Chapter 2

Place Assimilation Typology

In this chapter, we explore place assimilation typology to determine crosslinguistic generalizations and hierarchical implications of place assimilation. Based on the discussion of place assimilation patterns attested in English, Korean, Hindi and Malayalam, Mohanan (1993) claims that attested patterns of place assimilation display variability in targets, triggers, and domains; but, on the other hand, they obey the following crosslinguistic generalizations:

(1) Asymmetries in Place Assimilation (Mohanan p.76 #21)

a. Coronal Asymmetry

(i) If noncoronals undergo assimilation, so do coronals.

(ii) If coronals trigger assimilation, so do noncoronals.

b. Labial-velar Asymmetry

If labials trigger assimilation, so do velars.

c. Stop Asymmetry

(i) Nonstops do not undergo (the whole range of) assimilation.

(ii) If nonstops trigger assimilation, so do stops.

d. Sonorant Asymmetry

(i) If nonsonorants undergo assimilation, so do sonorants.

(ii) If sonorants trigger assimilation, so do nonsonorants.

We will first briefly survey generalizations. We will then discuss these generalizations classified by the manner, place and syllable position of the target and trigger consonants involved in place assimilation. Sections following the description

of the survey are organized in the following order: target manner, target place, target position, trigger manner, and trigger place.

2.1 SURVEY

We provide an in-depth discussion of place assimilation patterns attested in the following languages, alphabetically ordered: Brussels Flemish, Catalan, Diola Fogny, English, German, Hindi, Japanese, Keley-I, Korean, Lithuanian, Malay (Thai), Malayalam, Nchufie (Chiyao, Kikuyu), Toba Batak, Yakut, Yoruba, Zoque.[1] In addition, patterns from some other languages (Inuktitut dialects, Kambata, Musey and Russian), will be considered either when we discuss the derived generalizations, or when we attempt to formalize the generalizations in Chapter Four. The main reason why these languages were chosen is that the patterns attested in those languages were relatively well-studied and so have been employed in the previous literature. We investigated the following aspects of each language: (a) possible targets, (b) impossible targets, (c) possible triggers and (d) impossible triggers. In some cases, however, possible targets or triggers could not be determined or we did not have sufficient material to decide the behavior of some consonant classes; in the following description, these two cases are labeled (e) and (f) respectively.

<u>Brussels Flemish</u>

Our discussion of Brussels Flemish is solely based on De Vriendt and Goyvaerts (1989). In Brussels Flemish, /n/ assimilates in place of articulation to a following plosive:

(2) (Vriendt and Goyvaerts p. 54)

a.	[nə<u>mb</u>oːʀ]	een boer	'a farmer'
b.	[ɣiː<u>ŋk</u>ysəs]	geen kussens	'no cushions'

[1]Patterns from parenthesized languages are discussed with those of the language preceding them.

If /n/ occurs before fricatives, liquids and glides, it deletes while its preceding vowel gets nasalized:

(3) (Vriendt and Goyvaerts p.54)

a. Fricatives

(i)	[ə̃vʀaː]	een vrouw	'a woman'
(ii)	[ɣ̃iːɣustə]	geen goesting	'no inclination'

b. Liquids

(i)	[ə̃liːʀ]	een ladder	'a ladder'

c. Glides

(i)	[tẽːjuːʀ]	tien jaar	'ten years'

If /n/ occurs before a nasal, it deletes but its preceding vowel does not get nasalized:

(4) (Vriendt and Goyvaerts p.55)

a.	/da#kan#ni/	-->	[dakani]	dat kan niet	'this can't be the case'
b.	/ik#vin#niks/	-->	[ikfiniks]	Ik vind niets	'I don't find anything'

Notice that nasal deletion before a nasal applies only to the alveolar nasal:

(5) (from Vriendt and Goyvaerts p.89 footnote 25)

[ikomni]	ik kom niet	'I'm not coming'

Processes involving the alveolar nasal which we have discussed so far can be summarized as follows:

(6) Input = ..VnC..

a. if C = stop, then the output = ..VNC.. (NC is a homorganic nasal-stop cluster)

b. if C = nasal, then the output = ..VC..

c. if C = fricative, liquid or glide, then the output = ..Ṽ C..

De Vriendt and Goyvaerts claim that the alveolar nasals assimilate in place to following nasals as well as stops. When nasals are triggers, the derived nasal geminates undergo degemination which is a general process in Brussels Flemish: according to De Vriendt and Goyvaerts (p.15 #6), two identical consonants are always reduced to a single consonant.[2] Following their claim, we assume that nasals can trigger place assimilation. However, we still cannot determine whether fricatives, liquids and glides can trigger the assimilation, since /n/ deletes before them and this nasal deletion cannot be attributed to degemination. A summary of Brussels Flemish place assimilation is given in (7):

(7)

a. Targets: the alveolar nasal (see #2)

b. Non-targets:

<u>Noncoronal nasals (see #5)</u>

<u>Stops</u>

(i) /aə # ze: + t # ə<u>t # p</u>akskə/ --> [aəze:də<u>tp</u>akskə]

hij ziet het pakje ('he sees the small parcel', p.32)

<u>Fricatives</u>

(ii) /kʀɔəz + kə/ --> [kʀoeskə] kruiseje ('cross, dim.', p.11)

c. Trigger: <u>stops (see #5) and nasals (see #4)</u>

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[2] Degemination is fairly common in the phonology of Dutch (Vriendt and Goyvaert p.15).

e. Undetermined

Triggers: fricatives, liquids and glides

f. Unknown
Targets: liquids and glides

The data from De Vriendt and Goyvaerts are not sufficient for us to figure out whether liquids and glides can ever occur in the target position of place assimilation.

Catalan

According to Mascaró (1978), Catalan displays regressive place assimilation where alveolar nasals and stops optionally assimilate to the following consonant (8a). Notice that noncoronals cannot be targeted in the assimilation (8bi,ii).

(8) (all examples chosen from Mascaró, except (aiii) and (biii,iv))[3]

a. Targets:[4]

Alveolar nasals and stops

(i) so[m] pocs 'they are few' (cf. so[n] amics 'they are friends')

(ii) so[ŋ] feliços 'they are happy'

(iii) so[m] wit 'they are eight'

(iv) se[p,] focs 'seven fires' (cf. se[t] 'seven')

(v) se[m] mans 'seven hands'

Liquids

(vi) e[l,][ž]ermá 'the brother'

(vii) e[ɫ]gos 'the dog'

b. Non-targets:

Noncoronal nasals and stops

(i) so[m] dos 'we are two' (cf. so[m] amics 'we are friends')

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[3]We would like to thank Manuel Español-Echevarria for providing Catalan words (in 8aiii, biii, biv) and their pronunciations for me.

[4]'p,' and ' ɫ' represent a labiodental stop and a velarized /l/ respectively.

(ii) po[k] pa 'little bread'

Fricatives

(iii) tre[s] pans 'three bread'

Glides

(iv) tre[w] dos 'take off two'

c. Triggers:

Stops (ai), nasals (v), fricative (aii,iv), and glides (aiii)

e. Undetermined

Trigger: liquids

Also, /l/ can assimilate in place to a following palatal or velar (8avi,vii), but it cannot to a following labial: e[l] pa 'the bread'; e[l] foc 'the fire'.[5] Fricatives and glides do not undergo this assimilation (8biii,iv). Regarding triggers, stops, nasals, fricatives, and glides can trigger place assimilation (8c). Because all liquids are alveolar, we cannot determine whether liquids can trigger cross-articulatory assimilation in which only coronals can be targeted.

Diola-Fogny

The following discussion of Diola-Fogny is based on Sapir (1965). In Diola-Fogny, only nasals can form a cluster with the following consonant which could be any of a stop, a nasal and a fricative.

Across morpheme boundaries within the same word, when nasals are followed by a consonant, they behave differently depending on the type of the following consonant. Nasals assimilate in place to following stops and nasals as shown in (9a):

(9) (From Sapir pp.16-17)

a. Targets:

Nasals

(i) ni+gam+gam niganngam 'I judge'

[5]As discussed by Jun (1993:62-63), this must be due to the possible range of laterals. Labial laterals cannot occur, since labial articulations do not involve any part of the tongue.

(ii) pa<u>n+j</u>i+maɲj paɲ<u>ɲ</u>imaɲj 'you(pl) will know'

(iii) na+ti:<u>ŋ+t</u>i:ŋ nati:<u>nt</u>i:ŋ 'he cut (it) through'

(iv) na+mi:<u>n+m</u>i:n nami:<u>mm</u>i:n 'he cut (with a knife)'

c. Triggers:

<u>Stops (ai-iii) and nasals (aiv)</u>

e. Undetermined

Targets:

<u>Stops</u>

(i) lɛt+ku+jaw lɛkujaw 'they won't go'

(ii) ɛ+rɛnt+rɛnt ɛrɛrɛnt 'it is light'

(iii) na+manj+manj namamanj 'he knows'

<u>Fricatives, liquids and glides</u>

With no relevant examples, Sapir (p.17) provides the following deletion rule:
(N)C_1 + C_2 > C_2 (C_2 may be a nasal, C_1 may not.)

Triggers:

<u>Liquids and glides</u>

(iv) na+laɲ+laɲ nalalaɲ 'he returned'

(v) na+yɔkɛn+yɔkɛn nayɔkɛyɔkɛn 'he tires'

(vi) na+waɲ+a:m+waɲ nawaɲa:waɲ 'he cultivated'

f. Unknown

Trigger: <u>fricatives</u>

If a nasal occurs before a liquid or glide, the nasal deletes (9eiv-vi). Across morpheme boundaries, the first consonant of a CC sequence will delete if it is a nonnasal (9ei-iii). Here we cannot determine whether these deleted nonnasals undergo assimilation or not, since they never surface. For the same reason, we do not know whether liquids and glides can trigger assimilation, since nasals are always deleted before them. We also do not have sufficient data to find out whether nasals assimilate to a following fricative.

Let us turn to inter-word morphophonemics which show a slightly different pattern. Nasal assimilation occurs frequently enough but nasals delete before a following nasal:

(10) (From Sapir p.19)

a. <u>Nasals are targets</u> (when stops are triggers)

napum kuɲilak	-->	napuŋkuɲilak	'he pushed back the children'
najum tɔ	-->	najuntɔ	'he stopped there'

b. <u>Nasals delete</u> (when nasals are triggers)

ban ɲa	-->	baɲa	'finish now'

Thus, we cannot determine whether nasals occurring before another nasal undergo assimilation or not.

In summary, in Diola-Fogny, nasals assimilate in place to following stops or nasals across morpheme boundaries within the same word, whereas the trigger status of nasals is not clear in cross-word boundary assimilation.

<u>English</u>

In casual speech, English coronal stops and nasals optionally assimilate to following noncoronal stops, nasals, and fricatives (11a); but noncoronal stops and nasals, fricatives, and liquids are rarely targeted (11b). The relevant examples are shown in (11):

(11)

a. Targets:

<u>Coronal stops and nasals</u>

(i)	'meat ball'	[mi:t bɔl]	≈	[mi:p bɔl]
(ii)	'late kiss'	[leyt kis]	≈	[leyk kis]
(iii)	'man made'	[mæn meyd]	≈	[mæm meyd]
(iv)	'green flower'	[gri:n flawər]	≈	[gri:ŋ flawər]

b. Non-targets:

<u>Noncoronal stops and nasals</u>

(i)	'leap quickly'	[li:p kwikli]	*[li:k kwikli]
(ii)	'pingpong'	[piŋ poŋ]	*[pim poŋ]

Fricatives and liquids

(iii) 'gas pipe' [gæs payp] *[gæp payp] or [gæɸ payp]

(iv) 'tool case' [tul keys] *[tuk keys] or [tuL keys][6]

c. Triggers:

Stops (ai,ii), nasals (aiii), and fricatives (aiv)

d. Non-trigger:

Glides

(i) 'late work' [leyt wɔrk] *[leyp wɔrk]

(ii) 'mean wife' [mi:n wayf] *[mi:m wayf]

e. Undetermined

Target: glides

Trigger: liquids

Stops, nasals and fricatives can trigger place assimilation (11c). It cannot be determined whether glides can be targeted or whether liquids can trigger. It seems that in English, glides do not occur before a consonant; in other words, glides never occur in the target position in regressive assimilation. Also, all English liquids are coronal; thus they can never have a chance to trigger cross-articulatory assimilation with the preceding coronal which is the only target place in English place assimilation.

German

German also displays casual speech place assimilation in which only coronals are involved. According to Kohler (1991:186), across syllable boundaries, apical nasals and stops assimilate to the following noncoronal (12a), but noncoronal stops and nasals cannot be targeted (12bi-iii):[7]

[6]L represents a velar lateral.

[7]In fact, Kohler states that the patterns under consideration are cross-word-boundary phenomena but we think, on the basis of his data, that cross-syllable-boundary is the correct term for the phenomena. Thus, in (12), the word-boundary symbol '#' in Kohler (1990) is replaced by the syllable boundary symbol '.'.

(12) Across syllable boundaries (selected from Kohler 1990 p.86 and p.c.[8])

a. Targets:

Coronal nasals

(i) [n.b] --> [m.b] 'anbringen' ("to attach")

(ii) [n.m] --> [m.m] 'anmelden' ("to register")

(iii) [n.f] --> [ɱ.f] 'anfahren'

Coronal stops

(iv) [t.b] --> [p.b] 'mitbringen' ("to bring along")

(v) [t.m] --> [p.m] 'mitmachen' ("to join")

b. Non-targets:

Non-coronal nasals and stops

(i) [m.k] --> [m.k] 'rumkriegen' ("to win over")

(ii) [k.p] --> [k.p] 'Packpapier' ("wrapping paper")

(iii) [k.m] --> [k.m] 'zurückmelden' ("to report back")

Fricatives, liquids

(iv) [s.g] --> [s.g] 'ausgeben'

(v) [r.g] --> [r.g] 'vorgehen'

Glides (Kohler p.c.)

c. Triggers: stops (ai, iv), nasals (aii, v) and fricatives (aiii)

d. Non-triggers: glides (Kohler p.c.)

e. Undetermined

Triggers: liquids

Kohler (p.c.) informed us that fricatives and liquids cannot be targeted in place assimilation (12biv,v); fricatives can trigger place assimilation but less frequently than stops and nasals (aiii); and glides can be neither triggers nor targets. Also, as discussed with English place assimilation, whether liquids can trigger place assimilation cannot be determined since they cannot trigger cross-articulatory assimilation with a preceding coronal stop or nasal which is the only target place. All these patterns can be observed within a syllable, too. An additional pattern can be observed only within a syllable:

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[8]Many thanks to Klaus Kohler for providing some relevant information about German casual speech place assimilation for us.

(13) Within a syllable (trivially adapted from Kohler 1990 p.85)

a. Additional Target:

<u>Coronal nasals</u> (progressive)

(i)	'Wagen'	[va:gən]	-->	[va:gŋ]
(ii)	'geholfen'	[gəhɔlfən]	-->	[gəhɔlfm̩]

b. Non-target:

<u>Coronal stops</u> (progressive)

'Akt'	[akt^{h}]	-->	*[akk^{h}]

Across syllable boundaries, only regressive place assimilation can occur. In contrast, within a syllable, we also observe progressive assimilation in which only coronal nasals can be targeted (13a) (remember that coronal stops cannot be targeted, as shown in (13b)). Also, notice that if the alveolar nasal is followed by a vowel, this progressive place assimilation may be blocked.

(14) (trivially adapted from Kohler 1990 p.85)

	<u>with no following vowel</u>		<u>with a following vowel</u>
a.	[bən] --> [bm]	b.	[bənə] --> [bnə] or [bm̩nə]
	'eben' ("even")		'ebene' (inflected)
c.	[gən] --> [gŋ]	d.	[gənə] --> [gnə] or [gŋnə]
	'Regen' ("rain")		'gelegene' ("situated", inflected)

Kohler (p.85) states that as shown in (14a,c), the progressive assimilation occurs only when the apical nasal is followed by a consonant or a word boundary after the reduction of *ə*. If the apical nasal is followed by a vowel as in (14b,d), either the nasal stays nonsyllabic and unassimilated, or the nasal becomes syllabic, "leaving apical nasal off-glide to the following vowel." The difference, i.e. absence and presence of progressive assimilation, between cross-syllable-boundary and syllable-internal assimilation can be attributed to presence and absence of the vowel following

the alveolar nasal. Syllable-initial nasals can retain place cues in the transition of the following vowel (possibly in the release as well). In contrast, the nasal following a consonant or a syllable boundary is acoustically weak, since it lacks the transition cue in the following vowel. If the nasal release includes its place cue, the word-final nasal would additionally lose this cue under the assumption that the syllable-final nasal is unreleased. Under the Production Hypothesis (Ch 1 #35), acoustically weak segments are more likely to be subject to reduction than acoustically strong segments. From this, it follows that the coronal nasal before a consonant or a syllable boundary can be reduced easily, thus being targeted in place assimilation; but the coronal nasal followed by a vowel is hard to reduce. (See section 4.2.1.3 for more detailed discussion of this issue.)

In summary, in the consonant cluster C_1C_2, if C_1 and C_2 belong to separate syllables, coronal nasals and stops in the C_1 position can be targeted (regressive assimilation); if C_1 and C_2 are tautosyllabic, coronal nasals in the C2 position can additionally be targeted (progressive assimilation).

Hindi

According to Ohala (1975, 1983), morpheme-internally, Hindi nasal consonants must agree in place with a following stop in native words, as shown by the following generalization:

(15) Ohala (1975:323, #15)

In native words, within a morpheme, nasal + stop clusters must be homorganic.

This generalization suggests that in Hindi place assimilation which is displayed within a native morpheme, only nasals can be targeted and only stops can trigger. Relevant examples are chosen from Ohala:

(16) Within a morpheme (all examples in (a) chosen from Ohala 1975 p.327; the rest from Ohala 1983 pp.169-184)

a. Targets:

<u>Nasals</u>

(i) pʰəŋki	'handful'	(ii) gend	'ball'
(iii) tamba	'copper'	(iv) gəŋga	'Ganges'
(v) gəɲǰa	'bald'		

b. Non-targets:

<u>Stops</u>

(i) gətka	'a type of club'	(ii) gupta	'a last name'

<u>Fricatives</u>

(iii) sɪski	'sob'

<u>Liquids</u>

(iv) kɪrka	'a small bit of dust'	(v) d̪ʰolki	'drum'

<u>Glides</u>

(vi) gayki	'style of singing'	(vii) əwd̪er	'confusion'

c. Triggers:

<u>Stops (9a)</u>

d. Non-trigger:

<u>Nasals</u>

(i) samna	'frontage'

<u>Fricatives</u>

(ii) šəmšan	'cremation ground'

<u>Liquids</u>

(iii) ɪmli	'tamarind'

<u>Glides</u>

(iv) kɪnwani	'water droplets'

Also, Mohanan (1993:75) states that Hindi nasal place assimilation can be seen across morpheme boundaries. He provides the data displaying somewhat different patterns with respect to the triggers of place assimilation. The data provided by Mohanan are rearranged in (17).

(17) (Mohanan p.75 #18)

	<u>No assimilation</u>			
a.	aakaar 'shape'	samaakaar	'homophonous'	
	<u>Stop trigger</u>			
b.	kiirn̪an 'devotional'	saŋkiirn̪an	'collective devotional singing'	
c.	n̪ool 'measure'	san̪n̪ool	'equilibrium'	
d.	calan 'coduct'	sancalan	'movement'	
	<u>Nasal trigger</u>			
e.	naad̪ 'sound'	sannaad̪	'consonance'	
	<u>Fricative trigger</u>			
f.	sriṣṭ 'produced'	sansriṣṭ	'joined together'	
	<u>Liquid trigger</u>			
g.	reek^{h}aa 'line'	sanreek^{h}aa	'alignment'	
h.	leek^{h} 'writing'	sanleek^{h}	'protocol'	
	<u>Glide trigger</u>			
i.	yog 'meeting'	sãỹyog	'chance meeting'	(G. Mahajan p.c.)

Unlike morpheme-internal assimilation shown in (16), cross-morpheme boundary one can be triggered by various types of consonants, stops, nasals, fricatives and liquids.[9] Also, G. Mahajan (p.c.) informs me that this assimilation can be triggered by glides as well, providing a relevant example (17i).

In summary, in Hindi place assimilation, only nasals can be targeted both within a morpheme and across morphemes. Regarding triggers of place assimilation, the patterns are different: within a morpheme, only stops can be triggers, whereas across morphemes, not only stops but also other consonants (nasals, fricatives and liquids) can be triggers.

<u>Japanese</u>

It has been known in the literature (e.g. Yip 1991) that heterorganic consonant

[9]Mohanan states that this assimilation "does not occur across words, or even in certain morphological concatenations."

clusters are not allowed in Japanese. Word-finally, only the "mora nasal" (Vance's terminology) can occur: e.g. hoN 'book'.[10] Within a word, only homorganic nasal or geminate clusters can occur.

(18) (Chosen from Kuroda (1979), Vance (1987), and Yip (1991))

a. Homorganic nasal clusters

kampai	'cheers'	sensee	'teacher'
honrai	'originally'	boỹyari	'absent-minded'

b. Geminates

totta	'took'	gakkoo	'school'
simmiri	'guarded'	bassari	'decisively'

From the description of the mora nasal in Kuroda and Vance, its phonetic characteristics are almost the same as those of a following segment (including vowels); i.e. the mora nasal is a copy of the following segment except the nasality. This can be seen in the following statement from Kuroda (p.201):

> The phonetic realization of the nasalized consonantal mora may best be described as a nasalized continuous transition from the preceding segment to the following one.

This may indicate that Japanese homorganic nasal clusters are actually geminates except for the nasality superimposed on their first member. The attested clustering patterns in Japanese, shown in (18), may lead us to the hypothesis that targets and triggers of place assimilation are unrestricted, under the assumption that the gemination patterns are the result of place assimilation which is always accompanied by manner assimilation.

As shown in Kuroda, assimilations, which display surface alternations, can be

[10]See Vance (1987:34-35) for a summary of various arguments about the phonetic description of the mora nasal spoken in isolation.

observed in several areas of Japanese morphology. First, in Sino-Japanese compoundings, if the first morpheme has the form $C_1V_1C_2V_2$, where C_2 is *t* and V_2 is *i* or *u*; and the second morpheme begins with an obstruent such as *k, t, p*, and *s*, then C_2 assimilates to a following morpheme-initial consonant after deletion of V_2:

(19) (From Kuroda p.207)

a.	kotu-kaku	kokkaku	'frame'
b.	situ-pai	sippai	'failure'
c.	ritu-syoo	rissyoo	'proof'

As shown in Chapter One, Cho (1990) has a different interpretation which has been argued by Itô (1986) and Tateishi (1990), and also followed by Padgett (1991): V_2 is an epenthetic vowel when assimilation is blocked. Only coronal stops can be targeted. Also, this assimilation is blocked even with the coronal stop target, when the trigger is voiced, as can be seen in (20).

(20) (From Cho p.57)

a.	it + nen	-->	itinen (*innen)	'one year'
b.	it + bai	-->	itibai (*ipbai, *ibbai, *imbai)	'once'

However, following McCawley (1968), Kuroda (1979) and Vance (1987), we will assume vowel deletion, not vowel epenthesis, for the following reasons. First, it seems that the phonetic quality of V_2 cannot be predicted since /i/ occurs after /t/ in (20a,b) but /u/ occurs after /t/ in the following compound: bet + waku --> betsuwaku 'different category' (Tetsuya Sano, p.c.). Second, Japanese native speakers who we consulted have a somewhat strong intuition that the vowels under consideration are underlying. Finally, the vowel epenthesis proposal in which only coronal stops are targets of place assimilation is not compatible with either Japanese consonant clustering patterns, shown in (18), or place assimilation patterns in Japanese verbal morphology, shown below: coronal stops are not special in either pattern. These reasons might not be sufficient to ensure the vowel deletion proposal,

rejecting the vowel epenthesis one. However, we will not pursue this issue in any more detail, since, as can be seen later, neither choice will significantly change either the conclusion of the present chapter or that of the present work.

Let us turn to Japanese verbal morphology. When a verb stem, which ends in *t, n, p, m, r*, or *b*, is followed by a suffix such as *ta*, *te*, *temo*, or *tari*, regressive assimilation occurs:

(21) Chosen from Kuroda p.204 (ta = past tense marker)

	stem	past		
a.	kat	katta	'win'	
b.	sin	sinda	'die'	
c.	kam	kanda	'chew'	
d.	kar	katta	'mow'	
e.	tob	tonda	'fly'	
f.	kaw	katta	'buy'	(from Itô and Mester 1986 p.59)

Several points need to be considered. If the target is a nasal, it retains the nasality (21b,c). If the target is a voiced stop, it becomes a nasal while voicing the trigger (21e). Ito and Mester (p.59 footnote 14) claim that this coda nasalization is "a regular phonological process in Japanese responsible for the surface absence of voiced geminates." More importantly, noncoronals can be targeted (21c,e,f). Also, notice that glides (21f) can be targeted.

In summary, in Japanese place assimilation, there is no restiction to targets and triggers.

Keley-I

According to Hohulin and Kenstowicz (1979), Keley-I displays following patterns of place assimilation:

(22) (From Hohulin and Kenstowicz p.250)

a. Targets: coronal nasal

(i)	tepen	s-im-pen	'measure'	(infix -in-)
(ii)	hemek	h-im-mek	'pity'	

b. Non-targets:

Labial nasal

(i)	teled	ʔum-tetle	'sting'	(prefix and infix (ʔ)um-)
(ii)	kebed	ʔum-kekbed	'scratch'	

Stops, fricatives, liquids and glides (Hohulin and Kenstowicz 1979)

c. Triggers: stops (ai) and nasals (aii)

d. Non-trigger: glides

(i)	tewik	s-in-wik	'prick'	(infix -in-)
(ii)	peyuh	p-in-yuh	'bless'	

e. Undetermined

Target: velar nasal

Trigger: liquids

f. Unknown

Trigger: fricatives

Coronal nasals assimilate in place to a following stop or nasal (22a), but labial nasals do not (22b). Also, coronal nasals do not assimilate to following glides (22d). However, we cannot decide whether fricatives can trigger place assimilation or not, due to lack of the relevant data. Although Hohulin and Kenstowicz do not provide any specific examples which can indicate whether consonants other than nasals can undergo place assimilation or not, they state that the coronal nasal is the only one which shows some alternation; thus, we assume that consonants other than nasals cannot undergo assimilation. Also, in Keley-I, it cannot be determined whether the velar nasal can be targeted, as indicated by the following statement from Hohulin and Kenstowicz (1979:250):

> When standing before a consonant, n assimilates in point of articulation, while m does not. There are no good examples in which the behavior of the velar nasal **ng** can be assessed. It does not unambiguously appear in any prefix or

infix and there are no stems of the shape **ng**eCVC, where, upon deletion of the **e**, the assimilatory nature of ng could be determined.

Again, we cannot decide whether liquids can trigger cross-articulatory place assimilation, since all liquids are coronals.

Korean

In Korean, in casual speech, coronal nasals and stops optionally assimilate in place to following labials and velars (23ai-iii), and in addition, labials assimilate in place to velars (23aiv,v).

(23) Korean place assimilation[11]

a. Targets:

Coronal stops and nasals

(i)	/mit+ko/	-->	[mikko]	'believe and'
	'believe' 'and'			
(ii)	/cinan+pam/	-->	[cinampam]	'last night'
	'last' 'night'			
(iii)	/san+maɨl/	-->	[sammaɨl]	'a mountain village'
	'mountain' 'village'			

Labial stops and nasals (with velar triggers)

(iv)	/ip+ko/	-->	[ikko]	'wear and'
(v)	/nam + kɨk/	-->	[naŋkɨk]	'the South Pole'
	'south' 'end'			

[11]Broad phonetic transcriptions are employed for Korean examples. The representations include forms derived by a regular process of Korean coda neutralization in which underlying fortis and aspirated coda consonants are neutralized to their unreleased lenis counterparts in syllable-final position. Also, actual phonetic forms will be outputs of another regular process of Korean post-obstruent fortition in which lenis obstruents become fortis after an obstruent. See Kim-Renaud (1986) for more details about these two regular processes in Korean.

b. Non-targets:

<u>Velar stops and nasals</u>

(i)	/ik + ta/ 'ripe' SE[12]	-->	[ikta]	*[itta]	'ripe + SE'
(ii)	/paŋ + pota/ 'room' '(more) than'	-->	[paŋpota]	*[pampota]	'(more) than room'

<u>Labial stops and nasals</u> (with coronal triggers)

(iii)	/ip+ta/	-->	[ipta]	*[itta]	'wear + SE'
(iv)	/sum+ta/	-->	[sumta]	*[sunta]	'hide + SE'

<u>Liquids</u>

(v)	/al+ko/	-->	[alko]	*[aLko]	'know and'

c. Triggers:

<u>Stops (ai,ii,iv,v) and nasals (aiii)</u>

d. Non-trigger:

<u>Glides</u>

/pap'ɨn+waŋ/ 'busy' 'king'	-->	[pap'ɨnwaŋ] 'a busy king'	*[pap'ɨmwaŋ] or [pap'ɨŋwaŋ]

e. Undetermined

Target: <u>fricatives and glides</u>

Trigger: <u>liquids</u>

However, velars do not assimilate to a following consonant (23bi,ii), and labials do not assimilate to a following coronal (23biii,iv). Also, liquids do not undergo place assimilation (23bv). Stops and nasals can trigger place assimilation (23c) but glides cannot (23d). Finally, it cannot be determined whether fricatives and glides can be targeted, since the only fricative /s/ in Korean is neutralized to its homorganic stop /t/ in the coda position and glides never occur before a consonant in Korean. Also, the liquid /l/ in Korean becomes a nasal after a consonant (e.g. /sam+lyu/ --> [samnyu] 'third class'); thus we cannot decide whether the liquid itself can trigger place assimilation.

[12]SE represents Sentence Ender.

Lithuanian

Kenstowicz (1972) reports a morphophonemic nasal assimilation in Lithuanian, in which the dental nasal /n/ assimilates in place to a following stop or affricate:

(24)

a. Target: dental nasal

(i) sé[m]bernis	'old fellow'	(cf. sẽ[n]as 'old')
(ii) pi[ŋ]kite	'plait, imp. pl.'	(cf. pi[n]a 'plait; 3 pres.')

b. Non-targets: labial nasal

(i) té[m]ti	'darken, infin.'	(cf. tẽ[m]o 'darken, 3 past')
(ii) té[m]kite	'darken, imp. pl.'	

However, when /n/ occurs before nasals, fricatives, liquids and glides, it deletes:

(25) (Formation with a prefix san-: e.g. dora 'virtue' sandora 'covenant')

a. Nasals

moklas 'skill'	sa:mokslas	'conspiracy'

b. Fricative

ʃluoti 'sweep'	sa:ʃlavos	'sweepings'

c. Liquid

lyti 'to rain'	sa:lytis	'clash, contact'

d. Glides

jungas 'yoke'	sa:junga	'union'

Thus, we cannot determine whether consonants other than stops can trigger place assimilation or not, although, as discussed by Kenstowicz, this nasal elision must be related to nasal assimilation, since only dental nasal can be involved in both

processes: krimsti '3 past, chew' and krimto 'infinitive, chew' cf. bre:sti '3 past, ripen' and brendo 'infinitive, ripen '. The summary of Lithuanian nasal assimilation is as follows:

(26)

a. Targets: alveolar nasal

b. Nontargets: labial nasal

c. Triggers: stops

e. Undetermined

Triggers: nasals, fricatives, liquids, and glides

Malay

According to Lodge (1992), Malay displays casual speech place assimilation involving all places of articulation. Consonants /p t k m n ŋ/ occurring in coda position can optionally assimilate in place to following stops and nasals:[13]

(27)

a. Targets:

Nasals (trivially adapted from Lodge (1992:42))

(i) [malam tadi] ≈ [malan tadi]

(ii) [malam kames] ≈ [malaŋ kames]

(iii) [makan buah] ≈ [makam buah]

(iv) [hidoŋ mantʃoŋ] ≈ [hidom maṇtʃoŋ]

---

[13]When a nonnasal stop is followed by a nonnasal velar stop, assimilation is blocked:

(i) From Lodge (1992:16)
[bapʔ̚ kəduə] ≈ *[bapʔ̚ kəduə] ≈ [baʔ kəduə] 'the second chapter'

Lodge attributes this blocking to a language-specific constraint which prohibits a nonnasal velar stop in the coda position. Without any further investigation, we simply follow him.

(v) [pasaŋ topeŋ] ≈ [pasan topeŋ]

Stops (Lodge 1992:16)

(vi) [kuatʔ̚ bəladʒa] ≈ [kuapʔ̚ bəladʒa] ≈ [kuaʔ bəladʒa] 'to study hard'

(vii) [hiŋgapʔ̚ di'atas]≈[hiŋgatʔ̚ di'atas] ≈ [hiŋgaʔ di'atas] 'to land on top of'[14]

b. Nontargets: fricatives (s) and liquids (l, r) (Lodge 1992 p.42)

c. Triggers: Stops (ai-iii,v) and nasals (aiv)

e. Undetermined

Targets: glides

f. Unknown

Triggers: glides

Lodge (p.42) states, without providing the relevant examples, that the other possible coda consonants /s l r/ are not involved in assimilation. Thus, we assume that Malay fricatives and liquids cannot be targeted in place assimilation. We also assume that glides cannot occur in the coda position since it is not in the list of possible codas; thus, their behavior in the target position of place assimilation cannot be determined. We finally do not know how fricatives, liquids and glides behave in the trigger position due to insufficient data.

Let us discuss assimilation patterns in more detail. As can be seen in (27avi,vii), stops are obligatorily unreleased and glottalized. Glottal reinforcement is very common in Malay. It may occur before pause (28a,b) and between vowels (28c,d).

(28) (From Lodge 1992 p.15)

a. [hadapʔ̚] 'to face'

b. [dapatʔ̚] 'to obtain'

[14]Lodge adopts ['] for 'the glottal-catch onset to vowel-initial syllables, which is considerably shorter than [ʔ]-realizations of the stops'.

c. [buatʔ apə] ≈ [buatʔ apə] 'to do what?'

d. [diteopʔ aŋen] ≈ [diteopʔ aŋen] 'to be blown by the wind'

There are some other languages which display both place assimilation and stop glottalization. As described by Lodge (1986, 1992), Thai displays both patterns. The coda consonants /p t k m n ŋ/ assimilate in place to a following consonant. Stop coda consonants are obligatorily glottalized, as can be seen in the following examples:

(29) (From Lodge 1986 p.338 and Lodge 1992 pp.40-41)

a. /p^{e}u:tmái/ [p^{e}u:tʔ̚mái] ≈ [p^{e}u:pʔ̚mái] ≈ [p^{e}u:mmái][15] 'speak or not'

b. /t^{e}u:kfái/ [t^{e}u:kʔ̚fái] ≈ [t^{e}u:πʔ̚fái] ≈ [t^{e}u:ffái] 'touch the fire'

([π] is a voiceless, labiodental stop.)

Also, in English, as discussed above, coronal stops are often targeted in casual speech place assimilation, and glottal reinforcement accompanied by reduction is common in voiceless stops, especially coronal stop /t/, in coda:

(30) what [wʌt] ~ [wʌtʔ] ~ [wʌʔ^{t}] ~ [wʌʔ] (Hayes 1992:285)

We are not sure about why glottal reinforcement occurs. We may only conjecture that glottal reinforcement has to do with preservation of voicelessness perception, since it occurs only in voiceless consonants. Although we do not know the exact motivation of glottal reinforcement, it seems true that glottalization plays a role in obscuring the perceptual cue to point-of-articulation of stops (See Lodge 1992 for the relevant discussion). Therefore, according to the Production Hypothesis (Ch. 1 #35), glottalized stops will likely be subject to reduction, leading to place assimilation in consonant clusters. This might explain the difference in place assimilation between English, on the one hand, and Malay and Thai, on the other: in English, coronal stops are more often and more completely glottalized than noncoronals in coda position (Keating p.c.), whereas it seems that both coronals and noncoronals are often/very

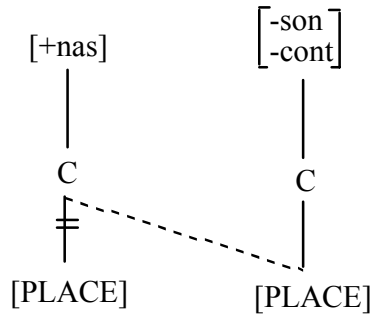
[15]Simple deletion of the target, i.e. [p^{e}u:mái] and [t^{e}u:fái], is also possible.

glottalized in Malay and Thai. However, glottalization is not the main factor explaining the observed asymmetry among these three languages, since nasals, which do not get glottalized, pattern with their corresponding voiceless stops in all the above-mentioned languages (in Malay and Thai, both noncoronal and coronal nasals can be targeted, whereas only the coronal nasal can be targeted in English). Further, glottalization should not be adopted to explain the coronal-noncoronal asymmetry in English place assimilation: the voiced coronal stop /d/ and the coronal nasal /n/ are also asymmetric targets. Without any further investigation, we leave this issue for the future research.

Malayalam

In Malayalam, only nasals assimilate in place to a following stop as indicated in the following rule proposed by Mohanan and Mohanan (1984:583):

(31) Homorganic Nasal Assimilation



According to Mohanan and Mohanan, this rule applies both across word boundaries (32av-viii) and within words (examples in #32 except av-viii):

(32)[16]

a. Targets:

Nasals (with stop triggers; Mohanan and Mohanan #15,16)

(i) [sam [giitam]] --> saŋgiitam 'music' (giitam 'song')

(ii) [[kuḷam][t̲oonṭi]] --> kuḷant̲oonṭi 'tool to scrape the bottom of the ponds' (kuḷam 'pond'; toonṭi 'scraping tool')

(iii) [[peṇ][kuṭṭi]] --> peŋkuṭṭi 'girl' (peṇṇə 'female'; kuṭṭi 'child')

(iv) [[miin][can̲t̲a]] --> miiñcan̲t̲a 'fish market' (miin 'fish'; can̲t̲a 'market')

(v) [awan] [t̲anne] --> awan̲t̲anne 'he himself'

(vi) [baalan][kārañnu] --> baalaŋkārañnu 'the boy cries'

(vii) [baalan] [pooyi] --> baalampooyi 'the boy went'

(viii) [paṇam][t̲ārु] --> paṇan̲t̲ārु 'give (me) money'

b. Non-targets:

Stops, liquids and fricatives (from Mohanan 1989 p.605)

(i) t̲ikt̲am 'bitter' (from Mohanan and Mohanan p.587)

(ii) spastam 'evident' (from Mohanan 1989 p.619)

(iii) maargam 'way' (from Mohanan 1989 p.622)

c. Triggers: stops (a)

d. Non-trigger: (from Mohanan and Mohanan p.593 #34)

Nasals

(i) n̲anma 'goodness'

(ii) uṇma 'essence'

(iii) suṣumna 'spinal cord'

Fricatives

(iv) himsa 'killing'

Liquids

(v) amḷam 'acid'

f. Unknown

Target: glides

Trigger: glides

---

[16]Transcriptions adopted by Mohanan and Mohanan are the following: dentals = t̲, n̲; palatalized = ī, s̄; palato-alveolars = n̄; and retroflexes = ṭ, ṣ, ḷ.

Notice that nasals assimilate in place to a following stop (32a) but not to following nasals, liquids and fricatives (32d). Stops, liquids and fricatives do not undergo this place assimilation (32b). Finally, we do not know glides' behavior with respect to place assimilation.

Nchufie

In Nchufie, a Bantu language spoken in Cameroon, basically no consonant clusters are allowed.[17] Whenever nasals occur before other consonants within words or across morpheme boundaries, they are homorganic. The following data show assimilation of an Nchufie nasal prefix where the nasal assimilates in place to a following stem-initial consonant, lengthening its preceding vowel:

(33)

a. Targets: nasals

(i) /a+ N + tuŋ/	-->	[a:ntuŋ]	'he kicked'

(a = 3rd person pronoun, N = past tense marker)

(ii) /a + N + pə:/	-->	[a:mbə:]	'he broke'
(iii) /a + N + ka/	-->	[a:ŋka]	'he ran'
(iv) /a + N + niŋi/	-->	[a:niŋi]	'he cooked'
(v) /a + N + fa:/	-->	[a:ɱfa:]	'he worked'
(vi) /a + N + ɣwe/	-->	[a:ŋgwe]	'he laughed'
(vii) /a + N + liɛ/	-->	[a:ndiɛ]	'he slept'
(viii) /a + N + yiɛ/	-->	[a:njiɛ]	'he said'

[17]Nchufie is also called Bafanji. Most examples are chosen from Jun (forthcoming) which is based on the data elicited in the field methods class at UCLA from 1991 Fall through 1992 Winter. Irrelevant aspects, e.g. tone, are ignored here. For work of varous topics on Nchufie, see UCLA Occasional Papers in Linguistics Volume 14 (Koopman and Kural eds.).

(ix) /a + N + pə + ŋɔ + N + wu + N + wu/ --> [a:mbə ŋɔ ŋgu ŋgu]

he pst be man pst short pst short 'he was a short man'

c. Triggers

Stops (ai-iii), nasals (aiv), fricatives (av,vi), liquids (avii), glides (aviii,ix)

e. Undetermined

Targets: consonants other than nasals

As can be seen in (33), assimilation outputs display different characteristics depending on the type of the trigger consonant. When coronal and velar stops are a trigger, simple place assimilation results (33ai,iii), but when a voiceless labial stop triggers assimilation, it becomes voiced (33aii). When a nasal triggers assimilation, it undergoes degemination (33aiv). If fricative /ɣ/, liquid /l/ and glides /y, w/ trigger assimilation, they undergo post-nasal hardening, becoming their homorganic stops or affricates (33avi-ix). This post-nasal hardening is very common in Bantu languages as can also be seen in the following examples from Chiyao and Kikuyu:

(34)

a. Chiyao (Mtenje 1990, 1991)

Stop trigger

(i) n - pel - ile --> mbesile 'I am tired'
SM Root TM[18]

(ii) n - kat - ile --> ŋgatile 'I have cut'
SM Root TM

Post-nasal hardening

(iii) n - lapit - e --> ndapite 'I have licked'
SM Root TM

(iv) a - n - wugul - ile --> ambugulile 'You open for me'
you(pl)-me-open-for

[18]The abbreviations have the following denotations: SM = subject marker, TM = tense marker.

b. Kikuyu (Clements 1985:244)

	imperative	1st sg. imperfect	stem (gloss)
<u>Stop trigger</u>			
(i)	tɛm-a	n-dɛm-ɛɛtɛ	'cut'
(ii)	kom-a	ŋ-gɔm-ɛɛtɛ	'sleep'
<u>Post-nasal hardening</u>			
(iii)	βur-a	m-bur-eetɛ	'lop off'
(iv)	ɣor-a	ŋ-gor-eetɛ	'buy'
(v)	reh-a	n-deh-eetɛ	'pay'

Here, it is not obvious whether fricatives and nonnasal sonorants can trigger assimilation, since the nasal may undergo assimilation after post-nasal hardening; then this will be a case of stop trigger. However, in Nchufie, at least some fricatives, f and s, trigger assimilation, while not subject to post-nasal hardening. Also, there is a lexical exception to post-nasal hardening: /a + N + li/ --> [a:nli] 'he flew'. Notice that the nasal in the output is still homorganic to the following /l/, although /l/ does not get hardened. Therefore, we will assume that all kinds of consonants can trigger nasal assimilation in Nchufie (probably, Chiyao and Kikuyu as well).

<u>Toba Batak</u>

Hayes (1986) provides an in-depth discussion of optional consonant sandhi phenomena in Toba Batak, while proposing an autosegmental analysis. According to his data, nine consonants can occur before a consonant: voiceless stops (p, t, k), a fricative (s), nasals (m, n, N), and liquids (r, l). Among these, only a coronal nasal undergoes assimilation to a following consonant within words and across word boundaries. As shown in (35a), a coronal nasal totally assimilates to a following consonant; they also lose nasality.

(35) (From Hayes pp.480-490)

a. Targets:

<u>Coronal Nasals</u>

(i) maŋan baoa an (cf. maŋan in isolation)

[b b]

eat man that 'that man is eating'

(ii) soŋon gottina

[g g]

as replacement 'in exchange'

b. Non-targets:

<u>Noncoronal Nasals</u>

(i) manaŋ pulpen

[k p]

or pen 'or a pen'

(ii) maŋinum tuak

[p t]

drink palm wine 'drink palm wine'

(iii) ŋb, mg, ŋm, mŋ are attested (see Hayes p.479 Table 1.)

<u>Stops</u>

(iv) pitpit ≈ piʔpit 'with closed eyes'

(v) mɛtmɛt ≈ mɛʔmɛt 'small'

<u>Fricatives</u> (sp, sk clusters cannot be altered; see Hayes p.479 Table 1.)

<u>Liquids</u> (rp, rk, lp, lk clusters cannot be altered; see Hayes p.479 Table 1.)

c. Triggers:

<u>Stops (ai,ii), and Nasals</u> (nm --> mm, nŋ --> ŋŋ; see Hayes p.479 Table 1.)

d. Non-triggers:

e. Undetermined:

Triggers:

<u>Liquids (l, r) and fricatives (s)</u>

In contrast, if labial and velar nasals occur before a consonant, either they lose nasality before a voicelss consonant (35bi,ii) or they are not altered at all before a voiced consonant (35biii). According to the table summarizing Toba Batak

consonant sandhi in Hayes (p.479, Table 1), a fricative and liquids do not undergo assimilation. If stops occur before a consonant, they optionally become a glottal stop (35biv,v), resisting place assimilation. Also, there are only coronal liquids and fricative in Toba Batak; thus, we cannot determine whether they undergo cross-articulatory assimilation to a preceding coronal nasal.[19] Finally, according to the phoneme inventory (Hayes, p.478 #14), glides do not occur in Toba Batak.

Yakut

According to Krueger (1962), in Yakut, verbal and nominal stem-final coronals assimilate in place to following suffix-initial noncoronal stops. In providing the relevant data, following Dobrovolsky (1983), we basically assume that the underlying representation of the suffix-initial segments is the form which appears after stem-final vowels.

(36) Chosen from Krueger (1962:58-99)[20]

a. Targets:

Coronal stops and nasals

(i)	sot-	'to wipe, clean'	sop-popun	'we do not clean'
(ii)	at	'horse'	ak-ka	'to a horse (at + ka)'
(iii)	ün-	'to creep, crawl'	üŋ-kür	'sloping, aslant'
(iv)	aan	'door'	aam-mit	'our door (aan + bit)'

[19]Although /h/ appears in the phoneme inventory (Hayes p.478 #14), Hayes states that its phonemic status is not clear: morpheme-finally, it is an allophone of /k/ in a pre-vowel position. When it occurs after a coronal nasal, it becomes [k] triggering an assimilation:

(i) maNan halak i
[k k]
eating person the 'the person is eating'

To avoid this bizarre case, Hayes suggests two alternatives. The first is that the correct phonemic representation is /kalak/ for /halak/ 'person'. The other option is a 'patch-up rule' which takes /h/ to /k/ after /n/. In either option, /h/ does not occur in the trigger position of assimilation: at the point of assimilation, it has been changed to /k/.

[20]The following conventions are employed. Depending on the stem-final vowel, A can be any of a, e, o and ö, and I can be any of i, ü.

b. Non-targets:

Noncoronal stops and nasals

(i)	-tAAɣAr	'comparative case'	sep-teeɣer	'than a tool'
			olom-nooɣor	'than a ford'
(ii)	-kA	'dative case'	sep-ke	'tool'
			ilim-ŋe	'net'
(iii)	-tA	'partitive case'	tobuk-ta	'knee'
			χatiŋ-na	'birch'
(iv)	-bIt	'our'	tünnük-püt	'our window'
			tiiŋ-mit	'our squirrel'

Fricatives and liquids

(v)	-kA	'dative case'	χos-ko	'room'
(vi)	-bIt	'our'	kilaas-pit	'our clasroom'
(vii)	-kA	'dative case'	učuutal-ga	'teacher'
			doɣor-go	'friend'

Glides

(viii)	-kA	'dative case'	sirey-ga	'son, boy'

c. Triggers: Stops (ai-iv)

e. Undetermined

Trigger: Nasals, fricatives, liquids and glides

Noncoronal stops, fricatives, liquids and glides do not undergo this place assimilation (36b). Regarding triggers of the place assimilation, only stops clearly trigger assimilation. According to Dobrovolsky (1983:78), suffix-initial segments in Yakut are t, -l, -n, -b, -c, and -k.[21] Thus, noncoronal nasals, fricatives and glides do not occur in the trigger position; thus we cannot determine whether they can trigger place assimilation or not.[22] Again, all liquids are coronal; thus they cannot trigger place assimilation to a coronal stop or nasal.

[21] *-p* is replaced with *-b* by us.

[22] Some suffixes begin with the velar fricative only when they follow a low vowel; elsewhere it is shown as a velar stop (e.g. aɣa-ɣit 'your school' cf. iskaap-kit 'your cabit').

Yoruba

In Yoruba, as described by Ward (1952), a nasal consonant, which is syllabic before another consonant, assimilates in place to a following consonant:

(37) All examples chosen from Clements (1992:186) except aviii,ix from Ward p.21

a. Targets:

Nasals

(i) m-bɛ	'be well'
(ii) n-dɛ	'be setting a trap for'
(iii) ŋ-ka	'be reading'
(iv) ŋm-kpa	'be killing'
(v) n-se	'be cooking'
(vi) n-lɔ	'be going'
(vii) n-ra	'be buying'
(viii) n-yo	no gloss
(ix) ŋ-wa	no gloss

c. Triggers:

Stops (ai-iv), fricative (av), liquids (avi, vii), and glides (aviii, ix)

Nasals (Clements 1992 p.186)

According to Clements (p.186) citing Ward, "before the glides /w, y, h/, the nasal is realized as syllabic [ŋ]: ŋyɔ, ŋwa, ŋhɔ (with no glosses). Some speakers also use [ŋ] before liquids; ŋlɔ, ŋri." Thus, this indicates that glides do not undergo assimilation and liquids do so on a speaker-variable basis. However, Ward (p.21) states that some speakers tend to produce [ŋ] before l and r, only when they are "articulated somewhat far back on the roof of the mouth." Also, he provides the data displaying assimilated glides (37aviii, ix). Thus, following Ward, we assume that in Yoruba, a nasal consonant assimilates in place to a following consonant, regardless of the manner-of-articulation of the following consonant.

Concerning the question of whether nonnasal consonants can be targeted in place assimilation, as indicated by Ward's (p.25) statement on syllable structure, only a nasal consonant can precede another consonant; thus, it seems that nonnasal

consonants are simply irrelevant to the target.

Zoque

Wonderly (1951) shows that in Zoque, heterorganic consonant clusters including nasal-plus-oral ones are attested within words as well as across words. But there is a nasal morphophoneme which assimilates in place to a following stop. We assume it is underlyingly an alveolar nasal /n/, since it surfaces as [n] when it fails to undergo assimilation, as shown in (38d):

(38)

a. Targets:

Alveolar nasal

(i) /n + pama/ --> [mbama] 'my clothing' (n = 'my')

(ii) /n + kayu/ --> [ŋgayu] 'my horse'

b. Nontargets: irrelevant

c. Triggers:

Stops (a) and nasals (see 40a)

d. Nontriggers

glides

(i) /n + waka/ --> [nwaka] 'my basket'

(ii) /n + yomo/ --> [nyomo] 'my wife'

e. Undetermined

Triggers: fricatives and liquids

When the alveolar nasal precedes nasals, fricatives and liquids, the alveolar nasal deletes:

(39)

a.	Nasals	/n + mok/	-->	[mok]	'mok'
b.	Fricatives	/n+faha/	-->	[faha]	'my belt'
c.	Liquids	/n + lawus/	-->	[lawus]	'my nail'

Due to this deletion, it cannot be determined whether nasals, fricatives and liquids can trigger assimilation. However, it seems plausible if we assume that at least nasals can trigger assimilation before undergoing degemination which is a general process in Zoque. Wonderly (p.119) reports morphophonemic alternations in which geminates of non-alveolar consonants p, k, ʔ, h, y are reduced to one consonant: e.g. /nihp + pa/ --> [nihpa] 'he plants it'. Also, according to Wonderly's tables showing attested consonant clusters, geminate consonants are very rare: word-medially, tt is the only stop geminate and nn is the only nasal geminate. Notice that the degemination-after-place assimilation cannot be assumed with fricative or liquid triggers. Thus, we assume that nasals trigger place assimilation just like stops do, but nasals simply delete before fricatives and liquids.

2.2 TARGET

Based on the brief survey, just presented, we now consider what kind of generalizations and implicational statements can be made about the target of place assimilation.

2.2.1 TARGET MANNER

Let us summarize surveyed patterns of place assimilation with respect to the manner of the target in the following table:

(40) (O = 'targeted', X = 'untargeted', blank = 'undetermined' or 'unknown')

	fricative	stop	nasal	liquid	glide
Brussels Flemish	X	X	O		
Catalan	X	O	O	O	X
Diola Fogny			O		
English	X	O	O	X	
German	X	O	O	X	X
Hindi	X	X	O	X	X
Japanese	O	O	O	O	O
Keley-I	X	X	O	X	X
Korean		O	O	X	
Lithuanian			O		
Malay	X	O	O	X	
Malayalam	X	X	O	X	
Nchufie			O		
Toba Batak	X	X	O	X	
Yakut	X	O	O	X	X
Yoruba			O		
Zoque			O		

O indicates that a consonant produced with the corresponding manner of articulation can be targeted in place assimilation, whereas X indicates that it cannot. Undetermined (and unknown) cases are unmarked. For instance, in Korean no fricatives can occur in the target position of place assimilation (i.e. coda); thus, it is impossible to determine whether fricatives can be targeted or not.

From the above short list of attested cases, several observations can be made. First, nonnasal sonorants, i.e. liquids and glides, are rarely involved in place assimilation. Second, among obstruents, fricatives are very reluctant to be involved in place assimilation. Notice that whenever fricatives, liquids or glides can be targeted, so can noncontinuants, stops and nasals (Catalan and Japanese). In

addition, among noncontinuants, nasals are more likely to undergo place assimilation than stops. It has been noted in the literature that nasals are the most common target in place assimilation. Unlike languages such as English, in which both nasal and oral stops can be targets of place assimilation, some languages allow only nasal stops to be targeted: Brussels Flemish, Hindi, Keley-I, Malayalam and Toba Batak. Thus, there are languages in which only the nasals are targets of place assimilation, but there are no languages in which only stops can be targeted. The implicational statement emerging here is that if stops are targets of place assimilation, so are nasals. Consequently, we can provide the following implicational statements about target manner:

(41) 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.

2.2.2 TARGET PLACE

Let us consider place of articulation of the target in place assimilation. The following table shows the surveyed patterns, summarized according to the point-of-articulation of the target:

(42) (O = 'targeted', X = 'untargeted', blank = 'undetermined')

	coronal	labial	velar
Brussels Flemish	O	X	
Catalan	O	X	X
Diola Fogny	O	O	O
English	O	X	X
German	O	X	X
Hindi	O	O	
Japanese	O	O	O
Keley-I	O	X	
Korean	O	O	X
Lithuanian	O	X	
Malay	O	O	O
Malayalam	O	O	
Nchufie	O	O	O
Toba Batak	O	X	X
Yakut	O	X	X
Yoruba	O	O	O
Zoque	O		

This table follows the same conventions adopted in (40). O indicates that a consonant produced at the corresponding point of articulation can be involved as a target, whereas X indicates that it is not. A blank indicates that it cannot be determined whether O or X in the language in question is; the relevant consonants do not occur either in the underlying level or in the target position.

The above table clearly shows that consonants produced at different places of articulation tend to be targeted in place assimilation to a different degree. First, coronals are common targets; all relevant cases in (42) involve coronals as a target. This is a well-known fact. It has been reported and discussed in the literature that crosslinguistically, coronals are favorite targets of place assimilation (Bailey 1970, Kiparsky 1985; Cho 1990; and most work in Paradis and Prunet 1991 among others). In (42), Brussels Flemish, Catalan, English, German, Keley-I, Lithuanian, Toba Batak and Yakut display patterns of assimilation in which only coronals can be targeted.

These languages contrast with languages such as Diola Fogny, Hindi, Korean and Malayalam in which not only coronals but also noncoronals can be targeted. Therefore, there are languages in which only coronals are targets of place assimilation but there are no languages where only noncoronals are targets. This implies that if noncoronals are targets of place assimilation, so are coronals.

Among noncoronals, only the Korean pattern in (42) is relevant in determining whether labials or velars are a more likely target in place assimilation than the other. Korean place assimilation is the only case which shows a discrepancy between labials and velars; in all the other cases involving labials as a target, velars are undetermined. In Korean place assimilation, not only coronals but also labials can be targets, but velars cannot be targeted. This fact somewhat weakly implies that labials are more likely to undergo place assimilation than velars. If the Korean place assimilation facts really reflect on the universal pattern of place assimilation, we can have the following tentative implicational statements:

(43) Target place

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

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

These tentative implicational statements can be supported by assimilation patterns attested in Inuktitut dialects. Dorais (1986) provides a trans-dialectal survey of Inuktitut. According to her survey, any consonant can be the second constituent of a cluster in all dialects; the first constituent can be limited mainly due to regressive (place or manner) assimilation. The degree of restriction is different depending on the dialects. The following table (chosen from Dorais Fig. 2) shows the attested types of consonant clusters of four dialect groups.[23]

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[23]Dorais's Fig 2 includes nine groups; the remaining groups display either all three types of heterorganic clusters, i.e. alv C, bil C and vel C (1,2,3), or none of them (8,9).

Uvular C clusters occur in the first seven groups (1-7); in Group 7, uvular C clusters are the only heterorganic ones. In Group 8, uvular C clusters tend to become pharyngealized geminates of the second consonant. Group 9 shows a stage of complete assimilation; the number of geminates is greatly increased. Also, a uvular consonant cannot occur in the syllable-final position; thus, even clusters whose second member is a uvular have been changed to velar-initial clusters (RR --> xx, qq --> kX).

(44) (Irrelevant parts, e.g. one concerning uvular C, are ignored.)

4 CO CA	5 AI PE	6 NB KI SE	7 TA IT
vel C	vel C	vel C	vel/vel
bil C	bil C	bil/bil	bil/bil
alv C	alv/alv	alv/alv	alv/alv

(The abbreviations adopted by Dorais are the following: CO = Copper, CA = Caribou, AI = Chesterfield Inlet Aivilik, PE = Polar Eskimo, NB = North Baffin-Aivilik, KI = South West Baffin Kinngarmiut, SE = Southeast Baffin, TA = Northern Arctic Quebec Tarramiut, and IT = East Coast of Hudson Bay Itivimiut.)

In CO and CA (Group 4), no place assimilation occurs; thus, various types of heterorganic clusters are attested. In AI and PE (Group 5), alveolars have been assimilated in place to the following consonant; thus there remains no heterorganic cluster beginning with alveolars. In NB, KI, and SE (Group 6), labials as well as alveolars have undergone place assimilation; as a result, only heterorganic clusters beginning with velars remain. Finally, in TA and IT (Group 7), even velars have been assimilated regressively; thus no heterorganic clusters remain. Although the attested patterns of consonant clusters in (44) are the results of historical place assimilation, this clearly supports the implicational statements in (43).

2.2.3 SYLLABLE POSITIONS

It has been noted in the literature (Webb 1982, Ohala 1990 among others) that targets and triggers in place assimilation correlate with syllable positions. Syllable onsets are more likely triggers than codas, whereas codas are more likely targets than onsets. In the following schematic representation (Webb 1982:318), a coda C_1 usually assimilates to an onset C_2:

(45) ...V C_1 \$ C_2 V...

This asymmetry in place assimilation between onsets and codas has been attributed to their different 'strength' with respect to weakening processes (Webb 1982 citing Vennemann 1972, Hooper 1976, among others): weakening processes occur more often in syllable-final position than in syllable-initial position. (We analyze this 'strength' of a consonant in terms of its inherent acoustic salience in Chapter Four.) The weakness of the coda in place assimilation can be confirmed by the surveyed patterns described in this chapter: all the patterns involve the coda as a target; none of them involve the onset as a target.

This coda weakness in place assimilation automatically leads to another well-known crosslinguistic generalization: regressive assimilation is much more common than progressive assimilation. In Webb's survey in which two hundred languages were surveyed in the Stanford Archiving Project, there is only one exception, i.e. Kambata, an Ethiopian language, where progressive place assimilation occurs in the environment of (45):

(46) Hudson (1980:105)

a.	ub-tooʔi	-->	ubbooʔi	'she fell'
b.	t'uf-tooʔi	-->	t'uffooʔi	'she closed'
c.	dag-tonti	-->	daggonti	'you (sg.) knew'

Musey, discussed by Shryock (1993), is similar exception to the generalization that onsets are more likely triggers as well as less likely targets than codas: Musey

displays progressive assimilation in the same environment.

(47) From Shryock pp.3-4

a. feminine enclitic /da/

(i)	/hap + da/	[happa]	'gruel + fem'
(ii)	/gof + da/	[goffa]	'recent past + fem'
(iii)	/kolom + da/	[kolomba]	'mouse + fem'
(iv)	/tok + da/	[tokka]	'meeting + fem'
(v)	/goŋ + da/	[goŋga]	'slave + fem'

b. masculine gender enclitic /na/

(i)	/hap + na/	[hapma]	'white + masc'
(ii)	/kuluf + na/	[kuluffã]	'fish + masc'
(iii)	/sem + na/	[semma]	'foot + masc'
(iv)	/suluk + na/	[sulukŋa]	'vengeance + masc'
(v)	/zoŋ + na/	[zoŋŋa]	'young man + masc'

However, in both Kambata and Musey, only suffix-initial (or enclitic-initial) consonants can be targeted. Suffixes (and clitics) are usually prosodically weaker than stems, which may be explained by Silverman's (1995) claim that suffixes do not require much contrastive information, compared to stems. Then, suffix or clitic-initial onsets may be acoustically weaker than stem-final codas in those languages, since lexical retrieval of stems is much harder for listeners than function words. If so, according to the Production Hypothesis (Ch. 1 #35), suffix-initial onsets of those languages will be more likely to be subject to the weakening processes than their stem-final codas, being targeted in place assimilation.[24] Therefore, although onsets are, in general, stronger than codas, suffix-initial onsets may be weaker than stem-

[24]In both languages, both flaps and coronal stops may be targets. We do not know whether this is accidental (perhaps a coincidence of coronals' frequent occurrence as a suffix-initial consonant) or not.

final codas, being targeted in place assimilation.

There is another typical case of progressive assimilation. If we turn to tautosyllabic consonant clusters, especially in word-final position, as shown in the following schematic representation, the word-final consonant C_2 may assimilate progressively to the preceding consonant C_1:

(48) ...V C_1 C_2 #

The relevant examples can be seen in German casual speech assimilation: e.g. /va:gən/ --> [va:gŋ] 'Wagen'. If C_2 is an unreleased stop or nasal, it is acoustically very weak, compared to C_1 which can retain place cues in the preceding vowel transition. Due to this acoustic weakness, C_2 tends to be reduced, being targeted in place assimilation.

Consequently, although regressive assimilation is much more common than progressive assimilation, its occurrence depends on syllable positions and other contextual factors. Let us summarize the generalizations that we have discussed above:

(49)

a. ..V C_1 \$ C_2 V.. C_1 is a target and C_2 is a trigger.

b. Possible exception to (a):

If C_2 is suffix-initial, C_2 may be a target and C_1 may be a trigger.

c. ...V C_1 C_2 # C_2 is a target and C_1 is a trigger.

If we consider only hierarchical relations between syllable positions, putting aside cases involving morphological details (49b) or relation among constituents within a syllable position (49c), we may suggest the following implicational statement[25]:

[25]This does not mean that these two cases (49b,c) are exceptions to our explanatory mechanism which will be presented, in full, in Chapter Four. We put them aside, simply because they are too specific, compared to other cases which we consider to provide universal generalizations on place assimilation. As long as these cases (49b,c) are subject to the Production Hypothesis, they will directly fall out from our mechanism, as can be seen in Chapter Four.

(50) Syllable Position

If the onset is a target of place assimilation, so is the coda.

2.3 TRIGGER

Different types of consonants may behave differently in triggering place assimilation. If C_aC_b --> C_bC_b but C_aC_c --> C_aC_c, then C_b would be considered a more likely trigger of place assimilation than C_c. Let us now consider generalizations and implicational statements about the trigger of place assimilation.

2.3.1 TRIGGER MANNER

The following table shows the summary of the surveyed patterns of place assimilation classified according to the manner of the trigger:

(51)

		fric	stop	nasal	liquid	glide
Brussels Flemish			O	O		
Catalan		O	O	O		O
Diola Fogny	(across morphemes)		O	O		
	(across words)		O			
English		O	O	O		X
German		O	O	O		X
Hindi	(within a morpheme)	X	O	X	X	X
	(across morphemes)	O	O	O	O	O
Japanese		O	O	O	O	O
Keley-I			O	O		X
Korean			O	O		X
Lithuanian			O			
Malay			O	O		
Malayalam		X	O	X	X	
Nchufie		O	O	O	O	O
Toba Batak			O	O		
Yakut			O			
Yoruba		O	O	O	O	O
Zoque			O	O		X

This table follows the same conventions adopted in (40) and (42). O indicates that a consonant produced with the corresponding manner of articulation is involved as a trigger, whereas X indicates that it is not. In cases where it cannot be determined, the cell is left blank.

One observation from (51) is that consonants produced with different manners of articulation have different tendencies in triggering place assimilation. Several more specific observations can follow. First, nonnasal sonorants, liquids and glides rarely trigger place assimilation, although liquids are often undetermined. Second, stops, nasals and fricatives often trigger place assimilation. Among these, stops are the most common trigger: they trigger place assimilation in all surveyed patterns. Whenever nasals or fricatives trigger place assimilation, so do stops. It is not clear which one, a fricative or a nasal, is a more likely trigger in place assimilation, since they pattern together in (51). Consequently, observations from (51) can lead us to the following implicational statements about trigger manner:

(52) 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.

2.3.2 TRIGGER PLACE

Most surveyed patterns do not show any asymmetric patterns with respect to the trigger place. The typical asymmetric pattern would involve the following case: C_aC_b --> C_bC_b but C_aC_c --> C_aC_c, where a, b and c are indexes representing different articulators. The only relevant case is from Korean place assimilation. In Korean, labials do not assimilate to the following coronals but they do to the following velars. This pattern indicates that velars are more likely to trigger place assimilation than coronals. Thus, in the absence of counterexamples, we will assume the following statement as one of our implicational statements on place assimilation:

(53) Trigger place

If coronals trigger place assimilation, so do velars.

2.4 CONCLUSION

According to the brief survey in section 2.1, attested patterns display language-specific variability, but they are subject to the implicational statements, summarized below:

(54)

a. <u>Target manner</u>

(i) If fricatives or nonnasal sonorants are targets of place assimilation, so are stops.

(ii) If stops are targets of place assimilation, so are nasals.

b. <u>Target place</u>

(i) If velars are targets of place assimilation, so are labials.

(ii) If labials are targets of place assimilation, so are coronals.

c. Syllable Position

If the onset is a target of place assimilation, so is the coda.

d. Trigger manner

(i) If nonnasal sonorants trigger place assimilation, so do nasals and fricatives.

(ii) If nasals or fricatives trigger place assimilation, so do stops.

e. Trigger place

If coronals are triggers, so are velars.

It seems that the implicational statements in (54) basically support but somewhat elaborate on Mohanan's generalizations (1), repeated below:

(1) Asymmetries in Place Assimilation (Mohanan p.76 #21)

a. Coronal Asymmetry

(i) If noncoronals undergo assimilation, so do coronals.

(ii) If coronals trigger assimilation, so do noncoronals.

b. Labial-velar Asymmetry

If labials trigger assimilation, so do velars.

c. Stop Asymmetry

(i) Nonstops do not undergo (the whole range of) assimilation.

(ii) If nonstops trigger assimilation, so do stops.

d. Sonorant Asymmetry

(i) If nonsonorants undergo assimilation, so do sonorants.

(ii) If sonorants trigger assimilation, so do nonsonorants.

What are the differences between them? First, in (54), we consider somewhat

specific segmental classes, e.g. nasal and nonnasal sonorants, whereas Mohanan considers broad classes, e.g. sonorants. Second, a generalization on syllable positions targeted in assimilation (54c) is not in (1). Third, Mohanan provides two asymmetries among three major points of articulation in triggering assimilation. Mohanan's labial-velar asymmetry (1b) is based on the following statement (p.76):

> Third, there are instances where the velar triggers assimilation and the labial does not (/pk/ --> [kk], but not /kp/ --> [pp]); there are none where the labial triggers assimilation and the velar does not (/kp/ --> [pp], but not /pk/ --> [kk]).

Notice that in the cited patterns, velars and labials are not compared with the same target. If we assume the asymmetries in (54b) among points of articulation for targets (i.e. velars are less likely targets than labials), then the cited patterns follow. The cited patterns do not say anything about the relative strength of velars and labials in triggering assimilation. Thus, as we discussed in section 2.3.2, we can have only the asymmetry between coronals and velars.

After we explore the mechanism of casual speech place assimilation in Chapter Three, in Chapter Four we will consider what phonetic motivation underlie the implicational statements in (54). There we will discuss the correlations between the implicational statements and acoustic facts, some of which have been pointed out by Ohala (1990) and Kohler (1991). We will then provide an explicit formal analysis of the implicational statements by proposing an independently motivated mechanism in which perceptually and articulatorily motivated constraints compete for the optimal output in speech production.