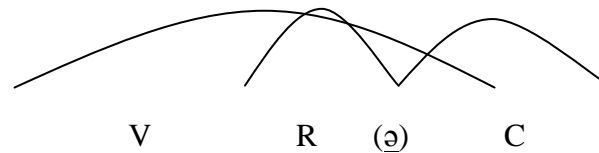


## CHAPTER 2. GESTURAL PHASING AND THE SYLLABLE

### 2.1. Syllabicity and segmenthood

In chapter 1, the thesis was defended that intrusive vowels are the result of an overlapping vowel articulation being heard in the period of acoustic release between two consonants. This structure accounts for the typological characteristics of vowel intrusion, such as the types of clusters that intrusive vowels occur in and the ‘copied’ quality of the vowels.

(65) Gestural score of vowel intrusion



This chapter focuses on how this gestural timing relates to syllable structure. I claim that vowel intrusion does not create a new syllable, and also that gestural timing constraints make crucial reference to boundaries.

#### 2.1.1. The non-syllabicity hypothesis

Steriade 1990, who first proposed the gestural structure above, assumes that gestural retiming automatically causes adjustments to syllable structure.

To complete the account, we must add the following assumption about the syllabic interpretation of overlapping vocalic and consonantal gestures: a vowel gesture is interpreted as a monosyllable only if all the superimposed consonantal gestures are peripheral, that is only if the beginning of a *contiguous* cluster of consonantal articulations coincides with or precedes the beginning of the vocalic gesture (or, in the case of a postvocalic gesture, only if the end of the cluster coincides with or follows the end of the vowel). Since Dorsey’s Law [vowel intrusion in Hocank- NH] creates a sequence in which a consonant gesture has come to be nonperipherally superimposed on a vowel gesture, it automatically turns a monosyllable into a disyllable. (391)

The phonological behavior of intrusive vowels does not support this claim. While there probably are disyllable structures that involve vowels fully overlapping consonants, such overlap does not in itself create a new syllable. Rather, intrusive vowels are a percept resulting from a certain type of gestural organization *within* the syllable or at syllable boundaries.

The first suggestion that gestural overlap doesn’t necessarily create a new syllable comes from Bosch 1995, who extends Steriade’s gestural timing analysis to intrusive vowels in Scots Gaelic. Bosch points out the extensive evidence from both phonology

and speaker intuitions (discussed in chapter 4) that Scots Gaelic intrusive vowels do not form full-fledged syllables:

[E]penthesis in Scots Gaelic, though typically considered a phonological process... must be analyzed in gradient rather than discrete terms. In particular, the syllable formed by the epenthetic vowel is properly understood to be an extension of the original syllable, as opposed to a second, new syllable position, thus pointing to the need for a gradient rather than discrete understanding of the syllable as constituent. (2)

She adds that Scots Gaelic intrusive vowels do not add a vowel slot on the timing tier, or a new moraic position to the word (Bosch 1995:11). This claim is particularly striking for Scots Gaelic because the intrusive vowels are quite long- as long as the non-intrusive portion of the vowel.

The proposal here differs significantly from Bosch's in that the intrusive vowel is not analyzed as syllabic in any sense. (Bosch does refer to "the syllable formed by the epenthetic vowel.") Nor is the syllable seen as a gradient constituent; it is fully discrete. A Scots Gaelic word like [ʃalək] is no more than a CVCC syllable; the timing of the gestures creates only the percept (for non-native speakers) of a second syllable.

On the basis of the languages studied here, I will argue that cross-linguistically, intrusive vowels *never* form syllables, regardless of their length. They act non-syllabic for a great variety of phonological diagnostics in different languages, such as language games (Kekchi), syncope (Scots Gaelic), allomorph conditioning (Finnish), stress (Spanish, Chamicuro), reduplication (Hocank), etc. Some of these patterns will be presented in detail in the individual case studies in this and following chapters. I am referring, of course, only to vowels that synchronically have the gestural representation in (65); there are also cases where once intrusive vowels have clearly been reanalyzed as segmental and syllabic. But there is often evidence in these cases that their gestural representation has changed as well, so that they are only historically related to the phenomenon at hand.

Why should intrusive vowels be non-syllabic? I propose that this follows from two facts: intrusive vowels are not associated with an independent segment, and syllables organize segments. Syllables do not organize sounds, nor subparts of gestures, no matter how perceptually prominent. The non-syllabicity of intrusive vowels also relates to the fact that they do not target marked clusters: they do not repair syllable structure because they do not create new syllables, and they do not create new syllables because their purpose is not to repair syllable structure.

This proposal runs counter to a pervasive (although usually unstated) assumption that a vocalic sound can be non-syllabic if it is very short and clearly 'transitional', but that a certain level of phonetic prominence entails syllabicity. The study of vowel intrusion makes it clear that there is no threshold of duration or quality that defines whether a vowel sound is syllabic: a non-syllabic vowel sound can be longer than a syllabic vowel sound even in the same language, as in Scots Gaelic. The notion of 'syllabicity' must be defined on grounds more categorical and abstract than the fieldworker's ear or intuition. To be syllabic, a vowel sound must correspond to an independent segment, with all the behavior that segmenthood implies, such as an ability

to have independent quality, and to be independently manipulated by phonological grammar.

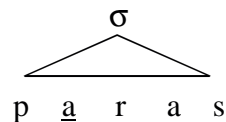
In the theory assumed here, a word's output representation consists of a string of segments organized into syllables, a set of gestures associated with the segments, and a set of phasing relationships among the gestures that organize them into a gestural score. In the representation, the intrusive vowel is not an entity with any formal status. It can be defined as the section of the vowel gesture that is heard in the interval between the release of one consonant and the closure of the next. But that subpart of a gesture, defined on basically auditory terms, is not something that any rule or constraint can refer to. In particular, the syllable structure cannot refer to it because it is not an independent segment.

### 2.1.2. Alternative accounts of monosyllabicity

The monosyllabic behavior of intrusive vowel sequences has been noted before (particularly for Scots Gaelic and Hocank), and linguists have proposed several structures for these sequences. All of the non-gesturalist proposals require expanding the type of structure that can constitute a syllable, and fail to predict many of the properties of intrusive vowels.

Alderete 1995 analyzes Hocank intrusive vowel sequences like [paras] 'flat' as single syllables with a CVCV(C) segmental content. He posits no further syllable-internal structure.

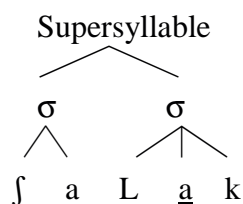
(66) CVCVC syllables



This syllabification is forced by a constraint, SYLL-PLACE, demanding that segments sharing a place feature (in this case, the two vowels) belong to the same syllable.

Bosch & de Jong 1998 propose that Scots Gaelic intrusive vowel sequences like [ʃalak] 'hunting' are "supersyllables". A supersyllable consists of two ordinary syllables. Some syllable-based phenomena refer to the regular syllables, and some refer to the supersyllables.

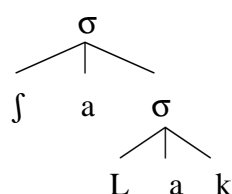
(67) Supersyllables



A disadvantage of this approach, as the authors note, is that it is not clear how a supersyllable differs from a foot.

Smith 1999, working within the X-bar theory of phonology, proposes that Scots Gaelic intrusive vowel sequences are recursive syllables. One syllable forms the coda of another syllable.

(68) Recursive syllables



These three proposals can be grouped as “expanded syllable” approaches. All of them treat the intrusive vowel as a true segment, which forces them to expand the set of possible syllable structures to allow non-adjacent vowels or new types of hierarchical structure. There is no alternative to such expansion if one is to keep the view that the intrusive vowel is segmental and yet the whole CVCVC sequence is one syllable.

The main problem with these approaches is that they do not straightforwardly predict the other characteristics of the vowel intrusion syndrome. As shown in chapter 1, these monosyllabic “CVCVC” structures tend to have identical vowels, and their middle consonant is a sonorant that’s heterorganic to the consonant to which it is underlyingly adjacent. Under the gesturalist view, independently motivated principles of gestural organization and physics predict that the structure in (65) would have these properties: there is more audible release between heterorganic consonants due to the task dynamics of producing consonant clusters, the vowels are identical because they are a single gesture, and the dispreference for vowel overlap with certain consonant types, while not yet well understood from a physical perspective, is at least supported by other phenomena such as vowel copy. But there is no obvious reason why CVCVC syllables, supersyllables, or recursive syllables would be subject to any of these restrictions. If we allow a syllable to form the coda of another syllable, for example, it does not fall directly out of the structure that the internal syllable should have to have a sonorant onset, or have the same vowel quality as the upper syllable, or have a heterorganic onset and coda. New principles can be added, of course, such as Alderete’s constraint SYLL-PLACE, but the necessity of these makes the expanded syllable approaches less explanatory.

It is better to keep a simple, standard view of the segmental content of syllables, while acknowledging that the phasing of the gestures associated with those segments can cause syllable-like percepts. In fact, far from creating their own syllables, intrusive vowels are crucially sensitive to the presence of syllable boundaries. This will be demonstrated by case studies of Dutch and Finnish.

## 2.2. Dutch

Dutch has an optional intrusive [ə] in tautosyllabic RC clusters. The difference between tauto- and hetero-syllabic clusters supports the existence of additional gestural alignment constraints. Dutch also provides evidence, from phonological patterning and speaker intuitions, of the intrusive vowel's non-segmental and non-syllabic status. Dutch may be the only language where there have been psycholinguistic studies on the processing and production of intrusive vowels, and these provide a unique type of evidence for the intrusive vowel's function.

### 2.2.1. Conditioning environment

Vowel intrusion occurs after an [l] or [r] that is followed by a labial or velar, i.e. [m], [p], [f], [k], or [x], and also in the cluster [rn]. According to Booij 1995:8, the Dutch /r/'s articulation varies: "The /r/ may be realized as an alveolar roll [r] (in particular in utterance-initial position), as an alveolar flap [r̥], as a uvular roll [R], as a uvular fricative [χ], or as a uvular approximant [ʁ]. In postvocalic position /r/ may also be realized as a palatal approximant similar to [j]. This is a matter of individual and regional variation." The symbol [r] is used below, but it should be borne in mind that the realization may differ.

A chart of final CC clusters in Dutch, based on Booij 1995:40-1, is given below. Clusters with vowel intrusion are shaded. This chart shows the surface forms of final clusters; underlyingly, final obstruents might be voiced. Some clusters with "appendix" consonants (explained below) are omitted.

(69) Dutch final clusters (some appendix Cs omitted)

	p	b	t	d	k	f	v	s	z	x	ɣ	m	n	ŋ	l	r
m	mp															
n			nt					ns								
ŋ					ŋk											
l	lp		lt		lk	lf				lx		lm				
r	rp		rt		rk	rf				rx		rm	rn			
s	sp		st		sk											

Basically, Dutch has vowel intrusion in all heterorganic sonorant-initial clusters. In effect, this means that intrusion occurs only after [l] and [r], since nasals are always homorganic to the following sound. The cluster [rn] is the only one that may contradict the heterorganicity generalization: it should be homorganic for those speakers who have an alveolar [r]. I do not have an explanation for this exception, although it's interesting to note that Irish Gaelic also allows vowel intrusion in [rn] sequences (although not in [nr] sequences). This suggests that there may be some factor particular to the transition between [r] and [n] that increases the likelihood of vowel intrusion.

Below are examples of each cluster that triggers vowel intrusion. The intrusive vowel is always transcribed as [ə], and is not present in spelling.

(70)	Dutch RC clusters with intrusive vowels		Booij 1995:127
a.	kɑl <u>ə</u> m	<i>kalm</i>	‘quiet’
b.	ɑr <u>ə</u> m	<i>arm</i>	‘arm’
c.	hɛl <u>ə</u> p	<i>help</i>	‘help’
d.	hɑr <u>ə</u> p	<i>harp</i>	‘harp’
e.	hɛr <u>ə</u> fst	<i>herfst</i>	‘autumn’
f.	ɛl <u>ə</u> f	<i>elf</i>	‘eleven’
g.	mɛl <u>ə</u> k	<i>melk</i>	‘milk’
h.	ʋɛr <u>ə</u> k	<i>werk</i>	‘work’
i.	ɑl <u>ə</u> x	<i>alg</i>	‘alga’
j.	ɛr <u>ə</u> x	<i>erg</i>	‘very’
k.	ʏr <u>ə</u> n	<i>urn</i>	‘urn’
l.	hɔr <u>ə</u> n	<i>hoorn</i>	‘horn’

Dutch also has an underlying, segmental [ə], which contrasts with intrusive [ə] in minimal pairs like the following:

(71)	Underlying vs. intrusive [ə]		
a.	ʋɪl <u>ə</u> x	<i>wilg</i>	‘willow’
b.	ʋɪl <u>ə</u> x	<i>willig</i>	‘willing’
a.	hɔr <u>ə</u> n	<i>hoorn</i>	‘horn’
b.	hɔr <u>ə</u> n	<i>horen</i>	‘to hear’
a.	bəl <u>ə</u> x	<i>balg</i>	‘bellows’
b.	bəl <u>ə</u> x	<i>ballig</i>	‘snooty’
a.	tɔr <u>ə</u> n	<i>toorn</i>	‘anger’
b.	tɔr <u>ə</u> n	<i>toren</i>	‘tower’

These words do not (necessarily) sound the same. In the speech of my consultant, the intrusive [ə] seemed shorter and less distinct than underlying [ə], and it was usually possible to tell the words above apart when they were spoken in isolation.

Some Dutch speakers also have a slight intrusive vowel in CR onsets (as pointed out to me by Fred Landman), but this phenomenon has received little attention and the precise conditioning environment is not known.

Intrusive [ə] is optional. Donselaar et al. 1999:60 report that for most speakers, there is no difference in prestige between the two pronunciations, but for those who do perceive a difference in prestige, the forms without vowel intrusion are more prestigious and standard. Wijnen, Krikhaar, & Den Os 1994 report that vowel intrusion is “practically standard” in child Dutch.

### 2.2.2. The role of syllable structure

Vowel intrusion in most dialects of Dutch happens only within syllables. There are two circumstances under which a heterorganic RC cluster may fail to show vowel intrusion: when C is the onset of a following syllable, and when C is an unsyllabified “appendix”.

#### 2.2.2.1. Heterosyllabic clusters

For most speakers, intrusive vowels appear only between two consonants that are in the same coda, not between two heterosyllabic consonants, as in the following words:

(72)	Heterosyllabic RC		
a.	ʋer.kən	‘to work’	Booij 1995:128
b.	tʏl.pən	‘tulips’	
c.	er.kər	‘bay window’	
d.	pəl.ka	‘polka’	
e.	kər.ma	‘karma’	Kuijpers & Donselaar 1997:7

Vowel intrusion does happen sporadically in such clusters, and may be regular in some dialects. According to Gussenhoven 1993:51, Amsterdam Dutch has intrusion in medial clusters only if the following syllable is weak: it could happen in the words above, but not in [bəl'kən] ‘balcony’, [hər'pun] ‘harpoon’, etc. He suggests that a stressed syllable adds the initial consonant of the following weak syllable to its coda. Under this analysis, intrusion happens only within syllables in all dialects; it is the syllabification of medial RC clusters that differs.

The dependence of vowel intrusion on syllable structure is very common cross-linguistically. Some languages, like Dutch, have intrusive vowels only within syllables; some, like Finnish, have them only between syllables; and some, like Scots Gaelic, have them in both situations.

(73)	Vowel intrusion locations:	between syllables	within syllables
	Scots Gaelic	Yes	Yes
	Dutch	No	Yes
	Finnish	Yes	No
	English (most dialects)	No	No

Hocank has a fifth pattern: it has intrusive vowels in both tautosyllabic and heterosyllabic clusters, but those within syllables are long, full vowels while those between syllables are

very short. The variety of patterns attested show that the grammar must contain different phasing constraints for tauto- and hetero-syllabic clusters.

There are several types of constraint arrays that could account for this typology. There could be a) general C-C phasing constraints that do not refer to syllable structure, b) C-C phasing constraints that refer only to tautosyllabic clusters, and c) C-C phasing constraints that refer only to heterosyllabic clusters. Any two of these constraint types are sufficient to produce the typology above; the third is redundant. Since gestural coordination is known to be most stable within the syllable, I will assume that constraints of type b) exist; for the second type I will, somewhat arbitrarily, choose a). One reason for preferring a) is that it allows a simple account of languages, like Dutch, where the same phasing holds between heterosyllabic CCs and CC sequences where one C is unsyllabified. It also allows a single (high-ranked) constraint to account for all the CC phasing patterns in languages like Scots Gaelic, where the same phasing holds within and between syllables.

In short, languages have general constraints on CC alignment, and constraints specifically on CC alignment within syllables. In languages where the general constraints are higher ranked, phasing will be the same for tautosyllabic and heterosyllabic CC clusters. In languages where a specific constraint is higher ranked, phasing within and between syllables may be different.

According to this analysis, the highest-ranked general constraint in Dutch is one that prefers the phasing  $\text{RELEASE} = \text{TARGET}$  (a phasing that produces no audible release) in RC clusters.

(74)  $\text{ALIGN}(\text{R}, \text{RELEASE}, \text{C}, \text{TARGET})$

In a  $C_1 C_2$  string,  $C_1$  a sonorant, the release of  $C_1$  is aligned with the target of  $C_2$ .

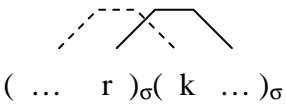
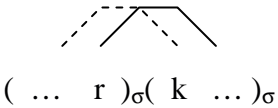
The highest-ranked constraint that refers specifically to tautosyllabic consonants is one that prefers a phasing of  $\text{CENTER} = \text{ONSET}$ , which will produce audible release.

(75)  $\text{ALIGN}(\text{R}, \text{CENTER}; \text{C}, \text{ONSET}) \text{ IN } \sigma$

In a  $C_1 C_2$  string,  $C_1$  a sonorant, where  $C_1$  and  $C_2$  belong to the same syllable, the center of  $C_1$  is aligned with the onset of  $C_2$ .

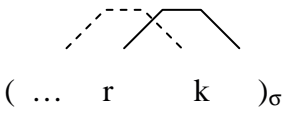
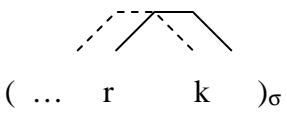
The syllable-specific constraint is ranked above the general constraint. Tableaus (76) and (77) show how this grammar treats heterosyllabic and tautosyllabic clusters differently. In [vɛrkən] ‘to work’, the [r] and [k] are adjacent across a syllable boundary. Since  $\text{ALIGN}(\text{R}, \text{CENTER}; \text{C}, \text{ONSET}) \text{ IN } \sigma$  does not apply,  $\text{ALIGN}(\text{R}, \text{RELEASE}, \text{C}, \text{TARGET})$  is able to enforce a high degree of overlap and prevent vowel intrusion.

(76) Dutch heterosyllabic clusters (no vowel intrusion)

/vɛrkən/	ALIGN (R, CENTER; C, ONSET) IN $\sigma$	ALIGN (R, RELEASE; C, TARGET)
a.  ( ... r ) $\sigma$ ( k ... ) $\sigma$ [vɛrəkən]		*!
a. →  ( ... r ) $\sigma$ ( k ... ) $\sigma$ [vɛrkən]		

In [vɛrk] ‘work’, [r] and [k] are tautosyllabic, so the higher-ranked ALIGN (R, CENTER; C, ONSET) IN  $\sigma$  forces a low degree of overlap, producing vowel intrusion.

(77) Dutch vowel intrusion in tautosyllabic clusters

/vɛrk/	ALIGN (R, CENTER; C, ONSET) IN $\sigma$	ALIGN (R, RELEASE; C, TARGET)
a. →  ( ... r k ) $\sigma$ [vɛrək]		*
a.  ( ... r k ) $\sigma$ [vɛrk]	*!	

For those Dutch speakers who do not have vowel intrusion at all, the constraint ALIGN (R, RELEASE; C, TARGET) must be ranked higher than ALIGN (R, CENTER; C, ONSET) IN  $\sigma$ .

**2.2.2.2. Appendices**

Vowel intrusion does not happen when [l] or [r] are followed by alveolar obstruents [t] or [s], as shown below.

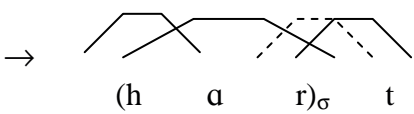
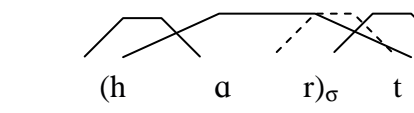
- (78) Dutch RC clusters without intrusive vowels Booij 1995:127
- |    |      |             |         |
|----|------|-------------|---------|
| a. | hart | <i>hart</i> | ‘heart’ |
| b. | hars | <i>hars</i> | ‘resin’ |
| c. | halt | <i>halt</i> | ‘stop’  |
| d. | hals | <i>hals</i> | ‘neck’  |

The lack of intrusion in [lt] and [ls] could be ascribed to the task dynamics of producing homorganic clusters, as discussed in chapter 1, but this explanation does not extend to the [r]C cases. Some Dutch speakers have a uvular /r/ ([ʀ], [χ], [ʁ]), which is not homorganic to [t] or [s]. If homorganicity were the only factor ruling out intrusion before [t] and [s], we would expect to find descriptions of dialects where [r] is uvular and [rt] and [rs] clusters have vowel intrusion. Such cases have not been reported.

Booij 1995 adopts a different explanation for the lack of vowel intrusion before [t] and [s]: these consonants are not part of the syllable. There is independent evidence for this claim (Booij 1995:26-7 and references therein). For example, long vowels like [a] can only be followed by one coda consonant in Dutch, making words like \*[kamp] impossible. But long vowels do occur before clusters of up to four consonants provided that all but the first are coronal obstruents. Words like [bɛdarst] ‘calmest’ and [kars] ‘candle’ are well-formed. This can be explained if [kars] has a one-segment coda, [r], and the [s] is an “appendix” consonant that is not part of the syllable. Appendix groups also violate otherwise regular constraints on sonority profiles within Dutch syllables.

If the final [t] or [s] is not syllabified, the constraint system already proposed accounts for final [rs] and [rt] clusters, as shown in tableau (79).

(79) No vowel intrusion before appendix

/hart/	ALIGN (R, CENTER; C, ONSET) IN $\sigma$	ALIGN (R, RELEASE; C, TARGET)
a.  (h a r) $\sigma$ t [hart]		
b.  (h a r) $\sigma$ t [harət]		*!

The claim that vowel intrusion happens only within syllables implies, of course, that the intrusive vowel is not itself a syllable. The following section summarizes the evidence for this claim.

### 2.2.3. Monosyllabic behavior

In Dutch, evidence for the non-syllabicity of intrusive vowels comes primarily from speaker intuitions and phonological patterning. There is also indirect support from phonetic measurements.

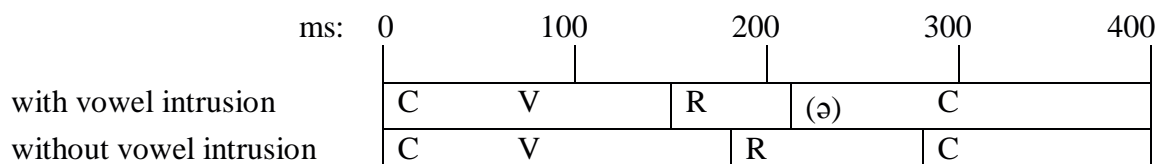
#### 2.2.3.1. Syllable duration

Donselaar et al. 1999 describe the timing of segments in words with and without vowel intrusion. These measurements were taken as a control on the stimuli for a larger experiment. Experiments 3 and 4 of this study involved tokens of 36 words, each pronounced by an experimenter once with and once without vowel intrusion (recall that vowel intrusion is optional). Each word was measured at three points: the end of the CV portion, the end of the CVR portion, and the end of the word. While there was no significant difference in overall word duration, the CVR and CV portions were shorter in words with vowel intrusion, as shown below<sup>10</sup>.

(80) Durations of CVRC words	CV	CVR	CVRC
with vowel intrusion	156	208	400
without vowel intrusion	181	277	401

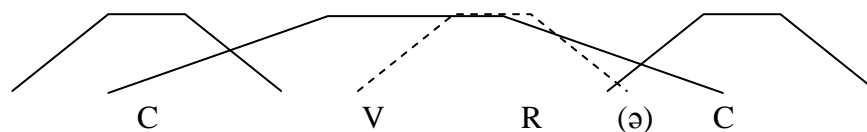
(81) shows these durations graphically.

(81) Timing patterns of CVRC words



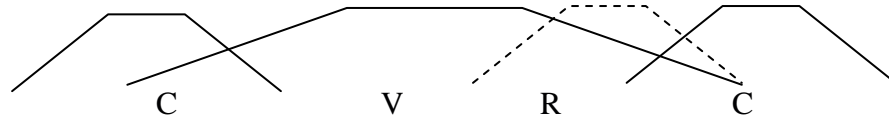
These data are strikingly consistent with the proposal that vowel intrusion is not addition of a syllable, but a special timing of segments within the syllable such that the sonorant heavily overlaps the vowel. An earlier onset and offset for the sonorant are precisely what the representations below predict.

(82) Syllable with vowel intrusion



<sup>10</sup> Donselaar et al. measure the words in two groups; I have averaged the figures according to the number of words in each group.

(83) Syllable without vowel intrusion



Donselaar et al. do not compare the duration of CVR<sub>ə</sub>C words with vowel intrusion and CVR<sub>ə</sub>C words where the ə is underlying. I have not taken instrumental measurements, but I consulted a native speaker from the central part of Holland, and found that there is a clearly perceptible difference between his pronunciation of minimal pairs like those in (71). Impressionistically, words with intrusive [ə]'s sound shorter than words with underlying [ə]'s. The consultant's conscious intuition is that words with intrusive vowels are monosyllables but that "it's sometimes difficult to get these consonants together." He adds, though, that the spelling might bias one to think this.

### 2.2.3.2. Syllable count judgments

Donselaar, Kuijpers, and Cutler 1999 report a psycholinguistic experiment in which native speakers treated words with vowel intrusion like monosyllables.

In the experiment, subjects heard a series of spoken words, some of them real words and some nonsense, and were asked to orally respond with a "reversed" version of each word. They were told that if the word was one syllable, they should reverse the segments, so that for the stimulus [tap] the subject would be expected to produce [pat]. But if the word was a disyllable, they only had to reverse the syllables, so that for [hotel] the subject would be expected to produce [telho]. Indirectly, the task forced speakers to make syllable count judgments. The stimuli included both words with underlying [ə] in the second syllable and words with intrusive [ə]s.

Subjects treated real words with intrusive [ə], like [tʌl<sub>ə</sub>p] 'tulip', as monosyllables 94% of the time, producing [plut] rather than [ləptu] (or, significantly, [pəlut]). Nonsense words with intrusive [ə] were treated as monosyllables 58% of the time. This suggests that subjects had trouble telling from a single hearing whether the [ə]s in nonsense words were meant to be segmental or intrusive. Perhaps their knowledge of which [ə]s are intrusive derives partly from noticing the variability present in multiple productions of the vowel.

The experiment is consistent with the claim that speakers consider the intrusive [ə] to be non-syllabic, since when presented with [tul<sub>ə</sub>p] subjects followed the instructions they were given for monosyllables. Also, their failure to keep the [ə] in the segment-by-segment reversal—i.e. producing [plut] instead of [pəlut]<sup>11</sup>—is consistent

<sup>11</sup> It is actually not made clear in Donselaar et al. 1999 that the "monosyllabic" responses were [plut], but this is stated in a summary of the experiment by Warner et al. 2001. The papers share a co-author, Anne Cutler. In addition, this is consistent with the results I have obtained in giving consultants the same task.

with the claim that the [ə] is not a segment, and hence unavailable for such manipulation. The experiment is open to the objection, however, that speakers may have consulted the orthography in order to complete the task.

Warner et al. 2001 report that Goetry et al. (unpublished) have data showing that preliterate Dutch children also judge forms like [tʏləp] as monosyllabic approximately half the time, in a way that differs from their treatment of true disyllables, but I have not had access to this manuscript.

### 2.2.3.3. [n]-deletion

The phonological behavior of intrusive [ə]s also differentiates them from regular, segmental [ə]s. The segment [ə] in a final syllable conditions two processes: deletion of a following [n] and selection of certain suffix allomorphs. Intrusive [ə] fails to condition either pattern. A regular CVCəC words also licenses a greater range of qualities for the first vowel than a CVCəC word where [ə] is intrusive, while CVCəC licenses lexical tones that CVCəC cannot. These patterns are highlighted in the next few sections.

An –[ən] coda that is followed by a morphological boundary can usually be pronounced without the [n], as in the examples below (exceptions are the indefinite article *een* and an /n/ at the end of a verbal stem). This deletion is optional for some speakers, including my consultant, and obligatory for others, according to Booij 1995. It happens in a variety of morphological contexts, both word-medially and word-finally.

(84)	Dutch [n]-deletion		Booij 1995:139
a.	<i>regen</i>	reɣən / reɣə	‘rain’
b.	<i>gouden</i>	ɣɔudən / ɣɔudə	‘golden’
c.	<i>boven</i>	bovən / bovə	‘above, upstairs’
d.	<i>bloemen</i>	blumən / blumə	‘flowers’
e.	<i>lopen</i>	lopən / lopə	‘to walk’ (pres. pl./inf.)
f.	<i>openlijk</i>	opənlək / opələk	‘openly’
g.	<i>regentje</i>	reɣəntjə / reɣətjə	‘rain’ (diminutive)
h.	<i>open-baar</i>	opənbɑ:r / opəbɑ:r	‘public’

This [n] deletion does not happen after an intrusive [ə], a fact that has not to my knowledge been noted in the literature. Consultants report that deleting the [n] of a word like *hoorn* ‘horn’, which is pronounced [horən], is completely unacceptable. [horə] has to mean *horen* ‘to hear’, whose alternate pronunciation is [horən].

The difference between these two phonetic [ən] sequences can be explained under the gestural approach if we assume that the constraint motivating [n]-deletion is one on well-formed syllable structure. [ə] is more restricted than other short nuclei in Dutch in what codas may follow it; for example, it cannot be followed by a cluster of two consonants in the same syllable (Booij 1995:19). Although [n] is not a branching coda, it

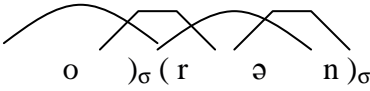
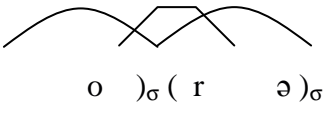
evidently falls in the group of codas that cannot follow [ə], for some speakers. The reason for this restriction is beyond the scope of discussion here; it will simply be instantiated with the following constraint:

(85) \*ən]<sub>σ</sub>

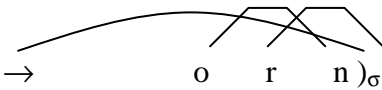
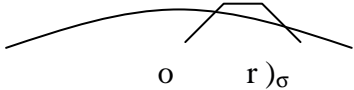
A syllable with the nucleus [ə] may not have coda [n]

This constraint will not favor [n]-deletion after an intrusive [ə], because this [ə] is not a segment or the nucleus of a syllable. In the tableaux below, it should be remembered that the constraint \*ən]<sub>σ</sub> is evaluating only the segmental representation, given under the gestural curves. The phonetic transcription in brackets is parenthetical and not part of the output representation at all.

(86) [n]-deletion after underlying [ə]

/horən/	*ən] <sub>σ</sub>	MAX
a.  [horən]	*!	
b. →  [horə]		*

(87) No [n]-deletion after intrusive [ə]

/horn/	*ən] <sub>σ</sub>	MAX
a. →  [horən]		
b.  [horə]	*!	

This pattern demonstrates that an acoustic [ən]-like sequence resulting from vowel intrusion is not treated by the grammar in the same way as a segmental [ən] sequence.

#### 2.2.3.4. Allomorph selection

Segmental [ə] and intrusive [ə] also trigger different allomorph selection. The suffix meaning ‘inhabitant of’ has three allomorphs. It is *-der* [dər] after an [r], as in a) below; *-aar* [ar] after a sequence of [ə] + coronal sonorant, as in b) and c) below; and *-er* [ər] elsewhere, as in d) and e).

(88) Suffix allomorphy

a.	<i>Bijlmermeerder</i>	bɛilmərmerdər	‘inhabitant of Bijlmermeer’
b.	<i>Diemenaar</i>	dimənar	‘inhabitant of Diemen’
c.	<i>Assenaar</i>	asənar	‘inhabitant of Assen’
d.	<i>Lochemer</i>	lɔxəmər	‘inhabitant of Lochem’
e.	<i>Amsterdammer</i>	amstərdəmər	‘inhabitant of Amsterdam’

Words that end in a [ən] due to vowel intrusion take *-er*, not *-aar* as words ending in underlying *-[ən]* do. The consultant offered the following near-minimal pair:

(89) a.	<i>Maarner</i>	‘inhabitant of Maarn’ ([marən])
b.	<i>Lorenaar</i>	‘inhabitant of Loren’

Both terms were nonce words for him rather than learned forms. This shows that in new word formation, the [ən] sequence resulting from vowel intrusion is not phonologically equivalent to the [ən] resulting from an underlying /ən/.

This allomorphy choice can be explained if the restriction on [-ər] is motivated by a constraint prohibiting [ə] *segments* in adjacent syllables. Such a constraint is independently motivated, since Dutch normally deletes the first in a sequence of [ə]s: /kopərən/ → [koprən] ‘copper’.

#### 2.2.3.5. Lexical tone

Words like [ɛrəm] ‘arm’ also pattern with monosyllables in their ability to host lexical tone. In some Limburghian dialects of Dutch, such as Venlo, stressed syllables with two sonorant moras can host a lexical H on the second mora (Gussenhoven & van der Vliet 1999:101). Monomoraic syllables cannot host this lexical tone.

If a word like [ɛrəm] were disyllabic, the first syllable, [ɛ], should be monomoraic and unable to host the lexical tone. But in fact, [ɛrəm] does host lexical tone in Venlo Dutch. Gussenhoven & van der Vliet, who assume [ɛrəm] to be disyllabic, analyze this as indicating that tone assignment precedes the division of /ɛrm/ into two syllables. But the data presented is equally compatible with the claim that [ɛrəm] is one heavy syllable on the surface.

### 2.2.3.6. Distribution of long vowels

Another argument that vowel intrusion does not create a new syllable comes from the patterning of long vowels and consonant clusters. A long vowel, meaning one of [i, y, u, e, ø, o, a] cannot be followed by two consonants in the same syllable. Thus, a word like \*[kimp] or \*[kump] is ill-formed in Dutch. Only the short vowels, [ɪ, ɛ, ɔ, ʏ, ɑ], can be followed by two coda consonants.

Booij 1995 analyzes this pattern as a restriction on syllable structure. He argues that the Dutch rhyme consists of a maximum of three positions on the X-tier. A long vowel occupies two positions and hence can be followed by only one consonant; a short vowel occupies one position and hence can be followed by two consonants.

This syllable-structure restriction provides a test of whether intrusive vowels are creating a new syllable. If vowel intrusion into a /CVCC/ input creates a CV.CəC output, then the first syllable should be able to license a long vowel. Long vowels occur in words like [ro.dər] ‘redder’ or [e.tər] ‘eater’, where the [ə] is underlying and segmental. There is even a class of words where vowels lengthen when the syllable they are in is opened by addition of a [ə]-initial suffix, as in [wɛg] ‘road’ vs. [wɛ.gən] ‘roads’ (Booij 1995:72).

If vowel intrusion caused the preceding syllable to become open, words like \*[kiləm] or \*[kuləm] (underlying /kilm/, /kulm/) should be possible. Yet they are not, according to Booij 1995:15. This is very simply explained if these words are monosyllabic: the rhyme consists of the segmental string [ilm] or [ulm], and is ruled out by the same syllable structure constraints that rule out words like \*[kimp] and \*[kump]. The non-opening of a preceding syllable is one example of the way that the intrusive [ə] fails to act syllabic.

### 2.2.3.7. The unmarkedness of RC clusters

Another, more indirect argument for the intrusive [ə] not being an epenthetic segment is the lack of motivation for epenthesis in this position. Donselaar et al. 1999:60 present evidence from Dutch truncation processes that the RC clusters broken by vowel intrusion are not treated as marked by other processes in the grammar. As mentioned in chapter 1, it is a general characteristic of vowel intrusion that it does not target clusters based on their markedness.

If the appearance of [ə] were a type of epenthesis, it would need to be motivated by high-ranked markedness constraint penalizing RC clusters of the particular kind that trigger [ə]-insertion. We would expect to find that the grammar avoided such clusters in other ways as well. Truncation is one situation in which the avoidance of marked clusters can be seen. A cluster that is heterosyllabic in a long word- for example, the [rb] of *Barbara*- may be tautosyllabic in the truncated form of the word, as in *Barb*. When the usual truncation pattern of a language would result in a marked coda, the grammar may repair this problem by truncating more than usual. In English, for example, the name *Albert* truncates not to *Alb*, as would be expected by comparison to *Barb*, but to *Al*. As

John McCarthy (p.c) notes, this is probably because [lb] is an extremely rare coda in English, occurring only in a few low-frequency words (*bulb* and *alb*).

Thus, if clusters like [rk] trigger vowel intrusion due to being marked codas, they might also be avoided in truncation processes. But in fact, Dutch truncation does not avoid creating the type of clusters that are subject to vowel intrusion. For example, the name *Marcus* can be truncated to *Marc* [marək], and a *directeur* (director) can be called the *dirk* [dirək]. The grammar doesn't take the option of avoiding the [rk] coda by truncating to \**Mar* or \**dir*.

This supports the idea that vowel intrusion does not function to remove an undesirable coda cluster by resyllabification, but simply reflects a certain timing relation within a coda cluster. Clusters like [rk] and [lp] are not especially marked clusters that are avoided in Dutch; they are perfectly acceptable clusters that simply need to be articulated in a way that results in the percept of a [ə] between them.

#### 2.2.3.8. Against ordering

One response to the phonological arguments presented above might be that rule-ordering is involved. [ə]-epenthesis could simply apply after processes like [n]-deletion, and this would explain why such processes ignore epenthetic [ə]: it isn't present when they apply. Such an analysis is not available within Optimality Theory, which is a non-serialist framework, but it would be the natural conclusion in other frameworks.

If this were the case, we would expect to find that other orderings were possible in other languages. Cross-linguistically, there are certainly many cases of epenthesis that have to be ordered before other rules, and there is no obvious reason that the type that breaks RC clusters should be different.

Synchronic vowel insertion with the characteristics of the vowel intrusion syndrome, however, seems to occur exclusively after other processes. This consistent ordering is unexplained under the serial derivation theory. While universally ordering this type of epenthesis after other rules would account for the data, it would do so in a stipulative and unexplanatory way. No connection is drawn between the derivational lateness of the epenthesis and the nature of the epenthesis. In the theory presented here, there is a better explanation of which 'inserted' vowels are visible to other processes. Those that are visible are the ones that have a conditioning environment straightforwardly based on avoiding marked syllable structures—i.e, the ones that are truly segments inserted to cause resyllabification. Vowel intrusion does not affect syllable structure because it does not repair syllable structure, and vice versa.

#### 2.2.4. Discussion: how can a vowel not be a syllable?

I have presented several pieces of evidence above that intrusive vowels act non-syllabic in Dutch- as I contend they do in all languages with vowel intrusion. The arguments in the case of Dutch include phonetic duration, phonological patterning, and perhaps most importantly, speaker intuitions as revealed through both casual questioning and psycholinguistic experiments.

Despite this evidence, it is the norm for researchers on Dutch to assume that these [ə]s are syllabic, and the same is true for many other languages with intrusive vowels. There is often an unstated assumption that where there is a vocalic-sounding period of a certain duration or perceptual prominence, there must be a syllable. I claim, on the other hand, that syllables are built out of segments, not out of sounds, and that a word may contain a very distinct vocalic-sounding period that does not correspond to any independent segment. Such a vocalic period cannot be the nucleus of a syllable.

It is important to remember that syllables are not a property of sound streams per se. It would be meaningless to talk about the syllable structure of a dog's barking, or even of human non-speech sounds like laughter or crying. Syllables are only a property of language. But even in language, they cannot be directly deduced from an acoustic record.

To demonstrate this, it may help to think about the difficulty, probably familiar to most linguists, of trying to count the syllables of a word in a foreign language. Other phenomena besides acoustic release may cause confusion. For example, the Afrikaans name *Coetzee* ends in a diphthong [iə] that sounds disyllabic to English speakers (as much so as the last two vowels in *Maria*) but monosyllabic to Afrikaans speakers. Since there is no corresponding English diphthong, the two vowels must be interpreted by the English speaker as nuclei of two syllables. On the other hand, the bisyllabic Hebrew word ['na.al] 'shoe' is usually heard by English speakers as one syllable. There is no clear demarcation of hiatus between the two identical vowels, such as a glottal catch, and English speakers assume that an unbroken vocalic-sounding period must be a single syllable peak. Native Hebrew speakers hear ['na.al] as clearly bisyllabic.

In such cross-language misperceptions, both speakers are right in one sense—they have correctly counted the number of syllables that such an acoustic record corresponds to *in their own language*. The reason they come up with different results is that the translation of an acoustic record to a syllable count goes through the intermediate step of interpretation by a language-specific phonology, and phonologies do not necessarily make a one-to-one association between vocalic-sounding periods in the signal and vowel segments. A single vocalic-sounding period may correspond to no segment, as with intrusive vowels, to one segment, or to two segments, as in [na.al]. Since syllables organize segments, a non-segmental sound such as an acoustic release will not be heard as syllabic by native speakers, and a bisegmental vocalic period like the Hebrew [a.a] will be heard as bisyllabic by native speakers.

Yet in describing the phonology of a language, there is a widespread and usually tacit assumption that "vocalic sound = syllable". For example, even as Donselaar et al. 1999:64 produce strong evidence that "the realizations of real words with schwa epenthesis are represented by listeners as monosyllabic," they still assume that "obviously, adding a vowel between two consonants adds an extra syllable to the word; the optional form with epenthesis has one more syllable than the underlying form without." They later comment that "*from the speakers' point of view*, schwa epenthesis may not arise via insertion of a segment as such, but simply via realization of the gestures corresponding to articulation of the consonant cluster" (p. 74, emphasis added). The unstated assumption is that segments and syllables have some type of reality outside of the speaker's representation of them. It is precisely this that I wish to argue against. Syllables exist in the mind, not in the air.

### 2.2.5. Intrusion and [l]-allophony

Warner et al. 2001 present a challenge to the analysis of intrusive [ə] as non-syllabic. Based on an articulatory study, they show that the realization of [l] before intrusive [ə] is more similar to that of onset [l] than coda [l]. They argue that this shows [l] has been resyllabified into onset position, and disproves the gestural timing hypothesis (which has been considered by other researchers, as shown by the Donselaar et al. quote above, although it has not to my knowledge been defended in print). I argue that there is an alternative explanation to these facts under the gesturalist view.

Similar to English, some Dutch dialects have ‘light’ [l] in onsets and ‘dark’ [l] in codas. An [l] consists of two gestures: a raising of the tongue tip to touch the alveolar ridge, and a backing of the tongue body (Sproat & Fujimora 1993). A light [l] is one that has a strong tongue tip raising gesture and a weaker tongue body gesture; a dark [l] has a stronger tongue body gesture and weaker tongue tip gesture.

Warner et al. compare tongue tip positioning for triplets like [film], [filəm], and [vɪləm]: that is, the same word pronounced with and without intrusive [ə] versus a word with an underlying schwa in the same position. For all seven of their subjects, the tongue tip was significantly higher when an intrusive [ə] was present, as in [filəm], than when it was not, as in [film]. They conclude that this shows the [ə] to be a phonologically inserted vowel.

In order for the schwa to condition allophonic variation, it must be present as a phonological unit, because the allophonic variation involves timing of the /l/ gestures relative to the vowel. If the schwa were simply a period of time without gestural specifications, which happens to be interpreted perceptually as a schwa-like sound, this targetless schwa would be merely a perceptual epiphenomenon, not a linguistic unit, and could not possibly condition allophonic variation. (395)

It is important to distinguish between conditioning and correlation: the fact that intrusive [ə] tends to cooccur with a light [l] does not necessarily mean that the schwa conditions the light [l]. If the schwa percept itself is a result of a particular gestural timing configuration within a cluster, then that same timing configuration could also be the cause of the [l]’s lightness.

In fact, there are two plausible reasons to think that the timing that produces intrusion would also lighten the [l]. The phasing of [filəm] differs in two ways from that of [film]: the [l] more heavily overlaps the vowel, and less heavily overlaps the [m] in [filəm]. Both of these facts would tend to produce a lighter [l], in different ways.

First, overlap between consonantal gestures tends to weaken them. This has been shown experimentally for English by Browman & Goldstein 1995, and van Reenan 1986’s questionnaire study suggests that it is also a factor in the weakening of the tongue-tip gesture in Dutch. Van Reenan asked subjects to report on vocalization of [l], which is an extreme form of darkening in which the tongue tip fails to make contact with the alveolar ridge. For each word where [l] preceded a consonant, 31% to 64% of respondents reported that they vocalized the [l], with particularly high percentages of

vocalization before stops. But for each word where [ɪ] was word-final, only 26% - 34% vocalized the [ɪ]. Thus, part of the coda [ɪ]'s darkness in Dutch may be due to overlap with the following consonant. As suggested by Louis Goldstein (p.c.), a configuration where there is less overlap between the consonants, as in vowel intrusion, allows a stronger tongue tip articulation and hence a 'lighter' [ɪ].

A second reason for the correlation of intrusion and lightening is that heavy overlap of the [ɪ] with the vowel brings a conflict between the tongue body gestures of the [ɪ] and the vowel. Both gestures want to use the same organ, and the conflict must be resolved. One potential resolution is to weaken the vowel's articulation.

There is a case similar to this in Scots Gaelic. Scots Gaelic has sonorants with strong secondary articulations of palatalization and velarization. In some dialects, these secondary articulations optionally disappear when the sonorant is involved with vowel intrusion. For example, when the palatalized [r'] is timed to overlap a vowel, it may depalatalize to [r]. If [r'] depalatalizes, then the intrusive vowel has the same quality as the preceding vowel; if it does not, then the intrusive vowel sounds like [i]. I interpret this to mean that the palatal gesture on [r'] is in conflict with the vowel, and one or the other must be eliminated.

- (90) Ross-shire depalatalization Borgstrøm 1941:140
- |    |  |                 |
|----|--|-----------------|
| a. | arəkət / ar'ɪ:kət                          | 'silver'        |
| b. | t <sup>h</sup> araj / t <sup>h</sup> ar'ɪ: | 'bulls'         |
| c. | duruj / dʉur'ɪ:                            | 'fishing-lines' |

In this case the depalatalization of [r'] could not be attributed to resyllabification as an onset: [r'] exists as an onset, even before back vowels as in [r'<sup>h</sup>u:ms] (Borgstrøm 1941:148; no gloss).

This hypothesis also helps explain some of the variability found in Warner et al.'s data. In the measurement of tongue-tip raising, three of their seven subjects had significant differences between the [ɪ] in [fɪləm] and that in [vɪləm], in addition to the significant differences between [fɪləm] and [film] (p. 404). In effect they were showing a third allophone of [ɪ], rather than a fully onset-like [ɪ]. This is problematic for the theory that [ə] causes resyllabification of [ɪ], but unsurprising under the theory that [ɪ] before intrusive [ə] is in a timing configuration unlike onset [ɪ] or other coda [ɪ]s.

### 2.2.6. Other allophony

In general, articulatory phonology analyses have not treated allophony with governed by rules of the form "use light [ɪ] in onsets and dark [ɪ] in codas." Rather, different productions of a segment fall out of rules of intra- and inter-syllabic coordination (such as the asymmetry in English between the way onsets and codas are phased with respect to the vowel), a few constraints that come into play when there is conflict between articulatory demands, and general principles of task dynamics. Different allophones are not categorically different objects in the mind (Sproat & Fujimora 1993).

Intrusive vowels sometimes do and sometimes do not condition allophonic processes where ordinary vowels would. In Tiberian Hebrew, for example, stops are normally spirantized after a vowel. This is shown in the contrast between a) and b) below, where the consonant-final root causes the feminine singular perfective suffix /t/ to become [θ]. When a root ends in a guttural, an intrusive vowel appears before the [t] suffix. As shown in c), [t] does not spirantize after the intrusive vowel.

- |      |    |          |                                 |
|------|----|----------|---------------------------------|
| (91) | a. | katav-t  | ‘write 2fs. perfective’         |
|      | b. | gali-θ   | ‘go into exile 2fs. perfective’ |
|      | c. | ʃalaha-t | ‘send 2fs. perfective’          |

In this case, an intrusive vowel fails to condition an allophonic variation in the way a normal vowel would.

In Saami there is optional degemination of a sonorant preceding an intrusive vowel, but not before other vowels. For example, [skuol:əfi:] ‘owl, nom. sg.’ can also be pronounced [skuoləfi:]. (This “degemination” may be simply a shortening of the gesture; I have seen no argument that a mora is actually deleted. If it does delete, this poses an opacity problem, since non-geminate sonorants do not normally cause vowel intrusion). In this case, an intrusive vowel conditions allophonic variation where a normal vowel would not.

In short, there is no single generalization about vowel intrusion and allophonic variation in neighboring consonants. Intrusive vowels may condition the same alternations that normal vowels do; they may condition alternations that normal vowels don’t; or they may fail to condition any alternations. The cause of each pattern must be sought in the particular pressures that lead to each type of allophony. For this reason, I do not consider the fact that Dutch intrusive vowels correlate with a pattern of [l] allophony to be evidence that the intrusive vowels are syllabic.

### 2.2.7. Summary

Dutch vowel intrusion is a variable, optional phenomenon, which speakers are often conscious of. Despite this awareness, they do not treat the vowel as syllabic or segmental, either in psycholinguistic experiments or in phonological patterning. Phonetically, vowel intrusion consists of an earlier production of the sonorant in a VRC sequence, while the duration of the whole sequence remains constant. This timing appears to make the word, and particularly the sonorant, more easily perceptible. This segmental retiming happens only within syllables.

### 2.3. Finnish

Finnish has vowel intrusion in heterorganic RC clusters. As in Dutch, intrusion depends on syllable boundaries, but with the opposite result: intrusion happens only between syllables, and not within them. There is evidence that speakers do not consider the intrusive vowels syllabic.

### 2.3.1. Conditioning environment

The following is a chart of intervocalic CC clusters in the Ostrobothnian dialect of Finnish, based on Harrikari 1999. The clusters that all sources agree not to have vowel intrusion are unshaded; the clusters agreed to have vowel intrusion are shaded. There is disagreement over whether there is intrusion after [r] (see Suomi 2000 vs. Harrikari 1999); rC clusters that may have intrusion are followed by a question mark.

(92) Ostrobothnian Finnish intervocalic clusters

	p	t	k	v	s	r	l	m	n	ŋ	j	h
p	pp				ps	pr	pl					
t		tt	tk	tv	ts	tr					tj	
k			kk		ks	kr	kl					
v												
s	sp	st	sk	sv	ss		sl	sm				
r	rp?	rt	rk?	rv?	rs	rr		rm?	rn		rj?	rh?
l	lp	lt	lk	lv	ls		ll	lm			lj	lh
m	mp							m m				
n		nt			ns				nn			nh
ŋ			ŋk							ŋŋ		
j												
h		ht	hk	hv		hr	hl	hm	hn		hj	

Vowel intrusion happens only after stressed syllables (Harms 1976:75), which are normally initial. Examples of each cluster type that triggers vowel intrusion are given below.

(93)	Finnish CC clusters with vowel intrusion	Harrikari 1999:6-7	
a.	hv	vah <u>ava</u>	‘strong’
b.	hj	lah <u>aja</u>	‘gift’
c.	hm	tuh <u>uma</u>	‘naughty’
d.	hn	tah <u>ana</u>	‘spread’
e.	hl	kah <u>alita</u>	‘to chain’
f.	hr	oh <u>ora</u>	‘barley’
g.	lk	hal <u>akaista</u>	‘to split’
h.	lv	kal <u>avo</u>	‘transparency’
i.	lj	kal <u>aja</u>	‘beer’
j.	lh	kulu <u>ho</u>	‘bowl’
k.	lm	kyly <u>mä</u>	‘cold’
l.	lp	hal <u>apa</u>	‘cheap’
m.	rp	turu <u>pa</u>	‘muzzle’
n.	rk	kor <u>okea</u>	‘high’
o.	rv	karav <u>as</u>	‘bitter’
p.	rj	har <u>aja</u>	‘brush’
q.	rh	kere <u>ho</u>	‘club’
r.	rm	ker <u>ema</u>	‘cream’
s.	nh	van <u>aha</u>	‘old’

This list of clusters shows several restrictions that are cross-linguistically common, as discussed in chapter 1. The intrusive vowels do not appear in obstruent-initial clusters, because vowels only overlap sonorants and [h]. No intrusive vowel appears in homorganic clusters, even if these are sonorant initial, such as [lt, ls, mp, ns, nt, ŋk, rn, rt, rs]. And, as is typical, the clusters with vowel intrusion are not those with especially marked sonority profiles: intervocalic [tk], [ps], [tv], and [ks] surface without the [ə], despite the fact that languages usually prefer sonority to fall across syllable boundaries (Venneman 1980).

### 2.3.2. Phonetic realization

Wiik 1965:142-3 reports that intrusive schwa is in free variation with zero, and has a duration that varies from 0 up to about 60 ms. Its formant positions are close to those of the nearest preceding vowel, but are more centralized. The centralization is a direct prediction of the gestural account, since it is the end of the vowel gesture that is being heard, and variability in length is also characteristic of intrusive vowels. The intrusive vowel is transcribed as a copy vowel by Harrikari 1999 and Wiik 1965 but as a [ə] by Harms 1976; this may reflect dialectal differences or differences in perception. Unlike Dutch, Finnish does not have a non-intrusive [ə].

Wiik 1965 mentions that the intrusive vowel sounds very much like an English unstressed vowel, and that Finnish learners of English in fact have difficulty distinguishing between words like *scalping* [skælpɪŋ] and *scalloping* [skæləpɪŋ] for this reason. Finns tend to perceive these words as sounding the same and produce both in a way that English speakers interpret as *scalloping*. Harms 1976:74 draws a similar comparison to English [ə] in describing Standard Finnish intrusive vowels:

[mɛləkein] (*melkein*) ‘almost’ has essentially the same vowel qualities ([ɛ, ə, ei]) and relative durations as the English verb *delegate*—[dɛləgeɪt]. From a descriptive phonetic point of view, the Finnish epenthetic schwa and the English reduced-vowel schwa represent very nearly identical classes of vowel sounds; i.e., they vary over a wide central area, with their range of variation conditioned by the preceding and following segments. But here the similarity ends. The schwa in the above Finnish forms is purely transitional in nature. Speakers perceive these forms as containing only two syllables, not three.

Harms’ observation supports the claim that the difference between intrusive vowels and segments is not primarily phonetic but phonological. There is no threshold of duration or audibility that determines whether a sound is segmental (and hence syllabic); speakers can learn to regard exactly the same phonetic signal as segmental or non-segmental depending on their native phonology.

### 2.3.3. Related phasing effects

Harms 1976 has already analyzed Finnish vowel intrusion as essentially a gestural phasing effect. “[l] is released and the transition to the following consonant is perceived as a short vocoid. Of course, this transition does not occur if a homorganic dental or alveolar consonant follows” (75). Harms explains vowel intrusion as a result of two factors: “the prosodic rules governing syllable stress and timing” and “the universal constraints on segment-to-segment transitions.” In Articulatory Phonology terms, these are instantiated as constraints on phasing combined with universal task dynamics.

Significantly, Harms notes that *all* sonorant or [h]-initial clusters have a distinctive phonetic realization when they follow the main stressed syllable. He attributes these distinctive realizations to a common goal of providing a clear separation between syllables.

Of special relevance for the epenthesis case... is the careful control of the syllable division, providing a clear separation between the final consonant of the first syllable and the initial consonant of the following syllable. This ‘control’ process occurs with all nongeminate sonorant plus consonant clusters, both homorganic (as in *valta* ‘power’, *parta* ‘beard’, *kansa* ‘folk’) and nonhomorganic (e.g., *valmis*, *kalja* ‘near beer’, *surma* ‘death’, *korko* ‘interest’). The same process is observed with clusters of [h] plus voiced consonant, as in *lähde* ‘spring’, *kahvi* ‘coffee’, *mahla* ‘sap’. In all these clusters, to a greater or lesser extent, the energy of the first syllable is ‘spent’ before the onset of the next syllable, and the result is often

a very short pulse of energy, vocoid-like in nature, at the end of the syllable. [r] clusters are basically no different from [l] clusters in this regard, although the available energy generally results in a stronger trill instead of a vocoid-like release. Even with [h] clusters under stress, a short voiceless or murmured vocoid can result; e.g., [kah<sub>3</sub>vi]. (p. 77)

This observation suggests that all heterosyllabic RC clusters, including those without intrusive vowels, have a low-overlap phasing relation such as CENTER = ONSET. In heterorganic [l]-initial clusters, this alignment results in the percept of an intrusive vowel, but for other cluster types there are other phonetic effects: an extra-strong trill in [r]C clusters, a voiceless vowel in [h]C clusters, and a dip in energy in homorganic clusters.

The existence of these phenomena in other R.C clusters strongly supports the claim that what the grammar regulates is gestural phasing rather than the presence of intrusive vowels per se. Intrusive vowels are just one byproduct of a particular gestural phasing; the grammar does not recognize them as an entity. The gestural alignment that produces vowel intrusion in heterorganic some RC clusters can produce different effects in other cluster types.

If intrusive vowels were seen as epenthetic segments, there would be no reason to expect those RC clusters that were not broken by epenthesis to have any special realization.

#### 2.3.4. Syllable boundary effects

While in Dutch, only tautosyllabic clusters have vowel intrusion, in Finnish only heterosyllabic ones do. Harrikari 1999 reports that an [rk] cluster is broken up, as in [korokea] ‘high’, while an [rkt] cluster is left intact, as in [arktinen] ‘arctic’.

The constraint types proposed above for Dutch can also explain the Finnish pattern. There is a family of constraints on the alignment of segments within syllables; in Finnish, one favoring a high degree of overlap is high ranked. Another family of constraints governs CC phasing without regard to syllable structure; in Finnish, a constraint favoring a low degree of overlap between segments is high ranked.

(94) ALIGN (R, CENTER; C, ONSET)

In a C<sub>1</sub> C<sub>2</sub> string, C<sub>1</sub> a sonorant, the center of C<sub>1</sub> is aligned with the onset of C<sub>2</sub>.

(95) ALIGN (R, RELEASE; C, TARGET) IN σ

In a C<sub>1</sub> C<sub>2</sub> string, C<sub>1</sub> a sonorant, where C<sub>1</sub> and C<sub>2</sub> belong to the same syllable, the release of C<sub>1</sub> is aligned with the target of C<sub>2</sub>.

As in Dutch, the syllable-internal phasing constraint is ranked above general CC alignment constraint, so CC clusters have different alignments depending on whether they are tautosyllabic. The constraints introduced for Dutch are also included in the following tableaux, as a reminder that the same constraints are present in every grammar, but they are low-ranked and have no effect.

(96) Vowel intrusion in Finnish heterosyllabic clusters

/korkea/	ALIGN (R, RELEASE, C, TARGET) IN $\sigma$	ALIGN (R, CENTER, C, ONSET)	ALIGN (R, RELEASE, C, TARGET)	ALIGN (R, CENTER, C, ONSET) IN $\sigma$
<p>a.</p> <p>( ... r )<math>\sigma</math>( k ... )<math>\sigma</math></p> <p>[koro<u>ke</u>a]</p>			*	
<p>b.</p> <p>( ... r )<math>\sigma</math>( k ... )<math>\sigma</math></p> <p>[kor<u>ke</u>a]</p>		*!		

(97) No intrusion in Finnish tautosyllabic clusters

/arktinen/	ALIGN (R, RELEASE, C, TARGET) IN $\sigma$	ALIGN (R, CENTER, C, ONSET)	ALIGN (R, RELEASE, C, TARGET)	ALIGN (R, CENTER, C, ONSET) IN $\sigma$
<p>a.</p> <p>( ... r k )<math>\sigma</math></p> <p>[ar<u>akt</u>inen]</p>	*!		*	
<p>b.</p> <p>( ... r k )<math>\sigma</math></p> <p>[ar<u>akt</u>inen]</p>		*		*

Thus, both Dutch and Finnish show that gestural phasing within the syllable is distinct from the phasing between syllables. There is no universal pattern as to whether hetero- or tautosyllabic clusters will show more overlap, however.

### 2.3.5. Geminates

Standard Finnish does not have vowel intrusion before geminates (Harms 1976), but other dialects do. Harrikari 1999, quoting Karlsson 1983:109, reports vowel intrusion before geminates in [lk:, lp:, rk:, rp:] in Ostrobothnian.

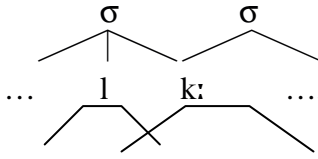
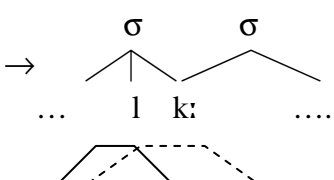
(98) Vowel intrusion in Finnish RC: Harrikari 1999:19

- a. palak:a 'salary'
- b. tylyp:ä 'blunt'
- c. kirik:o 'church'
- d. korop:i 'raven'

These two phasing patterns for geminates can be produced by different rankings of existing constraints.

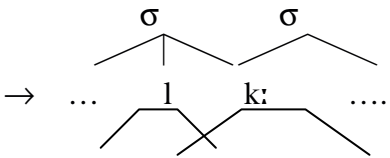
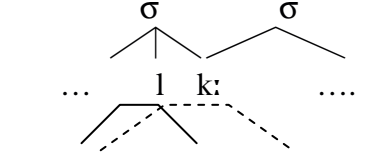
If we assume that geminates are ambisyllabic, then the ranking used above predicts no intrusion before them, since there is no intrusion within the syllable. The special constraint on geminate coordination proposed in chapter 1, ALIGN (C, CENTER, C:, ONSET), must be lower ranked.

(99) Standard Finnish: no intrusion before geminates

/palk:a/	ALIGN (R, RELEASE, C, TARGET) IN $\sigma$	ALIGN (R, CENTER, C, ONSET)	ALIGN (C, CENTER, C:, ONSET)
a.  [palak:a]	*!		
b.  [palk:a]		*	*

For those dialects that do have intrusion in RC: clusters, the special geminate phasing constraint must be higher ranked than ALIGN (R, RELEASE, C, TARGET) IN  $\sigma$ .

(100) Ostrobothnian Finnish: intrusion before geminates

/palk:a/	ALIGN (C, CENTER, C:, ONSET)	ALIGN (R, RELEASE, C, TARGET) IN $\sigma$	ALIGN (R, CENTER, C, ONSET)
<p>a.</p>  <p>→ ... l k: ...</p> <p>[palak:a]</p>		*	
<p>b.</p>  <p>... l k: ...</p> <p>[palk:a]</p>	*!		*

### 2.3.6. Vowel intrusion as contrast enhancement

Why should one language prefer a timing pattern in which segments show less overlap within than between syllables, while another language has exactly the opposite preference? This may relate to the different inventories of segment and syllable types within each language, and the different types of contrasts that need to be perceptible.

As Harms 1976 points out, the low overlap between heterosyllabic consonants in Finnish makes the contrast between RC and RC: clusters clearer. In standard Finnish, which has no vowel intrusion in RC: clusters, the presence of the intrusive vowel is a cue for distinguishing minimal pairs like [arək̚i] ‘weekday’ and [ark̚i:] ‘sheet of paper’. In dialects that have intrusive vowels in both words, a low degree of CC overlap may still help distinguish the two words. Releasing the sonorant’s constriction before the achievement of constriction for the stop should make it easier to perceive the length of the stop’s closure. Geminates do not occur within syllables, so enhancing the geminate / singleton contrast does not require vowel intrusion in tautosyllabic clusters, and none occurs. Furthermore, this particular functional motivation could only exist in a language like Finnish which has geminates; it would be irrelevant to Dutch, which has none. The difference between the types of clusters possible in Dutch and Finnish may influence which constraints on gestural phasing they rank highly.

According to the analysis given here, Dutch and Finnish differ in their ranking of the general (not syllable-specific) constraints on CC alignment, with Dutch preferring a high degree of overlap and Finnish a low degree. It is tempting to relate this to the fact that Dutch has a lexical [ə], which is confusable with intrusive [ə], while Finnish does not.



It is known that epenthesis may target CCC clusters and not CC clusters: for example, one of the [e]-epenthesis processes in Mohawk does so (Michelson 1988). But why would epenthesis break up CC clusters, as in [korokea], while leaving CCC alone, as in [arktinen]?

Such a pattern goes against all established motives for epenthesis. Epenthesis is usually used to remove segments from positions where they are unlicensed, by the creation of a new syllable. We expect epenthesis to remove marked structures. For example, some languages do not allow branching codas and insert an epenthetic vowel to turn one of the coda segments into an onset. But such languages would epenthesize into RC.C, not R.C. Some languages don't allow segment with certain features in coda position; obviously such a language would not allow [rk] codas while removing [r] codas. Epenthesis could be motivated by syllable contact law (Venneman 1980), which states that sonority is preferred to fall across a syllable boundary. By this criterion, [r.k] is again less marked than [rk.t].

To my knowledge, no well-motivated constraint on syllable structure prefers [rk.t] to [r.k]. On the other hand, it is well accepted that gestural phasing depends on syllable structure, and that heterosyllabic segments may not show the same phasing as tautosyllabic segments. Treating the vowels in Finnish RC clusters as intrusive rather than epenthetic removes an otherwise thorny analytical problem.

### 2.3.9 Creeping segmentization?

Harms 1976 claims that while vowel intrusion in standard Finnish is “purely transitional”, in other dialects, the intrusive vowel has been reanalyzed as a segment.

He gives two pieces of evidence for this. The first is that the inserted vowels in these dialects have the durations and qualities of normal unstressed vowels, rather than the short, variable duration and weak quality of the intrusive vowels in standard Finnish. Typological evidence shows this to be a weak argument. There are other languages, such as Scots Gaelic, where intrusive vowels are quite long and have distinct qualities, yet act clearly non-syllabic both in their phonological patterning and in speaker intuitions.

The second argument, however, carries more weight: Harms reports that the intrusive vowel is treated as a syllable by the alternating secondary stress pattern in some dialects, as in ['kele<sub>2</sub>kasta] ‘from the sled’. This is evidence that the intrusive vowel has come to be syllabic in these dialects- and hence, has ceased to be an intrusive vowel.

Reanalysis as a segment is an attested, but not universal, historical fate for intrusive vowels. It seems to have happened in Irish Gaelic, for example, but not Scots Gaelic. Such a reanalysis presumably happens when the auditory difference between intrusive and non-intrusive vowels becomes too slight for speakers to acquire the difference consistently, and perhaps when there are few phonological diagnostics for syllabicity.

Importantly, the onset of segmental behavior correlates with the loss of the other properties of the vowel intrusion syndrome described in chapter 1. In the Lapua dialect of Finnish, for example, the vowel no longer copies the vowel that is adjacent over the sonorant. Instead, it copies the following vowel in at least some words, like [kelakka] ‘sled’. (It is not clear from published sources whether the pattern of copying the

following vowel is general. Harms points out that for this word, the choice of vowel could be influenced by the fact that Finnish has many stems ending in [-akka] but none in [-ekka]). Once the intrusive vowel has been reanalyzed as an independent segment, it no longer shows the restrictions that once arose from its gestural nature.

#### **2.4. Conclusion**

The typology of vowel intrusion bears out the claim that gestural phasing is syllable-dependent. Dutch and Finnish both phase heterosyllabic consonant clusters differently from tautosyllabic ones. However, the type of phasing chosen for each cluster type is not consistent across languages. Dutch has low overlap between consonants within the syllable but high overlap between heterosyllabic consonants, while Finnish has the opposite pattern.

It is suggested here that the choice of phasing arrangements may relate to the type of contrasts that need to be made perceptible in each language. In Finnish, the low degree of overlap at syllable boundaries helps distinguish geminates from singletons, a consideration not present in Dutch. In Dutch, a low-overlap phasing within syllables reduces the tendency of [l] (and probably [r] as well) to lose its alveolar constriction in complex codas.

In each language, there is evidence that intrusive vowels are not syllabic, despite their auditory similarity to syllabic sounds in the same or other languages. The non-syllabicity of intrusive vowels is related to the fact that they do not have the function of repairing syllable structure. The next chapter focuses on the difference between intrusive and epenthetic copy vowels, showing how syllabic behavior correlates with conditioning environment.