bet kariim/	[bet kariim]	‘a generous family’
D37.	/matˤaatˤ kbiir/	[matˤaatˤ kbiir]	‘a big rubber’
D38.	/samaad gaasi/	[samaad gaasi]	‘a solid fertilizer’
D39.	/bedˤ gaasi/	[bedˤ gaasi]	‘solid eggs’

Coronal plosives /t, d, tˤ, dˤ/ do not assimilate in place to a following labial nasal, as seen in D40-D41. Notice that UJA does not have a velar nasal [ŋ] underlyingly.

D40.	/naadat marra/	[naadat marra]	‘she called once’
D41.	/marrat maraa/	[marrat maraa]	‘a woman passed by’

Coronal plosives /t, d, tˤ, dˤ/ do not assimilate in place to a following noncoronal fricative, as illustrated in D42-D47.

D42.	/bet fluus/	[bet fluus]	‘a rich family’
D43.	/matˤaatˤ faalit/	[matˤaatˤ faalit]	‘a loose rubber’
D44.	/samaad fawwaar/	[samaad fawwaar]	‘a strong fertilizer’
D45.	/bedˤ faasid/	[bedˤ faasid]	‘rotten eggs’
D46.	/bet xaali/	[bet xaali]	‘an empty house’
D47.	/bet ɣaali/	[bet ɣaali]	‘an expensive house’

Coronal fricatives do not assimilate in place to a following noncoronal, as shown in D48-D50.

D48.	/θalaθ barakaat/	[θalaθ barakaat]	‘three blessings’
D49.	/kiis banduura/	[kiis banduura]	‘a bag of tomatoes’
D50.	/kiis kuusa/	[kiis kuusa]	‘a bag of squash’

Finally, nonnasal coronal sonorants /l, r/ do not assimilate to a following noncoronal, as shown in D51-D54.

D51.	/lel kaaliħ/	[lel kaaliħ]	‘a very dark night’
D52.	/lel baraka/	[lel baraka]	‘a blessed night’
D53.	/dar kbiire/	[dar kbiire]	‘a big house’
D54.	/dar blaad/	[dar blaad]	‘a huge house’

3.3.2. Voicing assimilation

Voice assimilation between a coronal C_1 and a noncoronal C_2 occurs on condition that C_1 assimilates in place to C_2. This is illustrated by examples D33-D34. Given that place assimilation only occurs when both C_1 and C_2 are oral stops, this observation is in line with the generalization that voicing assimilation only occurs when all other surface features of the two consonants are identical (cf. §3.2.2). The only underlying feature that may differ between C_1 and C_2 without blocking voicing assimilation is emphasis. See §3.3.3 on emphasis assimilation below.

3.3.3. Emphasis assimilation

Emphasis assimilation also only occurs between a coronal C_1 and a noncoronal C_2 when place assimilation also occurs. Therefore, similarly to voicing assimilation, emphasis assimilation only occurs when all other surface features of the two consonants are identical. Given that only coronal consonants can be emphatic, the emphasis assimilation here equates deemphasis.

3.4. Interim summary

Before delving into the more complex assimilation patterns between two coronals, we summarize the patterns of place assimilation seen so far. There are clear asymmetries regarding both triggers and targets along the dimensions of place and manner, and they are generally in line with the implicational hierarchies of Mohanan's and Jun's. These asymmetries are summarized in (9)-(13).

(9) Target manner:

a. Nasals are more likely targets than stops.

b. Stops are more likely targets than fricatives and nonnasal sonorants.

(10) Target place:

Coronals are more likely targets than noncoronals.

(11) Trigger manner:

a. Stops are better triggers than nasals.

b. Nasals are better triggers than fricatives.

(12) Trigger place:

a. Labials are better triggers than velars.

b. Velars are better triggers than coronals.

(13) Position of target:

C_1 assimilates to C_2.

As we can see, these asymmetries are generally consistent with the established implicational hierarchies in (1)-(5). Two patterns not predicted by, but also not in conflict with, the existing implicational statements are that nasals are better triggers of than fricatives, and that labials are better triggers than velars. Jun (2005) does not

commit to a comparison between nasals and fricatives or between labials and velars in their ability to trigger place assimilation.

Neither Mohanan's nor Jun's works discuss patterns of what we call "minor place assimilation"—assimilation between two coronal consonants that differ slightly in place, e.g., alveolar vs. palatoalveolar. The following section discusses cases of minor place assimilation in UJA. To preview the findings, we show that (a) place assimilation is more likely to happen when the sonorancy of the two consonant matches; (b) there are a number of asymmetries regarding triggers and targets of place assimilation; and (c) voicing and emphasis assimilations occur when the places of the two consonants are identical, either underlyingly or as a result of minor place assimilation.

3.5. C_1 and C_2=coronals

3.5.1. Place assimilation

UJA has coronal sounds from three different passive articulators: interdental, alveolar, and palatoalveolar. If two adjacent coronal sounds do not agree in sonorancy, no assimilation occurs. If the adjacent coronals agree in sonorancy, minor place assimilation occurs, which triggers voicing and emphasis assimilations, rendering the two coronals identical. This total assimilation has the following exceptions. First, nonnasal sonorants /l/ and /r/ do not assimilate to the nasal /n/. Second, /r/ does not assimilate to /l/. Third, strident coronals /s, z, $s^ʕ$, ʃ, ʤ/ do not assimilate to nonstrident coronals /t, $t^ʕ$, d, $d^ʕ$, ð, $ð^ʕ$, θ/. Fourth, within stridents, palatoalveolars /ʃ, ʤ/ do not assimilate to alveolars /s, $s^ʕ$, z/. Fifth, within palatoalveolar stridents, the affricate /ʤ/ does not assimilate to the fricative /ʃ/. We illustrates these generalizations in turn below.

Examples D55-D60 show that when two coronals disagree on sonorancy, no assimilation takes place.

D55.	/sˤaar ʃab/	[sˤaar ʃab]	‘he became a chap’
D56.	/ʃaaʃ raasi/	[ʃaaʃ raasi]	‘the bandage of my head’
D57.	/tiin dʒabali/	[tiin dʒabali]	‘mountain’s figs’
D58.	/sardʒ naaʕim/	[sardʒ naaʕim]	‘a soft saddle’
D59.	/lel daafi/	[lel daafi]	‘a warm night’
D60.	/ward laamiʕ/	[ward laamiʕ]	‘shining roses’

Within sonorants, nonnasals trigger total assimilation of the nasal /n/, but not *vice versa*, as shown in D61-D64.

D61.	/miin ramaaha/	[miir ramaaha]	‘who threw it?’
D62.	/tiin libnaani/	[tiil libnaani]	‘Lebanese figs’
D63.	/sˤaar naajim/	[sˤaar naajim]	‘he became asleep’
D64.	/lel naadi/	[lel naadi]	‘a drizzling night’

Within nonnasal sonorants, /l/ assimilates to /r/, but not *vice versa*, as shown in D65-D66.

D65.	/lel raajiɡ/	[ler raajiɡ]	‘a calm night’

D66. /sˤaar libnaani/ [sˤaar libnaani] ‘he became Lebanese’

Within nonsonorants, nonstridents assimilate to stridents (D67-D71), but not *vice versa* (D72-D76). Assimilation is total in that minor place assimilation is accompanied by both emphasis assimilation (D69) and voicing assimilation (D71).

D67. /ħadiiθ ʃaajiʕ/ [ħadiiʃ ʃaajiʕ] ‘a common talk’

D68. /fulaað zjaade/ [fulaaz zjaade] ‘extra steel’

D69. /θaaliθ sˤabi/ [θaalisˤ sˤabi] ‘the third boy’

D70. /ħadiiθ saaħir/ [ħadiis saaħir] ‘a magical talk’

D71. /ħadiiθ zaajif/ [ħadiiz zaajif] ‘a fake event’

D72. /ʃaaʃ θaani/ [ʃaaʃ θaani] ‘another tissue’

D73. /gazaaz ðaajeb/ [gazaaz ðaajeb] ‘a melting glass’

D74. /lisˤ θaani/ [lisˤ θaani] ‘another thief’

D75. /kaas θaani/ [kaas θaani] ‘another cup’

D76. /ħiz θaani/ [ħiz θaani] ‘another slice’

Within stridents, alveolars assimilate to palatoalveolars (D77-D78), but not *vice versa* (D79-D80). Notice that in D78, voicing and emphasis assimilations occur concurrently with place assimilation; moreover, since UJA does not have /ʒ/ and /tʃ/,

assimilation of the [continuant] feature is forced by structure preservation in D78 and D80.

D77.	/kaas ʃaraab/	[kaaʃ ʃaraab]	‘a glass of juice’
D78.	/xalasˁ dʒidaal/	[xaladʒ dʒidaal]	‘enough of dispute’
D79.	/ʃaaʃ saalim/	[ʃaaʃ saalim]	‘whole tissue’
D80.	/ħadʒ sˁajjaad/	[ħadʒ sˁajjaad]	‘a skillful aged hunter’

Within palatoalveolar stridents, the fricative /ʃ/ assimilates completely to the affricate /dʒ/, but not *vice versa*, as in D81-D82.

D81.	/balaaʃ dʒidaal/	[balaadʒ dʒidaal]	‘stop disputing’
D82.	/faradʒ ʃaamil/	[faradʒ ʃaamil]	‘a total relief’

Within nonstrident obstruents, all segments are triggers and targets of total assimilation (place, voice, and emphasis), as shown in D83-D98. We also observe the assimilation of [continuant] due to structure preservation in all these data.

D83.	/bet θaani/	[beθ θaani]	‘a second house’
D84.	/harraaθ taʕbaan/	[harraat taʕbaan]	‘a tired farmer’
D85.	/rad ðaliil/	[rað ðaliil]	‘a weak answer’
D86.	/malaað daafi/	[malaad daafi]	‘a warm shelter’

D87.	/arðˤ dˤaawji/	[ardˤ dˤaawji]	‘a glowing land’
D88.	/bedˤ ðˤaamer/	[beðˤ ðˤaamer]	‘small eggs’
D89.	/dʒaatˤ θuum/	[dʒaaθ θuum]	‘a garlic-full dish’
D90.	/gararaat ðˤaalime/	[gararaaðˤ ðˤaalime]	‘unfair decisions’
D91.	/ʃartˤ ðˤaaher/	[ʃarðˤ ðˤaaher]	‘a clear provision’
D92.	/xatˤ ðibbaan/	[xað ðibbaan]	‘a line of flies’
D93.	/ʔil-fulaað dˤaruuri/	[ʔil-fulaadˤ dˤaruuri]	‘steel is essential’
D94.	/fulaað daaʕim/	[fulaad daaʕim]	‘a supporting steel’
D95.	/ħaðˤ daajim/	[ħad daajim]	‘a lasting luck’
D96.	/ɣaliiðˤ dam/	[ɣaliid dam]	‘he is not kind’
D97.	/walad ðˤaalem/	[waladˤ ðˤaalem]	‘a brainteaser boy’
D98.	/laðiið dˤaawi/	[laðiidˤ dˤaawi]	‘nice and complacent’

3.5.2. Voicing and emphasis assimilations

As we have seen in the previous section, when C_1 and C_2 are both coronal obstruents, voicing and emphasis assimilations occur if minor place assimilation also occurs. The following data exemplify the application of voicing and emphasis assimilations when the places of the two consonants are identical underlyingly.

D99.	/bas zalame/	[baz zalame]	‘but he is a man’
D100.	/ħiz saalem/	[ħis saalem]	‘a complete slice’

D101.	/nusˤ zalame/	[nuz zalame]	‘half a man’
D102.	/xubiz sˤaadʒ/	[xubisˤ sˤaadʒ]	‘a type of bread’
D103.	/nusˤ saalim/	[nus saalim]	‘half safe’
D104.	/bas sˤajjaad/	[basˤ sˤajjaad]	‘but he is a hunter’
D105.	/beet tˤawaabig/	[beetˤ tˤawaabig]	‘a multi-level house’
D106.	/balad dˤabaab/	[baladˤ dˤabaab]	‘a country of fog’
D107.	/bas sˤaajim/	[basˤ sˤaajim]	‘just fasting’
D108.	/malaað ðˤaalem/	[malaaðˤ ðˤaalem]	‘unfair shelter’
D109.	/arðˤ ðablaane/	[arð ðablaane]	‘a dry land’
D110.	/beet diin/	[beed diin]	‘a religious family’
D111.	/bas zalame/	[baz zalame]	‘but a man’
D112.	/ħadiiθ ðikir/	[ħadiið ðikir]	‘a religious talk’

3.5.3. Interim summary

We C_1 and C_2 are both coronals, we have observed that minor place assimilation only occurs when the sonorancy of the two consonants matches, and that there are the following asymmetries regarding targets and triggers:

(14) Target manner:

a. Nasal sonorants are more likely targets than nonnasal sonorants.

b. Nonstridents are more likely targets than stridents.

c. Fricatives are more likely targets than affricates.

(15) Target place:

a. Laterals are more likely targets than rhotics.

b. Alveolars are more likely targets than palatoalveolars.

(16) Trigger manner:

a. Nonnasal sonorants are more likely triggers than nasal sonorants.

b. Stridents are more likely triggers than nonstridents.

c. Affricates are more likely triggers than fricatives.

(17) Trigger place:

a. Rhotics are more likely triggers than laterals.

b. Palatoalveolars are better triggers than alveolars.

(18) Position of target:

C_1 assimilate to C_2.

Regarding voicing and emphasis assimilations, the generalization is the same as other C_1C_2 combinations: they occur provided that both C_1 and C_2 are obstruents and that they share the same place of articulation, either underlyingly or due to place assimilation.

4. Assimilation in prefix-stem combinations

4.1. The /ʔin/ prefix

One of the prefixes that end in a consonant is the passive voice prefix /ʔin/. The prefix-final /n/ has exactly the same assimilation behavior as a stem-final /n/. Namely, it assimilates in place to a following noncoronal oral or nasal stop (D113-D116), but does not assimilate to a noncoronal fricative (D117-D121); when followed by a coronal sonorant /l/ or /r/, it undergoes total assimilation (D122-D123); when followed by a coronal obstruent, no assimilation occurs (D124-D127).

D113.	/ʔin-baraa/	[ʔim-baraa]	‘it was sharpened’
D114.	/ʔin-makat/	[ʔim-makat]	‘he was put into grief’
D115.	/ʔin-katab/	[ʔiŋ-katab]	‘it was written’
D116.	/ʔin-ɡasam/	[ʔiŋ-ɡasam]	‘it was divided’
D117.	/ʔin-fataħ/	[ʔin-fataħ]	‘it was opened’
D118.	/ʔin-xatam/	[ʔin-xatam]	‘it was sealed’
D119.	/ʔin-ɣadar/	[ʔin-ɣadar]	‘he was cheated’
D120.	/ʔin-ħarag/	[ʔin-ħarag]	‘it was burnt’
D121.	/ʔin-ʕabar/	[ʔin-ʕabar]	‘it was crossed’
D122.	/ʔin-ramaa/	[ʔir-ramaa]	‘it was thrown’
D123.	/ʔin-laxam/	[ʔil-laxam]	‘he was confused by’
D124.	/ʔin-tˤamar/	[ʔin-tˤamar]	‘it was covered by soil’

D125. /ʔin-sarag/	[ʔin-sarag]	‘it was stolen’
D126. /ʔin-θagab/	[ʔin-θagab]	‘it was punched’
D127. /ʔin-ʃatˤab/	[ʔin-ʃatˤab]	‘it was crossed out’

4.2. The /ʔil/ prefix

The definite article /ʔil/ is the other prefix in UJA that ends in a consonant. The final /l/ in the prefix exhibits different assimilation behaviors from stem-final /l/, in that it undergoes total assimilation when followed by any coronal sound, not just /r/. This is illustrated in D128-D141.

D128. /ʔil-sir/	[ʔis-sir]	‘the secret’
D129. /ʔil-naas/	[ʔin-naas]	‘the people’
D130. /ʔil-tiin/	[ʔit-tiin]	‘the fig’
D131. /ʔil-daar/	[ʔid-daar]	‘the house’
D132. /ʔil-raas/	[ʔir-raas]	‘the head’
D133. /ʔil-θuub/	[ʔiθ-θuub]	‘the dress’
D134. /ʔil-zaraafe/	[ʔiz-zaraafe]	‘the giraffe’
D135. /ʔil-ðibbaan/	[ʔið-ðibbaan]	‘the flies’
D136. /ʔil-ʃams/	[ʔiʃ-ʃams]	‘the sun’
D137. /ʔil-sˤaber/	[ʔisˤ-sˤaber]	‘the patience’
D138. /ʔil-dˤabaab/	[ʔidˤ-dˤabaab]	‘the fog’

D139.	/ʔil-tˤawaabeg/	[ʔitˤ-tˤawaabeg]	‘the stories/levels’
D140.	/ʔil-ðˤalaam/	[ʔiðˤ-ðˤalaam]	‘the darkness’
D141.	/ʔil-dʒamal/	[ʔidʒ-dʒamal]	‘the camel’

Examples D142-D153 show that when the definite article is followed by a noncoronal consonant, no assimilation occurs.

D142.	/ʔil-malek/	[ʔil-malek]	‘the king’
D143.	/ʔil-binet/	[ʔil-binet]	‘the girl’
D144.	/ʔil-xubez/	[ʔil-xubez]	‘the bread’
D145.	/ʔil-ɣada/	[ʔil-ɣada]	‘the lunch’
D146.	/ʔil-faajiz/	[ʔil-faajiz]	‘the winner’
D147.	/ʔil-ɡalam/	[ʔil-ɡalam]	‘the pen/pencil’
D148.	/ʔil-kalib/	[ʔil-kalib]	‘the dog’
D149.	/ʔil-waadi/	[ʔil-waadi]	‘the valley’
D150.	/ʔil-jaabes/	[ʔil-jaabes]	‘the rigid’
D151.	/ʔil-ħub/	[ʔil-ħub]	‘the love’
D152.	/ʔil-ʕarab/	[ʔil-ʕarab]	‘the Arabs’
D153.	/ʔil-hawaa/	[ʔil-hawaa]	‘the air’

The same assimilation behavior also applies to loanwords. Examples D154-D159 illustrate total assimilation when C_2 is coronal, and examples D160-D163 show lack of assimilation when C_2 is noncoronal.

D154.	/ʔil-taksi/	[ʔit-taksi]	'the taxi'
D155.	/ʔil-raadju/	[ʔir-raadju]	'the radio'
D156.	/ʔil-sikirtera/	[ʔis-sikirtera]	'the (female) secretary'
D157.	/ʔil-ziŋk/	[ʔiz-ziŋk]	'the zink'
D158.	/ʔil-ʃaambu/	[ʔiʃ-ʃaambu]	'the shampoo'
D159.	/ʔil-naazi/	[ʔin-naazi]	'the Nazi'
D160.	/ʔil-kumbjuutar/	[ʔil-kumbjuutar]	'the computer'
D161.	/ʔil-fail/	[ʔil-fail]	'the file'
D162.	/ʔil-biira/	[ʔil-biira]	'the beer'
D163.	/ʔil-beergar/	[ʔil-beergar]	'the burger'

The assimilation behavior of the definite article /ʔil/ is shared by all known Arabic dialects (Watson 2002: 216).

5. Discussion

From the above data discussion, we can see that the implicational hierarchies on place assimilation established by Mohanan's and Jun's typological works are generally observed in UJA: in terms of targets, nasals are more likely targets than stops, which are

in turn more likely targets than fricatives and nonnasal sonorants, and that coronals are more likely targets than noncoronals; in terms of triggers, stops are better triggers than other consonants, and that noncoronals are better triggers of major place assimilation than coronals (cf. discussion of minor place assimilation below); in terms of the direction of assimilation, all assimilations in VC_1C_2V are regressive.

Two patterns that are not predicted by, but also not in conflict with, the existing implicational statements are that nasals are better triggers than fricatives, and that labials are better triggers than velars. Jun (2005) does not commit to a comparison between nasals and fricatives or between labials and velars in their ability to trigger place assimilation. It is likely that the comparison must be made on a language-specific basis, and that UJA happens to illustrate the pattern in which nasals and labials are better triggers of place assimilation.

What we deem more interesting is the observation that assimilation in UJA is sometimes conditioned by the similarity between the two adjacent consonants. This is reflected in three patterns of assimilation: (a) coronal consonants with a minor place difference (e.g., alveolar vs. palatoalveolar) may assimilate to each other only if the sonorancy of the consonants already matches; (b) coronal obstruents may undergo place assimilation (minor) when followed by a coronal obstruent, but not a velar obstruent; and (c) voicing and emphasis assimilations occur only if the places of the adjacent consonants are identical underlyingly or as a result of place assimilation. Some instances of the first two patterns in fact contradict Mohanan's and Jun's implicational hierarchies, at least on the surface. One manifestation of (a) above is that a nasal /n/ assimilates to a following sonorant /l/ or /r/, but not to a following stop or fricative. This goes against the

generalization that stops and fricatives are better trigger than nonnasal sonorants. The statement (b) above is in direct conflict with the generalization that noncoronals are better triggers than coronals.

We argue that the similarity between the two adjacent consonants must be taken into account to complete the typological picture of consonant assimilation. The intuition is that the more similar the two consonants are, the more likely that they will undergo assimilation to become identical. This line of reasoning has been applied to crosslinguistic patterns of laryngeal cooccurrence restrictions (MacEachern 1999), pseudo-reduplication (Zuraw 2002), and long-distance consonant harmony (Hansson 2001, Rose and Walker 2004), all of which show the preference for either complete identity or vast dissimilarity. The formalisms adopted in these works all echo Steriade (to appear)'s P-map theory of correspondence, which states that correspondence constraints and their intrinsic rankings are projected from a perceptual map of phonological contrasts, in that the farther apart perceptually two phonological contrasts are, the higher ranked the constraint that relates them as correspondents. We believe that a formalism similar to those adopted in these works can successfully account for the patterns observed here. In other words, Mohanan's and Jun's implicational hierarchies have not been rejected by the current observations, but they are incomplete in accounting for the full spectrum of consonant assimilation. Once they interact with the formalism that encodes the similarity effects, the patterns of UJA should fall out as not exceptions, but predictions. Due to space limitation, we will not provide the detailed formalism and analysis here, but hope to address the issue fully in a companion paper.

A number of asymmetries observed in minor place assimilation also warrants discussion. Two asymmetries in §3.5.3 seem to contradict Mohanan's and Jun's implicational hierarchies. They are "fricatives are more likely targets than affricates" and "nonnasal sonorants are more likely triggers than nasal sonorants." We argue that they are not exceptional in that their corresponding constraints "affricates are more likely triggers than fricatives" and "nasal sonorants are more likely triggers than nonnasal sonorants" follow the predictions of the established implicational hierarchies. In other words, the "exceptional" statements in UJA are simply epiphenomena of the predicted hierarchies. The exceptional nature of the statements is due to the limited clusters we have available to us for comparison, namely, fricative-affricate vs. affricate-fricative, and nasal-sonorant vs. sonorant-nasal.

The facts that stridents trigger assimilation in nonstridents and the rhotic /r/ triggers assimilation in the lateral /l/ asymmetrically are understandable along the same line of Jun's Production Hypothesis. With a high energy concentration in the higher frequency region, strident consonants are perceptually more salient than nonstrident consonants; and given that the rhotic /r/ in UJA is a trill, its acoustic properties are presumably more salient than those of /l/. The faithfulness constraints would then be ranked in such a way to preferentially preserve the stridents and the rhotic according to the Production Hypothesis.

The asymmetry between the alveolars and palatoalveolars is consistent with the "palatal bias" widely discussed in the literature (Shattuck-Hufnagel and Klatt 1979, Stemberger 1991, Hansson 2001, Pouplier and Goldstein 2005). E.g., similar to UJA, English /s/ is less stable than /ʃ/, as shown in the following examples: *Paris show* [*Parish*

show] vs. *fish soup* *[*fish shoup*]. Stemberger (1991) shows that alveolars (/s, t/) have a significantly greater likelihood of being replaced by palatoalveolars (/ʃ, tʃ/) in speech errors than the reverse. Hansson (2001) finds the same palatal bias in the crosslinguistic typology of consonant harmony systems. Stemberger (1991) accounts for the palatal bias by positing the underspecification of the [place] feature for alveolars—if "nothing" is truly encoded as the lack of activation of anything in mental representation, then a competing segment that has high activation is more likely to replace the lack of activation than to be inhibited by it. Pouplier and Goldstein (2005) use repetitions of *sop shop* to induce speech errors and investigate the movements of tongue tip and tongue body in the production of /s/ and /ʃ/. They find that /s/ involves only tongue tip raising, while /ʃ/ involves both tongue tip and tongue body raising, and that in a /s/ → /ʃ/ speech error (*sop shop* → *shop shop*), a 1:1 phase locking relation is achieved between the tongue tip and tongue body gestures. Therefore, their explanation for the palatal bias is based the preference for a 1:1 phase locking relation between gestures, not the underspecification of the alveolars. But irrespective of the true explanation of the palatal bias, the synchronic grammar must encode some form of correspondence relation that preferentially preserves a palatoalveolar place over an alveolar place.

Finally, the fact that a prefix-final /l/ is more prone to assimilation than a stem-final /l/ can be predicted by any theory that posits the intrinsic ranking of FAITH(stem) » FAITH(affix) (e.g., Beckman 1998). But the precise nature of the difference between stems and affixes, e.g., prefix-final /l/ assimilates more readily than stem-final /l/, but prefix-final /n/ behaves identically to stem-final /n/; or the precise class of segments that the prefix-final /l/ assimilates to, must be language-specific.

6. Conclusions

In this paper, we have presented a comprehensive picture of phonological assimilation in consonant clusters in Urban Jordanian Arabic. The discussion of the data has led to the following conclusions.

First, the implicational hierarchies regarding place assimilation established by Mohanan's and Jun's typological works generally make the correct predictions in UJA.

Second, a number of generalizations that seems to conflict with the established implicational hierarchies, e.g., /n/ assimilates to a following sonorant /l/ or /r/, but not to a following stop or fricative, and coronal obstruents may undergo place assimilation (minor) before a coronal, but not a velar, obstruent, can be accounted for if we take into account the similarity between the two adjacent consonant. The similarity requirement is also crucial in accounting for the behavior of voicing and emphasis assimilations.

Third, some asymmetries observed in minor place assimilation within coronals, e.g., the primacy of the rhotic (trill), stridents, and affricates, can be understood along the line of the Production Hypothesis proposed by Jun (1995, 2005).

Fourth, the palatal bias has an effect in local consonant assimilation.

The contribution of this work, we hope, lies in not only providing a comprehensive data source for consonant assimilation in Urban Jordanian Arabic, but also suggesting an addendum to the established implicational relations in place assimilation, namely, the effect of similarity.

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