Samuel Andersson
Christ's College, Cambridge, 2016 DRAFT #2

Sieves and Herrings: For Distinctive Vowel Length in Swedish[1]

0 Abstract

In this article, I reexamine the question of vowel and consonant length in Swedish, a hotly debated topic since at least Elert (1955). Vowel and consonant length depend on, and mutually predict, each other, so it's difficult to tell which is phonemic. I look at the traditional arguments used in the literature, but also introduce internal and external evidence that's never previously been discussed. The evidence favours Vowel Theory, where vowel length is distinctive. I'll also show that all major assumptions of Consonant Theory are false. I do this using evidence like minimal pairs for vowel length, previously claimed to be logically impossible in Swedish. I'll conclude that it's difficult to keep believing in underlying consonant length, and that an analysis with vowel length is better.

1 Introduction

This article is about vowel and consonant length in Standard Central Swedish (SCSw.), which is the variety of Swedish spoken in Stockholm and surrounding areas. Phonologists have debated this question for many decades without reaching a conclusion that everyone agrees on. The reason for this is that vowel and consonant length don't combine freely. Instead, the distribution of one determines the distribution of the other, and vice versa. The possible and impossible combinations of length are shown in (1) for stressed CVC syllables.

(1) The problem

	Long vowel	Short vowel
Long consonant	*['siːlː], ungrammatical	['sɪlː] 'herring'
Short consonant	['siːl] 'sieve, strainer'	*['sɪl], ungrammatical

(1) shows that every CVC syllable has either a long consonant (as in ['sɪlː] 'herring') or a long vowel (as in ['siːl] 'sieve'). Syllables where both vowel and consonant are short are ungrammatical (as in *['sɪl]). The same goes for syllables where they're both long (as in *['siːlː]). So if you know the consonant length, then you know the vowel length too: long consonant → short vowel, and short consonant → long vowel. But it's also true that if you know the vowel length, then you know the consonant length: long vowel → short consonant, and short vowel → long consonant. Phonologists have to choose what kind of length they want to represent in speakers' mental lexicons.[2] Maybe vowel length is underlyingly represented, with consonant length derived by predictable rules. I'll call this Vowel Theory throughout the article, and it's what I believe in. Or perhaps consonant length is underlying, with derived vowel length. I'll refer to that as Consonant Theory. This is the question that phonologists have debated for so long. The following solutions have been the most common in the literature:

1 I'd like to thank the following people for the invaluable help they've given me while working on this article: Bert Vaux, Ollie Sayeed, Lis Kerr, Tom Meadows, Tomas Riad, Anders Holmberg, and the audience at ULAB 2016. A special thanks to those of you who've taken the time to read and comment on previous drafts, especially Tomas Riad. This article would be far worse without your help.

2 We'll see an argument in section 4.1 against representing both kinds of length underlyingly.

(2) The solutions

Solution	Underlying representation of ['siːl] 'sieve'	Underlying representation of ['sɪlː] 'herring'	Some linguists in favour of this solution
Vowel length	/'siːl/	/'sil/	Engstrand (1999), Linell (1978), Witting (1977)
Consonant length	/'sil/	/'silː/	Riad (2014; R from now on)
Consonant gemination	/'sil/	/'sill/	Elert (1955), Eliasson (1978), Eliasson (1985; E from now on), Eliasson and LaPelle (1973)

In recent years, it seems that Consonant Theory (rows 2 and 3 in (2) above) has become more popular. For example, various forms of Consonant Theory are used in Eliasson (2010), Löfstedt (2010) and Riad (2014). But in this article, I'll argue for Vowel Theory (row 1 in (2) above). I think that SCSw. has 17 vowel phonemes, and a phonological process which lengthens consonants after short stressed vowels. We'll look at the evidence from the literature, and conclude that Vowel Theory is actually preferable, even when the opposite seems to be true at first. But an important part of this article also introduces new evidence for Vowel Theory. Using this new evidence, I show that all major predictions of Consonant Theory are empirically false. For example, it's often claimed that there are no minimal pairs for vowel length in SCSw., and even that such a contrast is impossible "by logical necessity" (Eliasson 2010: 28). But the empirical facts beg to differ, and I'll show that SCSw. has perfect minimal pairs for vowel length. This makes it difficult to believe in Consonant Theory, which incorrectly predicts that they don't exist. I also outline my own Vowel Theory analysis of SCSw., which straightforwardly predicts the new evidence. I give internal and external evidence for the processes Vowel Theory needs. Unlike Consonant Theory, my analysis also predicts native speakers' intuitions about length: some speakers claim that consonant length is impossible to hear, even when they're told it exists. But even though I argue for Vowel Theory, I also try to modify Consonant Theory to account for the new evidence throughout the article. I hope that this helps Consonant Theorists find possible solutions to the problems I present.

Here's how the rest of this article is structured. In section 2, we look at the basic facts about vowels and consonants in SCSw., and the phonological processes both theories agree on. In section 3, we turn to Consonant Theory and the processes it needs. We'll find internal and external evidence for those processes, and give a number of reasons why Consonant Theory is better than Vowel Theory. Section 4 is like section 3 but for Vowel Theory: rules, motivations and arguments. After we've seen both theories, we'll start comparing them. Section 5 gives counterarguments to what we saw in section 3, and reduces the motivation for believing in Consonant Theory. Section 6 is full of new evidence, including minimal pairs for vowel length. The point of the section is to show that when we look at the theories' main predictions, Vowel Theory comes out on top. We'll end with a conclusion in section 7.

2 Basic Facts

This section introduces the basic facts about the phones found in surface forms of SCSw. and the different ways of analysing them. We won't need to know every single allophone of every single phoneme, and I won't mention allophony that won't be relevant later on. With this said, let's look at the Swedish vowels. In the table below, you can see the 17 main vowel allophones of SCSw., along with their underlying forms according to Vowel Theory. What I (and all other phonologists working on Swedish) call ”long vowels” are partially or fully diphthongised in the surface form, as the transcriptions show (see also Eklund and Traunmüller 1997 and the references in R: 41). The exact quality of the offglides of these diphthongs is irrelevant for us here. I've transcribed them as realised in my idiolect.

(3) The vowels

UR (Vowel Theory)	SR	Translation
/ˈsiːl/	[ˈsiːjl]	sieve
/ˈsɪl/	[ˈsɪlː]	herring
/ˈsyːl/	[ˈsyːjl]	awl, needle
/ˈsʏl/	[ˈsʏlː]	sleeper (part of railway)
/ˈbeːt/	[ˈbeːətʰ]	bit, preterite of bite
/ˈbe̞t/	[ˈbe̞tʰː]	bite, noun
/ˈløːs/	[ˈløːəs]	loose
/ˈlø̞s/	[ˈlø̞sː]	lice
/ˈɧɛːl/	[ˈɧɛːəl]	reason, noun
/ˈɧe̞l/	[ˈɧe̞lː][3]	bark!
/ˈmɑːt/	[ˈmɑːətʰ]	food
/ˈmat/	[ˈmatʰː]	matte
/ˈmoːl/	[ˈmoːəl]	goal
/ˈmɔl/	[ˈmɔlː]	minor (music)
/ˈruːt/	[ˈruːβtʰ]	root
/ˈrʊ-t/	[ˈrʊtʰː]	rowed, active past participle[4]
/ˈfʉːl/	[ˈfʉːβl]	ugly
/ˈfɵl/	[ˈfɵlː]	full

It'll be useful for us to talk about these 17 vowels as 9 long-short pairs in many places, and to talk about /iː/ as the long vowel counterpart of /ɪ/, for example. If Vowel Theory is correct, as I'll be arguing, these 17 vowel qualities correspond to 17 vowel phonemes, leaving SCSw. with the following 18 consonant phonemes: /p, t, k, b, d, g, f, v, s, ʂ, ɧ, h, m, n, ŋ, l, r, j/.[5] Consonant Theory instead proposes nine vowel phonemes (one for each of the nine pairs above). Riad (2014) writes them with the quality of the long vowel: /i, y, e, ø, ɛ, ɑ, o, u, ʉ/ (R: 17), and I'll use the same symbols when writing underlying forms in Consonant Theory. Since Riad believes in consonant length, he's left with 34 consonant phonemes (R: 45). 34 isn't a typo for 36. The two consonants /ɧ, h/ never occur in codas, so their long counterparts *[ɧː] and *[hː]

3 This vowel is the same as in [ˈbe̞tʰː] 'bite' in SCSw. I've included it here to show that SCSw. is one of the varieties of Swedish merging the short vowel counterparts of /eː/ and /ɛː/. More on that in section 5.

4 /ʊ/ is quite a rare vowel, which is why, even as a native speaker, I haven't been able to find a monomorphemic minimal pair for it and /uː/.

5 /ɧ/ is the phoneme in /ˈɧɔk/ 'shock', and /ʂ/ the one in /ˈʂɔk/ 'thick, fat'. In my variety of SCSw., there isn't a contrast between /ʂ/ and /ɕ/, so the first sound of 'thick, fat' is the same as the sound at the end of /ˈdɵʂ/ 'shower'. See R: chapter 3.

don't exist in SCSw. (R: 45).[6] The word for 'sieve' would be /ˈsil/ according to Riad, and 'herring' would be /ˈsilː/.[7] Eliasson (1985) instead favours Consonant Theory with gemination, leading to the same nine vowel phonemes as in Riad's theory, and the same 18 consonant phonemes as in Vowel Theory. For Eliasson, 'sieve' is /ˈsil/, while 'herring' is /ˈsill/.

Before we move on to detailed phonological analyses, let's talk about a few phonological processes which both Vowel and Consonant Theory need. This is so that we won't have to repeat the processes and the data motivating them in the separate sections on Consonant Theory (section 3) and Vowel Theory (section 4). All processes will be given a name in **bold**, a prose description, and a formalisation in Rule-Based Phonology.

The first process common to both Vowel and Consonant Theory is **C short**, a process of unstressed consonant shortening. The motivation comes from words like the one given below (taken from R: 179). The superscript ^{2} is the so-called second pitch accent (see e.g. R: 181-191 for a phonological analysis, and references therein). I've included pitch accent in phonemic transcriptions not as a statement about underlying forms, but because the pitch accent won't concern us in this article. The same goes for stress marks.

(4) Motivating **C short**

UR (Vowel Theory)	SR	Translation
/^{2}ˈkrʏst-ad-t/	[^{2}ˈk^{h}rʏsːtat^{h}]	strained/contrived, neut. pass. past part.

An assimilation rule that we won't talk about gives an intermediate form ending in tt: ^{2}ˈkrʏst-ad-t → ^{2}ˈkrʏstatt. This is then shortened by **C short** because the syllable that the tt cluster is in is unstressed. So in prose, **C short** is: ”Shorten a consonant in an unstressed syllable.” Formally, it's: $C_i \rightarrow \emptyset \,/\, C_i\_$ when unstressed.

Next, we'll look at another consonant shortening rule, which I'll call **Shortening after Consonants**, or **SAC** for short. In prose, it's: “Shorten a consonant after another consonant.” Formally, it's: $C_i \rightarrow \emptyset \,/\, C\_C_i$ Here's an example, illustrated using the underlying form of Vowel Theory:

(5) Motivating **SAC**

UR (Vowel Theory)	SR	Translation
/ˈvẹnd-d/	[ˈvẹnːd][8]	turned, common gender passive past participle

The steps of the derivation are: vẹnd-d → vẹnd (**SAC**) → [ˈvẹnːd] (other theory-dependent rules, see sections 3 and 4). **SAC**'s missing from the description of Swedish found in Eliasson and LaPelle (1973), and I'm not entirely sure why. Since 'turned' doesn't surface with a long *[dː], some rule like **SAC** is clearly needed.

A final point I want to make has to do with the quantity rules we'll see in the next section. In both theories, quantity rules will make reference to stressed syllables. At least in my interpretation, a stressed syllable does *not* refer to the most prominent syllable in the

6 Actually, [ɧː] appears in a handful of borrowed names, like [ˈaɧːmẹd] 'Ahmed', so we might want to make this 35 instead of 34.

7 Riad actually uses a superscript Greek letter µ (for mora) instead of the IPA length diacritic, so 'herring' is /ˈsil$^{\mu}$/ in his notation (R: 45). He points out (p.c.) that he interprets the consonant system as having eighteen units, with a general quantity contrast, rather than 34 separate phonemes. This won't be relevant to us here.

8 The first consonant in CC clusters is sometimes written as half-long. For example, Eliasson (1982) uses the feature [half-long]. Some even write it as fully short (Löfstedt 2010: 12 and Witting 1977: 31). Witting and Löfstedt both cite Kloster-Jensen (1962), but that study only looks at Norwegian in the relevant ways. I follow Riad (R: 167, fn. 8), and assume that these consonants are long in the surface form, even if they may be shorter in the bodily output. For the distinction between surface form and bodily output, see e.g. Hale and Reiss (2008: 83).

word. Rather, these statements are meant to hold for a lower level of the prosodic hierarchy. Following Itô and Mester (2012), Riad calls this the minimal prosodic word (see R, ch. 5). This means that lengthening under primary stress can take place more than once per (phonological) word. This is the case with compounds, for example. Different prosodic word structure can give rise to surface minimal pairs for both vowel and consonant length (the vowel example is from R: 137):

(6) Prosodically conditioned minimal pairs

a) Consonants

Prosodic structure	UR (Vowel Theory)	SR	Translation
One prosodic word:	/^{2}ˈsløːs-ɪg/	[^{2}ˈsløːsɪg]	wasteful
Two prosodic words:	/^{2}ˈsløː-ˌsɪg/	[^{2}ˈsløːˌsɪgː]	lazy + cigarettes (perhaps 'cigarettes smoked when lazy')

b) Vowels

Prosodic structure	UR (Vowel Theory)	SR	Translation
One prosodic word:	/^{2}ˈtɪlt-a/	[^{2}ˈtʰɪlːta]	to tilt
Two prosodic words:	/^{2}ˈtɪl-ˌtɑː/	[^{2}ˈtʰɪlːˌtʰɑː]	to increase, intrans.

These aren't true minimal pairs, since the difference in length is caused by a prosodic difference. So for a), we don't need an underlying difference between /g/ and /gg/ to explain the surface contrast [g] vs [gː]. But it's worth remembering that the difference really is prosodic, and not morphological. We can find single-morpheme words which still have two long segments and two prosodic words, e.g. [^{2}ˈɪŋːe̞ˌfɛːra] 'ginger' and [^{2}ˈɑːˌɭanːda][9] 'Arlanda, place name.'[10] Notice that quantity isn't the only trace of prosodic word structure. Compare the aspiration in [^{2}ˈtʰɪlː**t**a] 'to tilt' and [^{2}ˈtʰɪlːˌ**tʰ**ɑː] 'to increase.' Differences in prosodic word structure won't play a large role in this article, but it's important to know how the word 'stressed' is interpreted, and that the minimal pairs illustrated above are different from the true minimal pairs in section 6.

We've now seen the basic facts about length in Swedish. There are 17 main vowel qualities, and 18 main consonant qualities. We've also noted two phonological processes common to both theories. In section 3, we'll begin to explore the formal sides of Consonant Theory. What phonological processes does it need, and how well-motivated are they?

3 Consonant Theory

In this section, we'll see that Consonant Theory needs two rules to account for the distribution of quantity, other than the ones introduced in the previous section. These remaining rules are **C_2 length** and **V length**. The latter rule covers four environments in which vowels lengthen, but I include it here as a single rule. When we see functionally similar processes, it's essentially an empirical question whether or not they're linked *formally*. Some criteria for thinking that rules are related are given in Kiparsky (1982: 112). These criteria include processes showing parallel developments in diachronic change, identical sets of lexical

9 Because the retroflex [ɭ] comes from underlying /rl/, I can't syllabify the surface form of words like these (including, among others, my last name). There's no reason for placing the secondary stress mark before the [ɭ] instead of after it. For more reading on retroflexes in SCSw., see Riad (R: ch. 4) and references therein.

10 Some might analyse this as having two morphemes, since the sequence /landa/ occurs in other names. But obviously the place that a name refers to isn't semantically built up from the meaning of any morphemes inside the name. So place names have to be stored wholes.

exceptions etc. Unfortunately, I don't know of any data allowing us to test these predictions. I'll talk about **V length** as if it were a single rule, acknowledging that there's no evidence for this. But let's begin with **C_2 length**.

3.1 C_2 Length

C_2 length lengthens consonants in certain clusters. In prose, it can be stated as: ”In a stressed syllable, lengthen the first of two or more consonants within a morpheme.” I'll write that formally as: $\emptyset \rightarrow C_i$ / V_C_i within a morpheme. The motivation for this rule is that consonant length is predictable in this environment. So there are words like [ˈmjø̞lːkʰ] 'milk' (underlyingly /ˈmjølk/ in Consonant Theory), but single morphemes of the type *[ˈmjøːlkʰ] ”are ungrammatical” (Löfstedt 2010: 49).[11] And if something's predictable, the argument goes, it's better to derive it by rule than to store it as a separate fact about each individual word. **C_2 length** applies to words like those in (7) a). It doesn't apply to the words in (7) b) since they've got a morpheme boundary within the cluster.

(7) Motivating **C_2 length**

UR (Consonant Theory)	SR	Translation
a) When it does apply		
/ˈfest/	[ˈfe̞sːtʰ]	party, noun
/ˈmjølk/	[ˈmjø̞lːkʰ]	milk
b) And when it doesn't		
/ˈkɑl-t/	[ˈkʰɑːltʰ]	bare, neuter; cf. [ˈkʰɑːl] 'bare, common'
/ˈsul-s/	[ˈsuːls]	sun, possessive; cf. [ˈsuːl] 'sun'

3.2 V length

The second and last rule we need to discuss is the most complicated one, **V length**. As I've already said, there's vowel lengthening in a number of different contexts. In the literature, there have been several proposals for how to formalise **V length**, including Teleman (1969) and Eliasson and LaPelle (1973). But both of these analyses make incorrect predictions. The problem lies in separating words like /ˈvit-t/ 'white, neuter' (which surface with a short vowel) from words like /²ˈmut-ˌtɑ/ 'to receive' (which surface with a long vowel). It's true that these linguists don't explicitly discuss what happens when you've got more than one minimal prosodic word, as in /²ˈmut-ˌtɑ/ 'to receive'. But their analysis with single prosodic words fails to extend to these cases. The problem is that both types of words have the sequence /t-t/, so the rules proposed by these linguists incorrectly give a short vowel in both of them. Some might also say that we should look for new anlayses for theoretical reasons. Both Teleman's and Eliasson and LaPelle's analyses involve Duke of York derivations (Eliasson and LaPelle 1973: 144). These derivations have the general form A → B → A, meaning a segment gets changed into something else only to get changed back into its underlying form later (Pullum 1976). For example, Teleman has 'white, neuter' start out with a short vowel, which then lengthens only to get shortened again.

Because of these issues with earlier analyses, I propose a new one here. It's quite convoluted, but at least it's empirically adequate. It goes without saying that any analysis which can't explain all Swedish words isn't the analysis that native speakers use. If a

11 Actually, there are many words of this form. They're typically treated as exceptions in Consonant Theory, and we'll discuss them more in section 6.

complicated analysis is the only one which explains everything, then it's preferable to others, even if it isn't neat or economical (see Boeckx, Hornstein and Nunes 2010: 2 for a different opinion). Now we're ready to take a look at **V length**. In prose, it's: ”Vowels lengthen under primary stress a) in open syllables b) before an optional consonant C_i, and an optional sequence of a morpheme boundary and a different consonant C_j, c) before an optional consonant at the end of a prosodically minimal word ω^{min}, d) before sequences of /r/ and a coronal consonant.” Here's how you might write those four lengthenings formally:

(8) **V length**, the rules
a) V → Vː / ˈ_.
b) V → Vː / ˈ_(C_i)(-C_j)
c) V → Vː / ˈ_(C)$]_{\omega\text{-min}}$
d) V → Vː / ˈ_r[+coronal, +consonant]

These four rules give lengthening in i) open syllables (9) a), ii) before a single word-final consonant (9) b), but not before geminate consonants (9) c) or before consonant clusters within a morpheme (9) d), iii) before an optional consonant, a morpheme boundary and a different consonant (9) e), but not before identical consonants split by a morpheme boundary (9) f), iv) before an optional consonant at the end of a phonological word, even if the following consonant is identical (9) g), and v) before /r/ followed by a coronal consonant (9) h).

(9) **V length** in action

UR (Consonant Theory)	SR	Translation
a) Open syllables		
/ˈse/	[ˈseː]	to see
/ˈpeter/	[ˈpʰeːtɛ̯r]	Peter
b) Before single word-final consonants		
/ˈsil/	[ˈsiːl]	sieve
c) Not before geminate consonants		
/ˈsill/	[ˈsɪlː]	herring
d) Not before consonant clusters within a morpheme		
/ˈmjølk/	[ˈmjø̞lːkʰ]	milk
e) Before an optional consonant, a morpheme boundary and a different consonant		
/ˈse-s/	[ˈseːs]	see, passive
/ˈgʉl-t/	[ˈgʉːltʰ]	yellow, neuter
f) Not before a consonant, a morpheme boundary and the same consonant		
/ˈvit-t/	[ˈvɪtʰː]	white, neuter
g) At the end of a minimal prosodic word		
/²sil]$_{\omega\text{-min}}$-førˌstør-else/	[²siːlfø̞ʂˌʈøːrɛ̯lsɛ̯]	sieve destruction
/²sil]$_{\omega\text{-min}}$-ˌlɑgr-iŋ/	[²siːlˌ(l)ɑːgrɪŋ][12]	sieve storage

12 For the quantity of the [l] or [lː] here, see Elert (1964: 37-38) and Hellberg (1974: 86)

h) Before /r/ and a coronal consonant

/ˈvɛrd/	[ˈvɛːɖ]	world

Having seen what **V length** does and doesn't do, let's look at the motivation for it. Something like **V length** is obviously needed in Consonant Theory. Since long vowels aren't underlying, they have to come from a lengthening rule. But there's also evidence for **V length** in morphophonological alternations, second-language transfer and loanwords. We'll begin with the alternations, since they've been so important in Consonant Theoretic argumentation. For example, they're the sole topic of Eliasson (1985), and an important part of Riad (2014). The argument runs as follows: **V length** says that vowels lengthen in (some) stressed syllables. If we somehow move the stress around in a word, vowel length should follow. This is exactly what we see in what I call the 'critical' alternations (E: 116).

(10) The 'critical' alternations

UR (Consonant Theory)	SR	Translation
/kriˈt-ik/	[k^{h}rɪˈt^{h}iːk^{h}]	criticism
/ˈkrit-isk/	[ˈk^{h}riːtɪsk^{h}]	critical

In 'critical', the stressed root has a long vowel. But in 'criticism', the suffix /-ik/ attracts the stress, so that the base becomes unstressed. The stress shift is why the root vowel in 'criticism' is short, and why the suffix vowel is long. Since these alternations will come up again, I'll ask you to remember that this kind of joint stress-length movement is what “the 'critical' alternations” refers to. These alternations have been claimed to be difficult or even fatal for Vowel Theory, for the following reasons. In Vowel Theory, we could include a vowel lengthening rule to explain alternations like these. But that defeats the point of the theory, ”given that one manages to bring all the other cases of long vowels under the rule” (R: 171). Another alternative would be to set up the vowel of /krit/ as underlyingly long, with shortening in unstressed syllables. But there's no reason to think that it's long in the base form [k^{h}rɪˈt^{h}iːk^{h}] 'criticism', so it's unclear why learners would propose that analysis. The alternations are also ”fully productive” (E: 120), which can't be explained other than by a vowel lengthening rule. Eliasson also thinks they're so frequent that an account which doesn't feature vowel lengthening is implausible (E: 119-120 and Eliasson 2010: 14).[13] Eliasson also makes the argument that Vowel Theory ”tends to obscure the relation between vowel length and stress” (Eliasson 1978: 118). It treats long and short vowel pairs as completely separate phonological units, even though they show a close interaction in the 'critical' alternations (see also Eliasson 1985: 119 and Eliasson and LaPelle 1973: 135).

Another argument for **V length** is that it applies in loanwords. Löfstedt (1992: 95) mentions [p^{h}aˈniːk^{h}] 'panic' (rather than *[p^{h}aˈnɪk^{h}ː]) from French [paˈnik]. This example isn't ideal, because the French tense vowel quality [i] might cause people to prefer the tense vowel [iː] over a form with the lax vowel [ɪ]. In other words, people might prioritise accurate quality over accurate quantity. But Löfstedt's point still stands, because other French loanwords show lengthening even when there's a mismatch in quality. We have [p^{h}aˈrɑːd] 'parade' from French [paˈʁad], even though *[p^{h}aˈradː] would match the French vowel quality better. A final argument for **V length** is Eliasson's (1982) report on unpublished work by Karlsson (1977). Karlsson found that when given a Finnish CVCV word, like [ˈtuli] 'fire', his students tended to

13 I've never seen the argument that children don't set up phonological rules which would have to apply very often. Eliasson doesn't give any evidence for why that would be true. The proposal seems to be immediately falsified by languages with vowel harmony.

lengthen the vowel – ['tʰuːlɪ] – as predicted by **V length** (Eliasson 1982: 189-190).

3.3 More arguments for Consonant Theory

Let's look at some more arguments for Consonant Theory, before moving on to Vowel Theory in the next section. The first argument has to do with morphophonology. Some long consonants come from sequences of two identical consonants. So /'vit/ 'white', when suffixed with neuter /t/, surfaces with a long [tʰː]. So we should assume that all long consonants are in fact clusters of identical consonants underlyingly. This simplifies our morphophonological descriptions, since long consonants both within and across stems have the same underlying source. This argument is found in many places in the literature, including Elert (1964: 40), Elert (1970: 55), Eliasson (1978: 113), Eliasson (E: 118), Eliasson (2010: 11) and Eliasson and LaPelle (1973: 137).

Typological arguments also seem to favour Consonant Theory. It's been pointed out that Vowel Theory requires 17 vowel phonemes for SCSw., a number so high that it's ”dubious from the perspective of a universal phonological theory” (Eliasson and LaPelle 1973: 133, my translation; see also Elert 1964: 42-43 and Eliasson 1985: 105-107). Eliasson has also argued for Consonant Theory on the basis of phonotactics (Eliasson 1978: 113, E: 118 and Eliasson and LaPelle 1973: 138). Look at table (11):

(11) Vowel Theory phonotactics

First C / Second C	s	k
s	-	/'fɪsk/ 'fish, noun'
k	/'fɪks/ 'fix, noun'	-

This table shows some attested and unattested clusters in Swedish according to Vowel Theory. Notice that /s/ and /k/ can be both the first and the second consonant in a word-final cluster. Morphemes like /'fɪss/ or /'fɪkk/ don't violate this pattern. /s/ is allowed in the first position, and in the second position, and /fɪss/ is perfectly consistent with that. But in Vowel Theory, there aren't any morphemes like /'fɪss/. They only exist in Consonant Theory, where consonant length is represented underlyingly. So Consonant Theory fills an otherwise unexplained phonotactic gap in Swedish.

Eliasson also points out that long consonants are syllabified in the same way as consonant clusters (Eliasson 1978: 113-114, E: 118 and Eliasson 2010: 11). This gives further justification to a theory where both clusters and geminates are represented as clusters underlyingly. Vowel Theory also stores predictable information – vowel length – in the lexicon, which is undesirable (Eliasson 1978: 118 and Eliasson 2010: 14). And the absence of minimal pairs for vowel length ”ought, of course, to be totally devastating” to Vowel Theory (E: 108). Note also that vowel length is oddly distributed if Vowel Theory is correct. For example, why are all vowels in stressed open syllables long? Why are all vowels before consonant clusters within the same morpheme short? Why are all unstressed vowels short? These facts follow from the contexts in which **V length** does and does not apply, but have to be stipulated in Vowel Theory (E: 114-115).

We'll end this section with the most persuasive argument for Consonant Theory that I'm aware of. It isn't applicable to Eliasson and LaPelle's (1973) or Riad's (2014) version of Consonant Theory, so it's hard to find this argument in the literature. And while there are linguists who have pointed out the facts I'm about to show you, I don't think anyone's used them as an argument for Consonant Theory over other options. The argument is that there's a contrast between a morpheme /t/ and a morpheme /tt/. This can't be expressed in theories without consonant length, like Vowel Theory. Let's start with /t/. The morpheme /t/ is the definite suffix for neuter nouns. The surface form varies between [ẹtʰ] and [tʰ], both within and across speakers (Riad 2003), but I think all speakers agree on these judgements:

(12) Definite knees

	UR (Consonant Theory)	SR	Translation
Non-definite form:	/ˈknɛ/	[ˈkʰnɛː]	knee
Definite form with correct suffix /t/:	/ˈknɛ-t/	[ˈkʰnɛːtʰ]	the knee
Definite form with incorrect suffix /tt/:	*/ˈknɛ-tt/	*[ˈkʰnẹtʰː]	intended: the knee

So the definite neuter suffix is a single /t/. Next we'll look at the neuter suffix for adjectives, which is /tt/ (for more suffixes which pattern this way, see R: 174). To prove its quantity, we'll do the same thing as in (12), but for the adjective 'new'. I'm not aware of any variation whatsoever for the quantity of this suffix.

(13) 'new' evidence

	UR (Consonant Theory)	SR	Translation
Common gender form:	/ˈny/	[ˈnyː]	new
Neuter form with correct suffix /tt/:	/ˈny-tt/	[ˈnʏtʰː]	new, neuter
Neuter form with incorrect suffix /t/:	*/ˈny-t/	*[ˈnyːtʰ]	intended: new, neuter

So the neuter adjective suffix is /tt/, not /t/. Now we've seen one suffix /t/ and another /tt/. In Vowel Theory, there's no way to express this contrast, because there aren't any geminate consonants within a morpheme. The quantity contrast in the suffix can only be expressed in Consonant Theory, so this is a very strong argument for believing in that view of Swedish quantity.

We've now seen the quantity rules that I propose for Consonant Theory, both of which are found in the existing literature already. While the motivation for **C_2 length** is purely language-internal, I've also given some external evidence in favour of Consonant Theory. And there's a large number of arguments in favour of underlying consonant length in Swedish. Now it's time to turn to Vowel Theory, to see if there's any hope left for it.

4 Vowel Theory

This section looks at the theory I believe in: Vowel Theory. I'll introduce the three rules I think are necessary, and motivation for them. All of the rules will be backed up by external evidence. We'll also see plenty of counterarguments against the ideas from the previous section. At the end of the section, we'll have a clear picture of both theories, and we'll be ready to start comparing them in more detail.

Samuel Andersson
Christ's College, Cambridge, 2016

4.1 C length

The first rule we'll look at is **C length**, which is the Vowel Theory equivalent of Consonant Theory's **V length**. **V length** was meant to explain where all long vowels came from, and my **C length** is meant to explain where all long consonants come from. Since I believe that vowel length is underlying, a prose description of **C length** becomes incredibly simple: “Lengthen a consonant after a short stressed vowel”. This looks like quite the improvement, simplicity-wise, over the four-environment rule **V length**. But there's one complication. What if the short stressed vowel is already followed by two consonants? This situation arises across morpheme boundaries, and the two consonants are never lengthened to overlong:

(14) Nothing is longer than long

UR (Vowel Theory)	SR	Translation
/ˈlḛt/	[ˈlḛtʰː]	easy
/ˈlḛt-t/	[ˈlḛtʰː], *[ˈlḛtʰːː]	easy, neuter

There are two possible analyses here. We could say that in /'lḛt-t/, we first get an intermediate form 'lḛtːt by **C length**. We'd then need a new rule to shorten that to tː. This would be a Duke of York derivation, where a short consonant becomes long only to shorten again. A Duke of York derivation is found in some analyses of Swedish (see section 3.2 and Eliasson and LaPelle 1973: 144). But that's not the option I'll go for. Instead, I'm going to restrict **C length** so that it doesn't apply in these contexts. In prose, **C length** then becomes ”Insert a consonant after a short stressed vowel and anything but that consonant.” How do we formalise that in Rule-Based Phonology? Well, the feature algebra of Reiss (2003) is a great solution. In this formalism, you can easily express the idea that two segments have to be different, no matter what features they share or don't share. But while I do believe in feature algebra, I'll use a simpler notation here. C_i and C_j are [+cons] segments which have different specifications for some feature. My suggestion is that we can also have C_i and X_j, where X_j differs from C_i in some feature, which may itself be [cons]. So X_j means effectively ”any *segment* but C_i” just as C_j means ”any *consonant* but C_i”. The entire rule is now: Ø → C_i / 'V_C_i(X_j)

The motivation for **C length** should be obvious. It's simply where all long consonants in Swedish come from. (15) gives a few examples of cases where **C length** applies:

(15) **C length**

UR (Vowel Theory)	SR	Translation
/ˈsɪl/	[ˈsɪlː]	herring
/ˈfḛst/	[ˈfḛsːtʰ]	party, noun
/a'tak/	[a'tʰakʰː]	attack, noun

According to the transcriptions in Riad (2015: 228), which match my intuitions, **C length** is also productive under so-called corrective focus. This is found in utterances of the type: “No I said X, not Y”, where X and Y are given extra stress to emphasise how they differ from each other. For example, take the words [pʰrʊ'sḛnːtʰ] 'percent' and [pʰrḛ'sḛnːtʰ] 'present'. Under corrective focus, we'd get: “No, I said ['pʰrʊsːˌḛnːtʰ], not ['pʰrḛsːˌḛnːtʰ]”. The /s/ lengthens automatically when the extra stress is added. Applying vowel lengthening here, as **V length** would appear to predict, is ungrammatical: *['pʰruːsˌḛnːtʰ], *['pʰreːsˌḛnːtʰ].

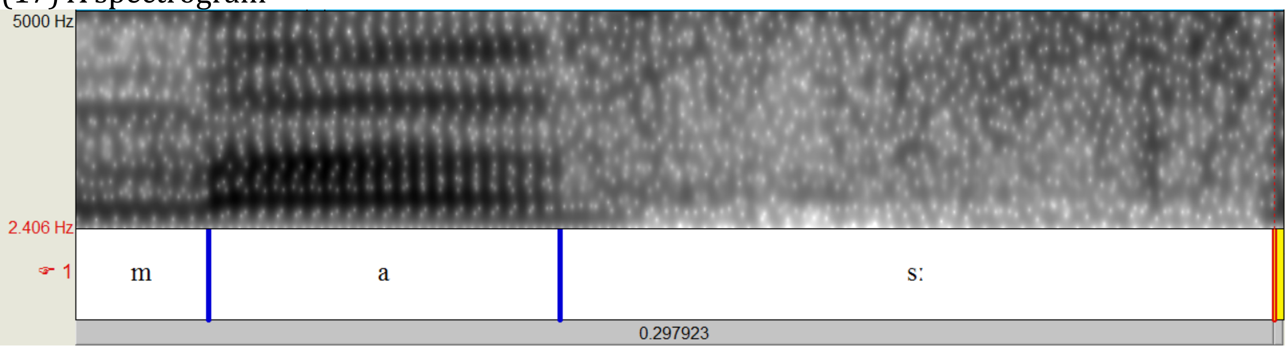
C length can also be used to explain alternations in morphologically related forms. We'll see two examples of this, beginning with new evidence which looks impossible to account for using Consonant Theory. So this new evidence will favour both **C length** and Vowel Theory in general. The data here come from Johanna Frändén, a football commentator during the European Championships in 2016. Before the championships, a player called Karim Benzema was suspended from the French team. His last name, [bɛnzɛ'ma] in French, was nativised by Frändén as [be̞nse̞'ma]. This name joins the group of small words in Swedish ending in a short stressed vowel, something we'll return to in section 6. But what's of interest to us is Frändén's use of the possessive form of the name. The possessive clitic in Swedish is a singleton /s/ in both Vowel and Consonant Theory. Crucially, it can't be a geminate in Consonant Theory, as shown below:

(16) Posesives

	UR (Consonant Theory)		SR	Translation
Base form:	/te/		['tʰeː]	tea
Correct possessive with singleton /s/:	/te-s/		['tʰeːs]	tea, possessive
Incorrect possessive with geminate /ss/:	/te-ss/	*['tʰe̞sː]	Intended: tea, possessive	

So in Consonant Theory, we'd have the possessive /bense'ma-s/, which should give *[be̞nse̞ 'mɑːs].[14] And yet, Frändén's possessive of [be̞nse̞'ma] was [be̞nse̞'masː] with a geminate [sː]. Looking at a spectrogram of the word makes it clear beyond any doubt that we have a short vowel followed by a long consonant:

(17) A spectrogram



In Vowel Theory, the variation between [s] and [sː] in this suffix is accounted for straightforwardly. When the stem ends in a long vowel, like /'teː/ 'tea', the underlying /s/is a short [s]. When the stem ends in a short vowel, like /be̞nse̞'ma/, the same /s/ turns to long [sː] by **C length**. In Consonant Theory, we would have to say that there are two allomorphs /s/ and /ss/. But how would a child learn that? None of the few words of this phonotactic shape are nouns, so it's incredibly unlikely that any child has ever heard them with a possessive suffix. So the data leading a Consonant Theory child to set up an allomorph /ss/ probably doesn't exist in the input. For this reason, Frändén's pronunciations are good evidence for the Vowel Theory explanation, where the [sː] arises automatically by the phonological rule **C length**.

I'd also like to mention some comments from a survey of 200 speakers of SCSw. The single question I asked was: “How do the pronunciations of ['siːl] and ['sɪlː] differ?”. With 176 out of 200 people saying the difference was in the vowel, you might think that's good evidence

14 Or, more likely, *[be̞nse̞ˈmaːs], with the long central vowel found in some loanwords in Swedish.

for Vowel Theory too. But actually, their answers could've been influenced by all sorts of things. Vowel length differences are bigger than consonant length ones (Linell 1978: 127-128), and the Swedish education system uses the terms long and short vowel, for example. So we'll ignore the survey, and focus instead on some of the quite revealing comments people gave.

(18) Some comments
a) During survey
”There's a difference in the vowel. ['siːl] starts with ['siː], but ['sɪlː] starts with ['sɪ]”
b) After survey, in response to my remark: “Some linguists think the difference is in the *l*.”
”Oh, I'd never thought of that, that the pronunciation of the *l* might be different.”
”What?! But it's obviously in the [iː]!”
c) After being told that there really is a difference in the [l]
”What?! But you can't *hear* that!”

In a), we see that this speaker was able to isolate out the vowel length, removing the consonant entirely. From a Consonant Theory perspective, why would you get rid of the phonemic difference between the words when illustrating how they differ? Especially since forms like ['sɪ] are thought to be ungrammatical (but see section 6).

But the b) and c) answers are even more interesting. In Consonant Theory, there's a difference in the *l*s of these words at every level of representation: underlying, every intermediate form, the surface form, the bodily output, the spelling etc. In ['siːl] vs ['sɪlː], the contrast between single and geminate *l* is always present. So if people are thinking about whether that contrast exists, then no matter what level of representation they look at, they should find it.

But the actual answers are very different from these predictions. People claim it's never occurred to them that the consonants might be different, and can't understand why linguists would say that. And in c), we see someone claiming that this contrast is impossible to hear, even when told that it does actually exist. Now, if consonant length is represented everywhere from underlying form to surface form to spelling, how come native speakers say they can't hear it? Can you think of any situation in any language where speakers can't detect a phonemic difference that's found in the spelling and that doesn't get neutralised?[15, 16]

Instead, the comments in (18) seem to reflect native speakers' general surprise when they're told about allophones in their language. English speakers are surprised to find out that English has aspirated and unaspirated stops, or clear and dark *l*s, for example. And we see that exact same surprise with Swedish consonant length. Now we have to admit that there are speakers which can hear a difference in consonant length (Anders Holmberg, p.c.). But this isn't a problem for Vowel Theory, since those speakers might be looking at the surface form, or the spelling. So unlike Consonant Theory, Vowel Theory can explain both those who can hear the difference, and those who can't.

C length also makes correct predictions about the language game *rövarspråket*. After every consonant, you insert the vowel /ɔ/ and a copy of the consonant. In my variety of *rövarspråket*, stress can fall on any of the /ɔ/ vowels. As we shift the stress from one /ɔ/ vowel

15 This argument is just as true of Consonant Theory as it is of theories where both kinds of length are represented underlyingly. These comments are the reason that I'm not considering such redundant solutions.

16 Riad (p.c.) suggests [ˈdɵʂː] 'shower' and [ˈkʰɵʂː] 'course', if the underlying forms are /ˈdɵʂ/ and /ˈkɵrs/. But the reason speakers can't detect the phonemic ʂ-rs difference is because it's neutralised (R: 61). In the surface form, there's no difference there to detect! But the [l]-[lː] distinction doesn't get neutralised in stressed syllables, which is why it's so surprising that people can't hear it.

to another, **C length** automatically lengthens the consonant after the stressed vowel:

(19) *Rövarspråket*/[rɔrø̝vɔva^{2}ˈrɔrːsɔspɔprɔrɔkɔke̝ˌtʰɔtʰː]

a) 'glass' in Swedish

UR	SR	Translation
/ˈglɑːs/	[ˈglɑːs]	glass

b) 'glass' in rövarspråket

Stress	SR
Initial	[^{2}ˈgɔgːlɔlaˌsɔsː]
Medial	[gɔg^{2}ˈlɔlːaˌsɔsː]
Final	[gɔglɔlaˈsɔsː]

So the external evidence from *rövarspråket* matches **C length's** predictions perfectly, with lengthening after every short stressed vowel. But it's important to point out that Consonant Theory can also explain this. A Consonant Theorist would say that the game is played by inserting the vowel /o/ and a geminate copy of every consonant. The underlying form of 'glass' would be /gogglollasoss/. Whichever /o/ vowel is stressed, it'll have a long consonant after it, and all the unstressed geminates will shorten by **C short**.[17] So the *rövarspråket* forms are one of Vowel Theory's correct predictions, not one of Consonant Theory's incorrect ones.

The same kinds of stress shift as we've just seen also exist in morphologically related Swedish words. In (15) above, we saw that the noun 'attack' is [aˈtʰakʰː]. The verb 'attack' is formed with the stress-attracting verbal suffix /eːr/, followed by the ending /a/ (which functions as the infinitive ending, the imperative ending, and the theme vowel). This gives [ata ˈkʰeːra] 'to attack/attack!'. Notice that the verb has a short [kʰ] while the noun has a long [kʰː]. My explanation is **C length**. In the noun, that underlying /k/ follows a short stressed vowel, so it's lengthened by **C length**. But in the verb, the suffix bears the stress, and the /k/ is no longer in a position where **C length** can apply. Here's a quick summary of this:

(20) 'Attack!'

/aˈtak/	[aˈtʰakʰː]	attack, noun
/ataˈk-eːr-a/	[ataˈkʰeːra]	attack, verb

If you've been reading very attentively, you might've noticed that this kind of alternation looks very similar to the 'critical' alternations in section 3.2. The 'critical' alternations showed vowel length moving with stress, and were used as an argument for Consonant Theory. But now we see there's consonant length moving with stress too! Surely we could use this as an argument for Vowel Theory in exactly the same way. The end result would be that some alternations favour Vowel Theory, and others Consonant Theory. No one really wins the battle of quantity and stress movement.

But as we've seen, Consonant Theorists have placed a lot of importance on the 'critical' alternations. This is puzzling to me, since we've just seen that no theory has the upper hand. It's even more puzzling since both Eliasson (1985) and Riad (2014) cite both kinds of alternations. Eliasson has even noticed that 'attack'-type alternations are problematic, and says that this “may at first seem like a drawback” (E: 112). Even so, Eliasson's article criticises Vowel Theory for an analysis which is identical to his own, only that it targets vowels instead

17 This explanation would presumably be ruled out by Eliasson, who's argued against phonological solutions where rules would have to apply very often, like **C short** would in this word. But as we said in footnote 13, that's not a very good argument to begin with.

of consonants.[18] There isn't a word in Eliasson (1985) about how the identical problems for his own theory might be solved.

Before moving on to our next rule, I'd like to spend some more time on the 'critical' alternations, and argue that they actually tell us nothing about Swedish phonology. My argument is this: The 'critical' alternations are also found in German and English, and these languages lack both long consonants and vowel-lengthening rules like **V length**. So because of languages like these, the existence of 'critical' alternations in Swedish aren't good enough evidence for long consonants and **V length**. Some German and English data are given here:

(21) Meanwhile in Europe

SR	Translation
a) Standard German (see also Wiese 2000: 287-296)	
['kʰanada]	Canada
[kʰaˈnaːdɪʃ]	Canadian
b) Standard Southern British English	
['kʰænədə]	Canada
[kʰəˈneɪdiən]	Canadian

Both German and English lack long consonants within morphemes, and both languages have minimal pairs for vowel length/quality, without any differences in the following consonant. For German, we have ['ʃtiːl] 'handle' and ['ʃtɪl] 'quiet' (see Wiese 2000: 11 for many more minimal pairs), and for English ['fiːɫ] 'feel' versus ['fɪɫ] 'fill.' Both languages also lack rules lengthening vowels in open syllables. German has ['ʃtɪlə] 'quiet (pl.)' and English ['fɪlɪŋ] 'filling.' The words for 'Canada' in both languages also show a lack of open-syllable lengthening. We don't have *['kʰaːnada] or *['kʰeɪnədə] And yet, both German and English show exactly the same kinds of quantity alternations as we see in Swedish. German in particular is strikingly similar to Swedish in the kinds of alternations we see, as Eliasson (2010) shows throughout. So clearly, it's possible for a language to have phonemic vowel length and show exactly the kinds of alternations we see in Swedish.

But Eliasson (2010) is committed to his 'critical' alternations in Swedish, and says that ”it may at least be contemplated” that the German long and short vowels are allophones of the same phoneme, with the (phonetically never present) consonant length being contrastive (Eliasson 2010: 44). I presume he'd argue the same thing for English. But Eliasson's arguments for this aren't good enough as evidence. The ambisyllabicity reported for German and English doesn't tell us we have geminates, because we know that ”ambisyllabic responses [in syllabification tasks – SA] /…/ are more frequent for the [b] of a word like *rabbit*, which is represented by an orthographic geminate, than the [b] of a word like *habit*, which is represented by an orthographic singleton” (Eddington, Treiman, & Elzinga 2013: 50; see also references therein). Eliasson doesn't exclude influence from spelling. He also doesn't exclude a templatic analysis of syllabification, where speakers attempt to fit as much material as possible into a syllable. For ['ʃtɪlə] 'quiet (pl.)', this would make the first syllable ['ʃtɪl] and the second ['lə], giving the impression of ambisyllabicity.

Eliasson's second argument is that by giving German geminates, we fill a phonotactic gap. In German (and English), consonants like /s/ can occupy both the first and second C position in VCC words (Eliasson 2010: 43). By setting up morphemes where it occupies both simultaneously, e.g. /Vss/, we're filling a gap which was previously unexplained. But the same phonotactic gap is found in languages like French too, as seen in ['bylb] 'bulb' and ['bibl]

18 But as we'll see in section 4.2, my analysis of the 'critical' alternations is morphological rather than phonological.

'Bible.' But we don't think this is enough evidence to say that French has geminate consonants. In other words, having this phonotactic gap isn't enough for learners to set up geminate consonants.

Finally, Eliasson cites German pronunciations in “deliberately slowed-down speech” (Eliasson 2010: 43) as evidence. This is clearly paralinguistic evidence, unless Eliasson thinks that the longer segments we find in slowed-down speech are due to a phonological rule specific to this register (e.g. iː → iːːːː / slow speech). Previously, he's rightly rejected paralinguistic evidence when it favoured Vowel Theory (Eliasson 2010: 10, footnote 4). If we're going to be methodologically consistent, we have to reject paralinguistic evidence everywhere, no matter what theory it favours.[19]

We started out by looking at some of the motivation for **C length**, and found both internal and external evidence in favour of the rule. Some of the new evidence I've presented seems to be very difficult to explain in Consonant Theory. We've also concluded that the 'critical' alternations aren't good enough evidence for Consonant Theory, as we argued in the previous section. And even if they had been, we've now seen the 'attack' alternations, which in that case would provide equally good evidence for Vowel Theory. I suggest that future research assigns a much more marginal role to these alternations when it comes to picking theories. We're now ready to move on to our next rule.

4.2 V short

Next in line is **V short**, which is probably the simplest rule we'll have to consider. In prose, it's: “Unstressed long vowels shorten.” Formally, that's: Vː → V in unstressed syllables. You might remember from section 3 that Eliasson (1985) proposed that this might be one way of dealing with the 'critical' alternations in Vowel Theory, as shown below:

(22) The 'critical' alternations revisited

Possible UR (Vowel Theory)	SR	Translation
/kriːˈt-iːk/	[kʰrɪˈtʰiːkʰ]	criticism
/ˈkriːt-ɪsk/	[ˈkʰriːtɪskʰ]	critical

The key is to suppose that the stem is /kriːt/ with a long /iː/, and not the short /ɪ/ which we see in the noun form. **V short** makes sure that the first underlying long vowel in 'criticism' surfaces as short, while the derived form shows the underlying long quantity of the stem vowel. But for a number of reasons, I actually prefer a non-phonological account of the data. Specifically, I propose a morphological lengthening before the /-ɪsk/ suffix, as well as in any other contexts that trigger this lengthening.

This helps us explain a number of otherwise surprising facts. First of all, there is at least one exception to the vowel lengthening. The /-ɪsk/ form of [gramaˈtʰiːkʰ] 'grammar' is [graˈmatːɪskʰ] 'grammatical' for many people, rather than *[graˈmɑːtɪskʰ].[20] Since Riad has a productive vowel lengthening rule, he has to say that this is simply an exception (R: 170, fn. 9). The same would be true for a phonological explanation under Vowel Theory, if forms like [kʰrɪ

19 It's also unclear to me what results of the experiment could have falsified Eliasson's view. His argument is that the consonants in [VːCV] and [VCV] words are different, because only the consonant in [VCV] words lengthened in slow speech. But consider the opposite result, where both consonants behave the same. Since some segment has to lengthen when speech is slowed down, both vowels would lengthen. And then Eliasson could've said that the vowels are behaving the same, and so they must represent the same phoneme. No result falsifies his idea.

20 While the form with consonant lengthening is prescriptively correct, there are certainly many people who use [graˈmɑːtɪskʰ], at least until told off by prescriptive authorities.

't^hiːk^h] 'criticism' are automatically assigned a stem with a long vowel, /kriːt/. Secondly, there are forms where the stem has consonant lengthening, but where the /-ɪsk/ form nevertheless shows vowel lengthening:

(23) Mozambique

SR	Translation
[mʊsamˈbɪk^{h}ː], *[mʊsamˈbiːk^h]	Mozambique
[mʊsamˈbiːkɪsk^h], ?[mʊsamˈbɪkːɪsk^h]	Mozambican

Forms like these suggest that we aren't dealing with phonological lengthening. Instead, people seem to lengthen the vowel before the /-ɪsk/ suffix by analogy with the many [ˈVːɪsk^h] forms that already exist. In 'Mozambican', we get lengthening even when the stem really has to have a short vowel. Consonant Theorists have also argued that the **V short** explanation is implausible for various reasons (see Eliasson 1985, passim, and R: 169-178). And so if they aren't prepared to entertain that option, they have to use morphological explanations to account for the similar kinds of lengthening we see in German and English (see section 4.1 above). And if they'll allow morphological explanations for those languages, they shouldn't be any less questionable when applied to Swedish.

So, given that these alternations don't actually require **V short**, what's the actual motivation for the rule? The answer is that some of these vowel length alternations really do seem to be phonological. They are productive in newly formed words, even outside of morphologically defined contexts like ”before /-ɪsk/”. Riad (R: 170) gives a particularly nice example of this:

(24) Melodies

UR (Vowel Theory)	SR	Translation
/mẹlʊˈdiː/	[mẹlʊˈdiː]	melody
/mɪlˈjøː/	[mɪlˈjøː]	environment
/mɪljøː-ˈdiː/	[mɪljø̣ˈdiː]	environmental melody

This word for 'environmental melody' is clearly a portmanteau of the words 'environment' and 'melody'. The long vowel in 'environment' has to be underlying, because there's no affix to trigger morphologically conditioned lengthening, and vowels don't lengthen in open stressed syllables.[21] And the short vowel in 'environmental melody' cannot be morphologically triggered either, because the learner of Swedish is never exposed to words in the environment of ”preceding a truncated part of the word for 'melody'”. This justifies a phonological rule of vowel shortening. It's an open question which suffixes are like /-ɪsk/ (morphological vowel lengthening), and which are like 'environmental melody' (phonological vowel shortening). I'll leave that question for future research.

We've actually already seen another bit of external evidence for **V short** in section 4.1. When we discussed the language game *rövarspråket*, we said that stress can fall on any of the inserted /ɔ/ vowels. This means that any non-inserted vowels, i.e. the ones that were part of the original Swedish word, are unstressed. So by **V short**, we'd predict that any long vowels in the original word should shorten, and that's exactly what we see. The word for 'glass' in *rövarspråket* is repeated here to illustrate this. The stress placement doesn't matter, so I've

21 This is a controversional claim, since most theories of Swedish do have stressed open syllable lengthening. But we've already seen the name [bẹnsẹˈma] 'Benzema', which doesn't show lengthening. And we'll argue that Swedish lacks lengthening in more detail in section 6.

given it initial stress:

(25) *Rövarspråket*, part 2
a) 'glass' in Swedish

UR	SR	Translation
/ˈglɑːs/	[ˈglɑːs]	glass

b) 'glass' in rövarspråket

UR	SR
/^{2}ˈgɔglɔlɑːˌsɔs/	[^{2}ˈgɔgːlɔlaˌsɔsː], *[^{2}ˈgɔgːlɔlɑːˌsɔsː]

Löfstedt, who believes in Consonant Theory, gives some more possible evidence for vowel shortening. Shortened long vowels, to the exclusion of normal short vowels, can have the quality of the long vowel (Löfstedt 1992: 116). Statements to this effect, or data showing it, are also cited in Eliasson (E: 109), Elert (1964: 18), Elert (1970: 66) and Riad (R: 201-203). We're talking here about words like 'grindery', which are roughly [slipȩˈriː], but never *[slɪpȩˈriː]. Notice the first vowel is different. But I don't think this is good evidence, because I think these vowels are still long. Phonetically, they often seem to appear as half-long, which is why some transcribe it with the IPA half-long diacritic (e.g. R: 202). At least in fast speech, they can be fully short, and when you speak slowly, they can be fully long. I take it that the surface forms always contain fully long vowels, which may be phonetically shortened due to performance factors, like speaking quickly. This gives the variable phonetic length which we see. So Löfstedt's proposal is interesting, but it doesn't provide evidence for **V short**, since **V short** doesn't apply.

It's worth fleshing this out in a bit more detail. The data are as follows: we have [ˌsliːpȩ ˈriː] 'grindery', never *[slɪpȩˈriː], but both [maˌɧiːnȩˈriː] and [maɧɪnȩˈriː] 'machinery.' The root 'machine' is lexically unstressed, /maɧiːn/, not /maˈɧiːn/ (R: 203[22]). Stress is optionally added to it before the suffix is added. If stress is added, we get [maˌɧiːnȩˈriː], with the stress protecting the vowel from **V short**. If stress isn't added, we get [maɧɪnȩˈriː], with the stem vowel undergoing **V short** because it's in an unstressed syllable. The root 'grind', on the other hand, is lexically stressed (R: 218), and is protected from **V short** because it never loses that stress.

Riad (2015: 86-87) thinks it's problematic that a word with two stresses isn't given second pitch accent. This is obligatory in compounds,[23] and seems to be the default when two stresses come together. But we know independently that there are other exceptions to this, in words like [ˈkʰreːaˌtʰiːv] 'creative' (see Riad 2015: 226-229). This word has two prosodic words in it, which we can see from the two long vowels and the two aspirated stops, *[ˈkʰreːa ˌtiːv]. Still, it doesn't get second pitch accent. I suggest that words with the suffix /ȩˈriː/ constitute a new class of exceptions to the rules of second pitch accent.[24]

Riad (p.c.) suggests a different analysis. What I transcribe as [ˌsliːpȩˈriː] 'grindery' (with two stresses and two long vowels), Riad would have with one stress and one long vowel: [sli(ˑ)pȩˈriː]. The first vowel is [i(ˑ)] rather than [ɪ], the normal outcome of /i/ in an unstressed syllable. The reason for this is the fact that the root 'grind' is lexically stressed. The idea is to have the vowel undergo **V length** by still having a stress. Afterwards, deletion of that stress

22 But of course Riad wouldn't include the vowel length in the underlying form, as I've done here.
23 Though compounds with 'berry' do not show get second pitch accent. We have e.g. [ˈbloːˌbɛːr] 'blueberry', rather than *[^{2}ˈbloːˌbɛːr].
24 Maybe they could even get the same analysis as words like [ˈkʰreːaˌtʰiːv] 'creative.' Riad (2015: 226-229) suggests that they're actually phrases, and shows that the prosody is the same as for some phrases. Maybe words in /ȩˈriː/ are also phrases, but with the second element of the phrase stressed, rather than the first.

then counterfeeds **V length**, which is why we see traces of vowel length in the surface form. This analysis seems to work, although we'd have to account for why the surface vowel is [i(ˑ)] rather than [iː]. As we saw (or rather didn't see) in section 3, Consonant Theory doesn't have a rule like **V short**.

But even though such an analysis might be perfectly adequate empirically, I suspect that individual Consonant Theorists might disapprove of it. It hinges on Riad's theory of lexical stress, and many scholars have analysed Swedish stress without his assumptions (e.g. Bruce 1993 and the many references in R: 193). They prefer to treat stress as predictable, even if that leads to complicated generalisations (like "trisyllabic words with an open penult and closed final syllable get antepenultimate stress", Frid 2001: 30) and many lexical exceptions (R: 194).

And even if we accept this theory of stress (as I do), we need a theory of phonology which can account for the counterfeeding. Depending on one's theory, this could be difficult or undesirable (see Kager 1999, ch. 9 for a useful overview of opacity in Optimality Theory, for example). But the problems get worse, because words like 'grindery' would require a Duke of York derivation if the first vowel in this word really is shortened phonologically. It starts out underlyingly short, like all vowels in Consonant Theory. It then lengthens because its morpheme 'grind' is lexically stressed. Stress is then shifted to the suffix, and the vowel becomes short again. Many theories which explain opacity well often can't implement Duke of York derivations like this one (e.g. McCarthy 2007 for Optimality Theory with Candidate Chains).

Summarising our discussion, I think that Riad's solution for these words could be made to work. If I believed in Consonant Theory, I would be proud to have thought of this analysis. But it remains to be seen whether other followers of Consonant Theory are willing to accept this analysis with lexical stress, counterfeeding opacity and Duke of York derivations. Those who don't will have to provide a different analysis, as I've done in the framework of Vowel Theory, and as Löfstedt (1992) did by proposing a cyclical phonological component. But we've seen that although **V short** isn't necessarily implicated in the 'critical' alternations or in words like 'grindery', we still need a phonological rule of vowel shortening in SCSw. I've given both internal and external evidence for **V short**, and provided analyses of related phenomena using morphology and phonetics rather than phonology.

4.3 Shortening after Long Vowels

The third and final rule we need in Vowel Theory is **Shortening after Long Vowels** (**SLV** for short). In prose, **SLV** is just: "Shorten a consonant after a long vowel". Formally, it's: $C_i \rightarrow Ø$ / V:_C_i The need for this rule is a bit questionable. Only some of the data actually support **SLV's** predictions, while the rest contradicts it. The key question is: "What's the regular outcome of an underlying form /V:C_iC_i/?" It should be obvious that **SLV** predicts [V:C_i], with shortening after the long vowel. But Consonant Theory makes a different prediction. Since long vowels aren't underlying, we would be asking what happens to the sequence /VC_iC_i/ instead. And of course, that would lead to a surface form like [VC_iː]. And as I've said, the data seem to support both options, depending on which morphological context you look at:

(26) Confusion

Support for Consonant Theory

a) Neuter adjectival /t/

Consonant Theory's prediction	Vowel Theory's prediction	Translation
/ˈvit/ → [ˈviːt^{h}]	/ˈviːt/ → [ˈviːt^{h}]	white, common
/ˈvit-t/ → **[ˈvɪt^{h}ː]**	/ˈviːt-t/ → ***[ˈviːt^{h}]**	white, neuter

b) Preterite /de/

Consonant Theory's prediction	Vowel Theory's prediction	Translation
/ˈblød/ → [ˈbløːd]	/ˈbløːd/ → [ˈbløːd]	bleed!
/^{2}ˈblød-de/ → **[^{2}ˈblø̞dːe̞]**	/^{2}ˈbløːd-de/ → ***[^{2}ˈbløːde̞]**	bled, preterite

Support for Vowel Theory

c) Possessive /s/

Vowel Theory's prediction	Consonant Theory's prediction	Translation
/ˈruːs/ → [ˈruːs]	/ˈrus/ → [ˈruːs]	rose
/ˈruːs-s/ → **[ˈruːs]**	/ˈrus-s/ → ***[ˈrʊsː]**	rose, possessive

d) Present /r/

Vowel Theory's prediction	Consonant Theory's prediction	Translation
/ˈhyːr/ → [ˈhyːr]	/ˈhyr/ → [ˈhyːr]	rent!
/ˈhyːr-r/ → **[ˈhyːr]**	/ˈhyr-r/ → ***[ˈhʏrː]**	rent, present tense

The forms in bold are the crucial ones, and as the asterisks show, only Consonant Theory gets a) and b) right. But only Vowel Theory gets c) and d) right. So it seems that no theory has the upper hand here. Whichever one you choose, you'll still have some contexts which you just have to call 'morphological exceptions'. To be a bit more specific about what that means, I suggest that there's a morphological rule of vowel shortening before suffixes like neuter adjectival /t/ and preterite /de̞/. So the derivation for [ˈvɪt^{h}ː] 'white, neuter' runs /ˈviːt-t/ → ˈvɪt-t (morphological shortening) → [ˈvɪt^{h}ː] (phonological rules). Meanwhile, the possessive form of 'rose' has /ˈruːs-s/ → [ˈruːs] by the regular phonology, including **SLV**. So some suffixes have a diacritic feature meaning that they'll shorten the vowel, while other suffixes lack it. The Consonant Theory explanation would presumably be identical, only the diacritic feature is on other suffixes.

But there's actually one way we can tell what the morphological exceptions are. In first-language acquisition, there's often a difference between regular phonology and irregular morphology. An English-speaking child might give the simple past of 'keep' as *keeped* rather than *kept*. They've acquired the past tense morpheme and its allomorphy, but they haven't learnt that 'keep' is one of the English verbs with an /iː/-/ɛ/ alternation (like sleep-slept, creep-crept etc., Stemberger 1995: 252). In Vowel Theory, the suffixes which are diacritically marked for shortening are like 'keep'-type verbs in English. They show an irregular morphological alternation, which is nevertheless shared by other words, and which has to be learnt for each word/suffix. This predicts that, just like in English *keeped*, we sometimes don't see the irregular morphological process applied. In other words, suffixes like the neuter /t/ should sometimes fail to cause vowel shortening. And the acquisition data cited in Linell (1978: 126) confirm this prediction. In the table below, we can see that children sometimes produce precisely those ungrammatical forms in a) and b) which Vowel Theory predicts:

(27) How to say *keeped* in Swedish

UR (Vowel Theory)	SR (target)	SR (actual)	Translation
a) The neuter suffix /t/			
/ˈviːt-t/	[ˈvɪt^{h}ː]	[ˈviːt^{h}]	white, neuter
b) The preterite suffix /de̩/			
/^{2}ˈblød-de/	[^{2}ˈblø̩dːe̩]	[^{2}ˈbløːde̩]	bled, preterite

So while adults never use the SRs marked ungrammatical in (26) a) and (26) b), children do. This gives striking confirmation that a) and b) are the morphological exceptions, and that in the regular phonology of SCSw., /Vː$C_i$$C_i$/ becomes [Vː$C_i$], as in (26) c) and (26) d). And that's why we need a phonological rule **SLV**. This has implications for one of the arguments we saw in section 3. You might remember that my favourite argument for Consonant Theory was the last one, where I showed that we need a contrast between one morpheme with singleton /t/ and one with geminate /tt/. But that geminate morpheme was the neuter adjectival suffix in [ˈvɪt^{h}ː] 'white, neuter'. And we've now seen external evidence that that form only exists because the suffix is diacritically marked to cause vowel shortening. The regular form would be [ˈviːt^{h}], as in (27) above. So it turns out we never have a phonological contrast between /t/ and /tt/. We just have one /t/ that doesn't cause shortening, and another /t/ that does. Morphology, not phonology.

I think this case shows the limitations of internal evidence in phonology. We can stare at (26) all we like, but the data aren't going to magically start favouring one theory over another. But through clever use of language-learning data, we can tease out the exceptions from the regulars. In this particular case, that also turned out to help us refute one of the strongest arguments for Consonant Theory in section 3. So the use of external evidence really is crucial in phonology. Now we've seen all of the machinery of both theories, and it's time we started comparing the two.

5 Counterarguments

Some of you might feel that it's a bit too early to accept Vowel Theory. What about all the good arguments for Consonant Theory that we saw in section 3? And you'd be right, because we haven't answered all of them. In this section, we'll look at the ones that haven't come up yet. We'll see that there are counterarguments even to the strongest of arguments, and by the end of the section, we'll have answered all of section 3's reasons to believe in Consonant Theory.

One argument was that long and short vowels show such a close interaction that it would just be wrong to treat them as separate phonological units. And yet that's what Vowel Theory does. It's certainly true that there are rules like **V short**, where long vowel phonemes get shortened. But of course that doesn't mean that they aren't different phonemes. Languages with final devoicing might still have a voicing contrast elsewhere, so it's perfectly possible for rules to exchange phonemes too. And in fact, there are processes where long and short vowels behave differently. That's not impossible to explain in Consonant Theory, but it shows that we do have justification for treating long and short vowels as separate units.

First of all, there are historical sound changes. Swedish used to have four mid unrounded vowels: /eː, ɛː, e, ɛ/. But going into modern SCSw., short /e/ and /ɛ/ have merged as /e̩/ (see R: 23-24, Leinonen 2010: 21 and references therein). This merger is why SCSw. has 17 vowel phonemes and not 18, as you'd expect from nine long-short vowel pairs. So this sound change shows long and short vowels being treated separately, as though they were separate phonological units. But obviously languages change over time. We can't be sure that the phonological system of Swedish, at the time of the merger, is the same as the one we have today. So let's look at a synchronic phonological rule instead. SCSw. has an optional rule neutralising short /ø̝/ and /ɵ/ to [ɵ] before /r/ (e.g. R: 86-88 and Wenner 2010). As with the heat-bonnet merger immediately above, the long vowels /øː/ and /ʉː/ are unaffected.

(28) Darken vs rotten

UR (Vowel Theory)	SR	Translation
a) The short vowels optionally merge		
/^{2}ˈmø̝rkn-a/	[^{2}ˈmɵrːkna] ~ [^{2}ˈmø̝rːkna]	to darken
/^{2}ˈmɵrkn-a/	[^{2}ˈmɵrːkna], *[^{2}ˈmø̝rːkna]	rotten, pl. and def. sg.
b) The long vowels never merge		
/ˈbøːr/	[ˈbøːr], *[ˈbʉːr]	should, ought to
/ˈbʉːr/	[ˈbʉːr], *[ˈbøːr]	cage, noun

So even in synchronic Swedish phonology, long and short vowel phonemes are treated differently in some processes. We might also be tempted by the transcriptions of SCSw.-speaking children in the Göteborg corpus (Plunkett and Strömqvist 1992, Strömqvist, Richtoff, and Anderson 1993) in the Germanic section of CHILDES (MacWhinney 2000: 274-323). The transcriptions indicate that all five of the Swedish children there have vowels harmonising for backness. And long back /ɑː/ seems to behave differently to short central /a/ for these children. That seems like another process where a long vowel behaves differently from a short one. But we need to be sceptical here. Transcriptions are in Swedish spelling, not in the IPA. So they might lack crucial phonetic detail. And there are words from all children that don't undergo harmony. That suggests this isn't really a phonological rule of vowel harmony at all. But either way, (28) gives synchronic phonological evidence for long and short vowels behaving differently.

Our next argument was that vowel lengthening looks like it's productive in loanwords. This isn't true anymore. Löfstedt's example, the word for 'panic', was borrowed into SCSw. in the middle of the 19th century (Svenska Akademiens Ordbok). And just as I wouldn't use Lewis Carroll's speech as evidence on modern English, I won't accept 19th century loanwords as evidence on modern SCSw. And if we look at more recent loanwords, they tend to show consonant lengthening instead:

(29) Recent loanwords into Swedish

SR (SCSw.)	SR and source language	Translation of SCSw. word
[ˈʂ̺ɪtʰː]	En. [ˈʃɪt̚]	shit
[ˈfakʰː]	En. [ˈfʌk̚]	fuck
[ˈve̝bː]	En. [ˈwɛb]	web (internet)
[^{2}ˈɧɔpːa]	En. [ˈʃɒp̚]	to shop/shop![25]
[ˈbe̝tːɪŋ]	En. [ˈbɛtɪŋ]	betting
[ˈtʰvɪtːe̝r]	En. [ˈtʰwɪtə]	Twitter
[ˈsɵʂ̺ːɪ]/[ˈsʊʂ̺ːɪ]	Jap. [sɯ̀ɕí↓]/[sɯ́↓ɕì]	sushi
[ˈʂ̺ɔkʰː]	Turk. [ˈtʃokʰ]	very (prefix)

Though an exception worth mentioning is that English /æ/ is often borrowed as long [ɛː]. As

25 The pitch accent is caused by the infinitival ending /-a/, added onto the borrowed stem. Notice that English [ʃ] is borrowed as [ɧ] here, even though the perceptually nearly identical [ʂ̺] is allowed in this position in the native vocabulary.

we've just seen, SCSw. lacks a short /ɛ/-type vowel because of a sound change merging it with /ẹ/. This leads to borrowings like ['ajːˌpʰɛːd] for 'iPad', ['mɛːkʰˌbɵkʰː] for 'Macbook' etc. But vowel lengthening isn't generally productive in loanwords.

But our next argument looks like it says something similar about modern Swedish, using experiments on Swedes' pronunciation of Finnish. Remember from section 3 that in Karlsson's (1977) work, native speakers of Swedish pronounced Finnish words and seemed to apply vowel lengthening where Consonant Theory predicts it. But I agree with Linell (1978) that these results are unreliable. The speakers often applied consonant lengthening and not vowel lengthening (Eliasson 1982: 191), the exact opposite of what Consonant Theory would predict. Linell (1978: 130) cites the forms with consonant lengthening as the most common pronunciations. And we can't exclude influence from spelling either. In writing, Swedish quantity is only represented in the consonants. ['siːl] is written <sil>, while ['sɪlː] is written <sill>. This means that the <CVCV> words used in the study would be read with a long vowel if they'd been Swedish words. And then it's possible that people are backtracking to an underlying form using the Finnish orthography rather than the Finnish surface form. In other words, it becomes a real possibility that the reason for vowel lengthening is orthographic and not phonological (Linell 1978: 130). Eliasson himself admits that there's a risk of this (Eliasson 1982: 191), and so we don't know if these results say anything at all about Swedish phonology.[26]

Some people have also argued that Vowel Theory is typologically unrealistic because it gives the language 17 vowel phonemes. But this isn't particularly high at all. First of all, remember from section 2 that the long vowels are actually diphthongs. So we've got 8 short vowels and 9 diphthongs. Now consider the Musa Dagh variety of Armenian, reported on by Vaux (1997). It has 8 short vowels, 5 long vowels and 31 diphthongs (23 of which appear in roots). If learners can arrive at such a large vowel inventory, what's implausible about the 17 phonemes of SCSw.?

With all of these things considered, there isn't much reason to believe in Consonant Theory. But of course, it's still a theoretical possibility. From what we've seen so far, the rules in section 3 still work, even if the arguments behind them aren't always great. But in the next section, we'll try to show that the rules don't work, and that SCSw. vowel length isn't predicted by the rules of Consonant Theory.

6 Comparing Predictions

In the previous sections, we've looked at Vowel Theory and the evidence for it. We've also argued against Consonant Theory, and seen that in some cases, Vowel Theory seems preferable. But here I'll try to show that Consonant Theory in fact makes a large number of incorrect predictions. Vowel Theory makes correct predictions at every turn, which is why I think it's the better theory. We'll start off with a number of predictions that Consonant Theory makes, which turn out to be false.

1) There are no long vowels in closed syllables, except word-finally before single consonants (Löfstedt 2010: 8 and 59, Raffelsiefen 2007: 49; Lorentz 1996: 112 for Scandinavian in general, and Rice 2006: 1172 for Norwegian)
2) There are no short vowels in open stressed syllables (Schaeffler 2005: 7, Witting 1977:

26 Eliasson's (1982) transcriptions also imply that the Swedish speakers mapped Finnish [t] onto Swedish [tʰ] (both of which are written <t>), even though Swedish [d] would seem to provide a closer perceptual match. This is another reason to think that Karlsson's (1977) results were influenced by spelling.

33 and the analyses referred to in E: 104)

3) Every stressed syllable is heavy (bimoraic), and every unstressed syllable is light (monomoraic; Löfstedt 1992, 2010, *passim*, and R: 159 and references therein)
4) There are no minimal pairs for vowel length (Eliasson 1978: 118[27], E: 107, Eliasson 2010: 28, Riad 1992: 281 and R: 165)
5) Vowel length is predictable from consonant length (Eliasson 1978: 118, E: 103-4 and the references therein, and Löfstedt 1992: 96)

Let's start with 1). If you look back at the formulation of **V length** in section 3, you'll see that it can't produce a surface form like [Vː CC] within a morpheme. There's no lengthening in that environment, and **C_2 length** eventually comes along and lengthens the first consonant. There are a few exceptions to this, all recognised in the literature. For example, words like [^{2}ˈseːbra] 'zebra' show open-syllable lengthening because these two consonants can form an onset: ^{2}ˈseː.bra (R: 170). It's also at least possible that some of these cases arise through counterbleeding of a vowel deletion rule. These are words with a vowel-zero alternation, like [ˈguːgẹl] 'Google', but [^{2}ˈguːgla] 'to Google'. Maybe the underlying form contains /ẹ/, and the lengthening in the /u/ in the verb happens before that vowel's been deleted. So these exceptions aren't problematic at all for Consonant Theory.

But it's generally acknowledged that there are a handful of problematic forms too. Löfstedt (2010: 59), for example, says that although the ban on long vowels in closed syllables ”is exceedingly robust, there are two monomorphemic exceptions”. The view that this pattern is somehow marginal in Swedish is also found in Riad, who says that there are ”a few monomorphemic forms /…/ before the coronal consonant clusters [ln] and [st]” (R: 171). Earlier work by Löfstedt also mentions three exceptions before ”the coronal cluster /st/” (1992: 96). So the general consensus seems to be that there are very few exceptions, and that they all have something in common, like appearing before /st/ or /ln/. But this isn't true. Below I list all of the exceptions I've been able to think of. Words marked with % either have alternative pronunciations without [VːCC] for some people, or are so rare that some people won't know them.

(30) The many [VːCC] words in SCSw.

UR (Vowel Theory)	SR	Translation
a) Content words with retroflexes perceived to be native		
/ˈɑːrt/	[ˈɑːʈʰ]	kind, species
%/ˈstɑːrt/	[ˈstɑːʈʰ]	start, noun
/^{2}ˈtoːrt-a/	[^{2}ˈtʰoːʈa]	cake
/ˈsnɑːrt/	[ˈsnɑːʈʰ]	soon
/ˈsmɑːrt/	[ˈsmɑːʈʰ]	smart
/^{2}ˈvoːrt-a/	[^{2}ˈvoːʈa]	wart
/ˈpoːrtẹr/	[ˈpʰoːʈẹr]	stout (beer)
/ˈkɑːrt/	[ˈkʰɑːʈʰ]	unripe fruit
/^{2}ˈɑːrt-a sẹj/	[^{2}ˈɑːʈa sẹjː]	to look good (in e.g. ”It's starting to look good now”)
/^{2}ˈkɑːrt-a/	[^{2}ˈkʰɑːʈa]	map, noun
/^{2}ˈɑːrt-ɪ(g)/	[^{2}ˈɑːʈɪ(g)]	polite
/ˈpɑːrt/	[ˈpʰɑːʈʰ]	share, noun
/ˈfɑːrt/	[ˈfɑːʈʰ]	speed, noun

27 Eliasson does mention ”some truly marginal cases”, but does not say what they are. He is presumably referring to paralinguistically short vowels, discussed in Eliasson (2010: 10).

/^{2}ˈʉːr-ˌɑːrt-a/	[^{2}ˈʉːrˌɑːʈa]	to degenerate, spin out of control
%/ˈpuːrt/	[ˈp^{h}uːʈ^{h}]	gate, large door
%/^{2}ˈvɑːrse̞/	[^{2}ˈvɑːʂe̞]	aware (in ”to become aware of something”)
%/^{2}ˈɧuːrt-a/	[^{2}ˈɧuːʈa]	shirt
%/^{2}ˈjuːrtrɔn/	[^{2}ˈjuːʈrɔn]	cloudberry
%/^{2}ˈʂuːrte̞l/	[^{2}ˈʂuːʈe̞l]	kirtle
%/ˈkuːrt/	[ˈk^{h}uːʈ^{h}]	card
%/^{2}muːrte̞l/	[^{2}muːʈe̞l]	mortar

b) Content words without retroflexes perceived to be native

/ˈmoːln/	[ˈmoːln]	cloud
/ˈɑːln/	[ˈɑːln]	ell (unit of length)
/^{2}ˈʂøːln-a/	[^{2}ˈʂøːlna]	kiln
/^{2}ˈoːsn-a/	[^{2}ˈoːsna]	donkey
/^{2}ˈstøːdj-a/	[^{2}ˈstøːdja]	to support
/^{2}ˈuːdl-a/	[^{2}ˈuːdla]	to grow (transitive, agriculture)
/^{2}ˈøːdl-a/	[^{2}ˈøːdla]	lizard
/^{2}ˈstɛːvj-a/	[^{2}ˈstɛːvja]	to stifle
%/ˈliːnje̞/	[ˈliːnje̞]	line, noun
%/ˈvɛːnj de̞j/	[ˈvɛːnj de̞j]	get used to, imperative
%/^{2}ˈhɛːvd-a/	[^{2}ˈhɛːvda]	to claim, assert
/^{2}ˈvɛːdj-a/	[^{2}ˈvɛːdja]	to beg, plead
%/^{2}ˈiːdk-a/	[^{2}ˈiːdka]	to practise
/^{2}ˈʂeːdj-a/	[^{2}ˈʂeːdja]	(to) chain, noun and verb
%/ˈglɛːdj de̞j/	[ˈglɛːdj de̞j]	rejoice, imperative
/^{2}ˈmiːdj-a/	[^{2}miːdja]	waist
%/ˈboːld/	[ˈboːld]	noble, mighty, proud etc.

c) Names of people and places

/ˈlɑːrs/	[ˈlɑːʂ]	-
/ˈvɑːlbɔrj/	[ˈvɑːlbɔrj]	-
/ˈsuːlve̞j/	[ˈsuːlve̞j]	-
%/ˈheːdvɪg/	[ˈheːdvɪg]	-
%/ˈeːdvɪn/	[ˈeːdvɪn]	-
/^{2}ˈkoːlsˌrʉːd/	[^{2}ˈkoːlsˌrʉːd]	-
/ˈɑːdle̞r/	[ˈɑːdle̞r]	-
/^{2}ˈeːdla/	[^{2}ˈeːdla]	-
/^{2}ˈsoːlna/	[^{2}ˈsoːlna]	-

d) Loanwords and names perceived to be foreign

/ˈʂøːrtʂɪl/	[ˈʂøːʈʂɪl]	Churchill
/ˈoːste̞r/	[ˈoːste̞r]	Auster (name)
%/ˈsɛːnde̞rs/	[ˈsɛːnde̞ʂ]	Sanders (name)
%/ˈsøːrvɪs/	[ˈsøːrvɪs]	service
%/ˈskɑːrf/	[ˈskɑːrf]	scarf
/ˌɑːfte̞rˈskiː/	[ˌɑːfte̞ˈʂkiː]	after-ski
/ˈstɛːndap/	[ˈstɛːndap^{h}]	stand-up (for some also [ˌstɛːnˈdap^{h}ː])
/ˈsɑːrs/	[ˈsɑːrs]~[ˈsɑːʂ]	SARS

/ˈbɑːskḛt/	[ˈbɑːskḛt^{h}]	basketball (the game)
%/ˈmoːtsart/	[ˈmoːtsaʈ^{h}]	Mozart
/hʊˈrɑːtsɪɵs/	[hʊˈrɑːtsɪɵs]	Horace
/ˈgrɑːtsɪḛ/	[ˈgrɑːtsɪḛ]	pleasure
/^{2}ˈiːsraḛl/	[^{2}ˈiːsraḛl]	Israel
%/ˈkeːnja/	[ˈk^{h}eːnja]	Kenya
/ˈsvɑːlˌbɑːrd/	[ˈsvɑːlˌbɑːɖ]	Svalbard

Hopefully you'll be able to appreciate that there are far more exceptions than the two cited in Löfstedt (2010: 59). Depending on differences between idiolects, the list above shows between 41 and 62 exceptions, hardly ”marginal to the system” (Eliasson 2010: 13). Given these attested examples, I don't fully understand how Löfstedt (2010: 49) can claim that this phonotactic pattern is ungrammatical.

Some might feel that this list contains wrongly included words, so it's worth taking some time to justify them in more detail. Retroflexes, for example, are just a single segment on the surface, even though they're taken to come from a consonant cluster underlyingly (see R, ch. 4 and references therein). So even though [ˈɑːʈ^{h}] 'kind, species' comes from /ˈart/ in Consonant Theory, couldn't we claim that retroflexion applies first, giving aʈ, which then allows vowel lengthening exactly as in /ˈsil/ 'sieve'? The answer to this is no. Such a solution can't explain words with long retroflexes, like [ˈk^{h}vaʈ^{h}ː] 'quarter of an hour'. Riad's solution to this retroflex problem is that words like [ˈɑːʈ^{h}] are /ˈart/ underlyingly, while words like [ˈk^{h}vaʈ^{h}ː] are /ˈkvarrt/ underlyingly (see the transcriptions in R: 79).[28]

You could easily extend this solution to non-retroflex cases, like [ˈmoːln] 'cloud' versus [ˈk^{h}ø̞lːn] 'Cologne', which would be /ˈmoln/ and /ˈkølln/ respectively. Riad (p.c.) doesn't like this, given that there are so few [ˈmoːln]-type words. And Eliasson and LaPelle (1973: 140) say that this solution is “obviously a non-desirable result.” But as the list above shows, there are actually quite many [ˈmoːln]-type words (11-17 native content words, 15 in my idiolect). Why would we use the geminate solution for retroflexes (for which there are 13-21 native content words, 14 in my idiolect), but not elsewhere? The only other alternative would be admitting lexical vowel length for [ˈmoːln] and the other 10-16 words of this type. Consonant Theorists have to choose whether they prioritise having a neat theory over accounting for the pronunciations of Swedish words.[29]

You could also argue that some of these long vowels are in open syllables. SCSw. syllables can begin /sk/, so a word like [ˈbɑːskḛt^{h}] 'basketball (the game)' should be syllabified [ˈbɑː.skḛt^{h}], with the expected lengthening in a stressed open syllable. But syllabifying it that way makes wrong predictions. If a word like [ˈhḛsːt] 'horse' is underlyingly /ˈhest/, it should get a long vowel if we attach a vowel-initial suffix. So /^{2}ˈhest-ar/ 'horses', should be syllabified ˈhe.star and undergo open-syllable lengthening. This isn't what we get. The plural 'horses' is [^{2}ˈhḛsːtar], not *[^{2}ˈheːstar]. This either means that Swedish lacks onset maximisation when dividing words into syllables, or that the word 'horse' should be /ˈhesst/ in Consonant Theory. I suggested that kind of representation for words like [ˈk^{h}ø̞lːn] 'Cologne' above for independent reasons.

While on the topic of basketball, it's worth mentioning Riad's (2014) treatment of

28 In section 3.2, I used this analysis when I included lengthening before /r/ and coronal consonants as the fourth environment of **V length**. It's also worth noting that Riad's transcriptions are a bit inconsistent here. R: 61 has /ˈkʉrs/ as underlying form of [ˈk^{h}ɵʂː], even though it should be /ˈkʉrrs/.

29 It's hopefully obvious what my position is. A phonologist's only job is to explain a language's pronunciation. If a theory doesn't account for all the pronunciations, then it's clearly not the theory native speakers use. Having a neat theory means absolutely nothing unless you can explain the actual data. See section 3.2 for some more discussion.

['bɑːskẹtʰ]. He suggests that Swedish has a suffix /ket/ 'to do with sports/games', which we also see in e.g. ['rakːẹtʰ] 'racket'. Since there's now a morpheme boundary between the s and k, we'd get vowel lengthening. As a native speaker, this analysis does not correspond to my intuitions at all. If you're a native English speaker, you might want to consider whether you think that /bɑːs-kɛt-bɔːl/, /ɹæ-kɛt/ and /krɪ-kɛt/ are appropriate morphological divisions for 'basketball', 'racket' and 'cricket'. Either way, such a morpheme boundary doesn't explain the many other words in (30) above which don't end in /ket/ or have to do with sports.

Individual solutions like the one for 'basketball' can be found for other words too. Riad (p.c.) suggests that [²ˈuːdla] 'to grow' may be /²ˈud-l-ɑ/, with a verbal suffix /l/. The problem is that there is no reason to think that there is a verbal suffix /l/ in Swedish. There is no meaning it could possibly have, and the hypothetical stem /ud/ never appears without it. Again, this analysis doesn't correspond to native speaker intuitions at all. If decompositions like these are real, how come native speakers who have access to their own lexicon claim that they're wrong? The same decomposition argument could be made for verbal forms with /j/ as the second consonant. But according to Riad (R: 173), the verbal /j/ suffix causes preceding vowels to shorten. So whether the words of the shape [VːCj] above contain this suffix or not, the long vowel is still unexplained.

Another solution for the /Cj/ words could be counterbleeding opacity. Suppose that words like [²ˈmiːdja] 'waist' are underlyingly /²ˈmidi-a/. Then vowel lengthening can take place in open syllables as usual, counterbled by a hypothetical rule turning unstressed /i/ to j. But that doesn't work, because there's a contrast between unstressed /i/ and /j/: [fɪˈuːl] 'violin' vs. ['fjuːl] 'last year, noun' (Elert 1970: 79, footnote 2). The situation in post-stress syllables is admittedly different, with optional neutralisation of /i/ and /j/, but the neutralisation is only optional. 'media' may be pronounced either ['meːdja] or ['meːdɪa], while 'waist' is only [²ˈmiːdja], never *[²ˈmiːdɪa]. This suggests that 'waist' underlyingly has a /j/, while 'media' has an underlying /ɪ/ which optionally reduces to j in post-stress syllables. The words in the list above are only those which don't allow an alternative pronunciation with [ɪ].[30]

In Eliasson and LaPelle's (1973) analysis, some of the words in (30) are accounted for, since their vowel lengthening rule predicts lengthening before sequences of [-son] and [+cons, +son, +cor] (Eliasson and LaPelle 1973: 139). But out of the 62 words in (30), this still leaves us with 56 exceptions. The wording in Eliasson (2010: 13) gives the same results. So these analyses get rid of a few exceptions, but it's still the case that none of the Consonant Theoretic analyses in the literature can account for the words in (30) above.

So point 1 in our list above isn't true. SCSw. does allow [VːCC] clusters, and there are around 40-60 of these words, not just 2-3 as a lot of linguists have assumed. Let's move on to points 2 and 3, which we'll discuss together. Point 2 says: no short vowels in stressed open syllables. This is like the claimed English ban on words like *[lɪ], *[sɛ], or *[mɔ]. Lorentz (1996: 112), who's writing about Scandinavian in general, explicitly says that there are ”no exceptions” to this generalisation.[31] In Consonant Theory, **V length** rules out this phonotactic pattern because it lengthens all such vowels. Together with other quantity facts about Swedish, this has led a lot of researchers to conclude that every stressed syllable in Swedish is heavy (has two moras), while every unstressed syllable is light (has one mora). This is point 3 above (see there for references). This generalisation is key in a lot of analyses of Swedish, such as Löfstedt (1992, 2010) and Riad (2014). Rice (2006) even uses the bidirectional implication

30 Ollie Sayeed (p.c.) has suggested that we could still have the counterbleeding if there's a three-way contrast between /i/, /j/ and underspecified /J/. 'waist' would be /²ˈmidJa/, which could plausibly allow vowel lengthening by **V length**. /J/ would then obligatorily be syllabified as the consonant [j].

31 Lorentz acknolwedges that Faroese, Norwegian and Swedish are slightly different. But the only difference he mentions has to do with vowels in closed stressed syllables.

'stressed syllable ↔ syllable with two moras' to justify an Optimality Theoretic analysis of Norwegian (Rice 2006: 1171), which is very similar to SCSw. when it comes to quantity.

But these analyses can't account for the words that do have short vowels in stressed open syllables. I don't have a long list like for point 1, and there are in fact very few words of this type. It's hard to find examples in related languages like English and German too, so the reason there are so few of them is probably historical. In other words, we don't have to explain why they're so rare in our synchronic phonological theories. Below are the three that I know of. Two of them actually come from Elert (1964: 35). Elert's work is extremely well-known and well-cited, but somehow these words have escaped the notice of both Vowel and Consonant Theoretic linguists.

(31) 'What?!'

UR (Vowel Theory)	SR
/ˈa/	[ˈa]
/ˈva/	[ˈva]
%/ˈjɵ/	[ˈjɵ]

['a] means 'for' when referring to prices, as in *Två kex* [a] *5 kronor (styck)* 'Two biscuits **for** 5 kronor (each)'. It can also translate the 'to' of '10 to 20 biscuits.' ['va] is used to ask someone to repeat something ('come again/what?'). Some speakers also use it as a filler at the ends of clauses, especially in long utterances. ['jɵ] is an adverb appearing in declarative clauses. It conveys the information: I expect you to already know this information, or find it obvious. A translation might be 'of course'. It's also the first (for some, also the second) 'the' in sentences like '*the* slower you walk, *the* longer it will take you to get there'.

There are also examples of open-syllable words where both a long and a short vowel are used in different contexts. Here I agree with Eliasson (2010: 10), who calls the forms with short vowels paralinguistic. The short-vowel forms always express the same meaning as the long-vowel forms, plus some emotion. For example, ['noː] means 'well', while ['nɔ] is how you say 'well' when impatient (E: 109). There's no reason to think these are separate lexical entries. But this isn't the case for the words in (31). ['a] isn't a paralinguistically shortened form of *['ɑː], which is ungrammatical with this meaning.[32] And while ['va] could plausibly be connected to the question word 'what', the two words don't overlap in meaning and can't be used interchangeably, like ['noː] and ['nɔ] 'well'.

How could you analyse these words in Consonant Theory? Well, there aren't any previous analyses to build on, since Consonant Theory predicts that no words like this exist. I'll give some suggestions for how you could go about it. Maybe words like ['va] 'come again' aren't really language. They're stored pronunciations, but they don't have anything to do with phonology. You could use that explanation for English examples like ['mɛ] 'meh' as well. This might work for ['va], but it can't explain ['a] and ['jɵ]. First of all, ['a] is a preposition. Why would prepositions be something other than words with underlying representations? And prepositions in Swedish in general don't escape **V length**: ['iː] 'in' and ['pʰoː] 'on'. And ['jɵ] is an adverb, meaning that we can use syntactic word order facts to show that it definitely participates in linguistic processes. (32) below shows that ['jɵ], written <ju>, follows the main verb in main clauses, but precedes it in subordinate clauses, like other Swedish adverbs. The position of <faktiskt> 'actually' in the sentences below shows these word order differences. And syntactic derivations are of course usually taken to operate on words.

32 The situation with [ˈjɵ] is more complicated, since many speakers have [ˈjʉː] for this word. Since speakers are exposed to different varieties of Swedish, I suspect some will allow both pronunciations with the same meaning.

(32) Word order in main and subordinate clauses

Det	**är**	**ju**	**faktiskt**	så.
It	**is**	***ju***	**actually**	so.

'Of course, it actually is that way.'

*Det	**ju**	**är**	**faktiskt**	så.
It	***ju***	**is**	**actually**	so.

Intended: 'Of course, it actually is that way.'

Det är viktigt att komma ihåg	att	det	**ju**	**faktiskt**	**är**	så.
It's important to remember	that	it	***ju***	**actually**	**is**	so.

'It's important to remember that of course, it actually is that way.'

?Det är viktigt att komma ihåg	att	det	**är**	**ju**	**faktiskt**	så.[33]
It's important to remember	that	it	**is**	***ju***	**actually**	so.

Intended: 'It's important to remember that of course, it actually is that way.'

For [ˈjɵ], there are also phonological reasons for thinking that it isn't just a stored, unanalysed whole. The pronunciation of the palatal approximant [j] as a palatal fricative [j̝] is becoming more prestigious. This means that many SCSw. speakers are switching from /j/ to /j̝/, or are at least beginning to allow both [j] and [j̝]. This sound change is affecting [ˈjɵ] as well, suggesting that it's a lexical entry with a phonological representation. So these words really have to be explained by phonological theories.

Another way out might be to say that these words aren't actually stressed (Riad, p.c.). Riad (2015) shows that there's reason to think that Swedish has stressless words anyway. But this approach doesn't work either. Because remember what we said in section 4.1 about the French football player Karim Benzema. His name was pronounced as [be̝nse̝ˈma]. Now I think the last vowel is phonologically stressed, but how can I prove that? It actually isn't very difficult. Remember the possessive form [be̝nse̝ˈmasː]. Back in section 4.1 we talked about how the geminate [sː] was a problem for Consonant Theory since the possessive morpheme can't be long. And now it turns out that that long [sː] is going to cause even more trouble. Because geminates only ever appear in stressed syllables. When unstressed, everyone agrees that long consonants shorten (see section 2). So the final syllable really has to be stressed. And then the non-possessive form more or less has to be stressed too. This is what we see in every other word in Swedish, and there's nothing suggesting that this name is any different. And given that short stressed vowels in open syllables *are* allowed, there's no reason to suppose that citation forms of words like [ˈjɵ], [ˈva] and [ˈa] are stressless either.

The only other way out, at least that I can see, would be to say that the words are underlyingly stressless, but become stressed later in the derivation. This would be an example of counterfeeding opacity, since the addition of the stresses applies too late to feed into **V length**. But while this approach can account for everything, it has a theoretical downside, beyond the fact that it involves opacity, which some theories can't model. To see this, let's look at a quote from Riad, explaining one of the advantages of his theory. Note that his Stress-to-Weight is my point 3: stressed syllables need two moras.

33 This is grammatical only with a pause after 'that'. I have the same judgements for the English sentence: "We have to ask ourselves what are we going to do?". Without a pause, it's impossible, but with a pause, the question becomes reported speech and the sentence is acceptable.

> If a vowel is short in an open syllable and receives stress, it will lengthen to two moras by Stress-to-Weight (CV_{μ} > $CV_{\mu\mu}$, phonetically CV:). If a vowel is short and followed by a long consonant, then Stress-to-Weight is met by the short vowel and the mora of the consonant ($CV_{\mu}C_{\mu}$, phonetically CVC:). If a vowel is short and followed by a consonant cluster, part of which is in the same syllable, then Stress-to-Weight will make the postvocalic consonant moraic, i.e. weight will be instantiated by position ($CV_{\mu}C.CV$ > $CV_{\mu}C_{\mu}.CV$, phonetically CVC:.CV). These are the only three cases and they always result in heavy stressed syllables (R: 178)

He thinks it's good that Consonant Theory generalises across all of these contexts using a single constraint. But if there's counterfeeding involved, that can't be. Because in the possessive [be̥nse̥ˈmas:], we now know that the word starts out without a stress. **V length** fails to apply, because there aren't any stressed syllables. Then the possessive /s/ (remember that it's got to be a singleton in Consonant Theory) is added, and the word becomes stressed. After that, some version of Stress-to-Weight applies again, making sure that we get [be̥nse̥ˈmas:] and not *[be̥nse̥ˈmas]. So vowel lengthening and Stress-to-Weight have to apply at different points in time, meaning they can't possibly be a single process. Even if you abandon any rule-based thinking and use Optimality Theory, it's clear that stressless /bensema/ can't become stressed [be̥nse̥ˈma] using just an undominated constraint like Stress-to-Weight. Candidates with lengthening would always win. I leave it to future Consonant Theorists to decide how to analyse these facts.

The conclusion of all this is that Swedish definitely has open syllables with short stressed vowels. This is the same thing as saying: point 2 is false. These words are also light (monomoraic) stressed syllables, which point 3 forbids. So analysing Swedish by using something like an undominated constraint requiring stressed syllables to be heavy isn't going to work. I've only been able to find one way of analysing these facts in Consonant Theory. It involves counterfeeding and forces us to abandon any neat generalisations that Consonant Theory might be able to express. Meanwhile, the Vowel Theory analysis is as simple as can be. Some words have underlying short vowels, and these never lengthen. Yes, I'm abandoning any teleological generalisations, like point 3, but I can easily account for *all* Swedish words, and not just the majority of them.

Next we're going to see some more conclusions that we can draw based on the data we've seen. Point 4 says there aren't any minimal pairs for vowel length, and point 5 says vowel length is predictable from consonant length. If we could falsify 4, we'd be falsifying 5 as well. There's a widespread view in the literature that minimal pairs for any kind of quantity would be impossible. Eliasson (E: 107) says their absence ”must be strongly emphasized”. Riad says that minimal pairs for vowel or consonant length could not exist (R: 165). And Eliasson (2010: 28) claims that long and short vowels can't contrast ”by logical necessity”. Firstly, note that due to differences in prosodic structure, we get perfect minimal pairs for both vowels and consonants, as we saw in section 2. But here we'll look at another kind of minimal pair, one that's never been discussed in the literature until now. In (33) below, I show two perfect minimal pairs for the vowel phonemes /a/ and /ɑ:/, without any differences in the duration, quantity or quality of any other segment:

(33) They exist

/'a/	['a]	for (of price per item; see text below (31))
/'ɑː/	['ɑː]	A (music), A (letter of the Latin alphabet), A (grade in schools)
/'va/	['va]	come again (for elaboration, see text below (31))
/'vɑː/	['vɑː]	to be, was/were, what (interrogative)[34]

Contrary to what people have been saying with such conviction, Swedish has perfect minimal pairs for vowel length. Point 4 is false. Of course it follows that vowel length can't be predicted from consonant length, so point 5 is false too. Only a theory with lexical vowel length can explain this in a satisfying way. This also means that Consonant Theory is the only theory storing predictable information, consonant length, in the lexicon. Now there's one point that we have to discuss in relation to minimal pairs, as well as the few words like /'a/ that exist in Swedish. There's a view among many linguists that marginal contrasts are unimportant, and that if something is only found in a handful of words, we can ignore it. In this question, I agree fully with the following quote from Rice (2006: 1180) on a different topic: ”While there may be relatively few such words in Norwegian, their number is surely not as important as their status.”

All native speakers of SCSw. can and do produce words with short stressed vowels in open syllables, and all of them have the minimal pairs in (33). Whatever theory their brains implement, it's got to be able to explain these facts. Any theory that doesn't, isn't the one native speakers use. And my goal as a phonologist is to find the theory native speakers use. We have to account for *all* of the data, not just the bits of it which happen to support our theory. And I'm arguing that the best theory for *all* the facts of Swedish quantity is Vowel Theory. It correctly predicts the existence of these contrasts, while Consonant Theory incorrectly predicts their absence. Of the two theories, only Vowel Theory offers an explanation for all of a native speaker's phonological competence.

We've now falsified five crucial points of Consonant Theory. Some of them have been absolutely essential to the existence of that theory in the first place. All of our five points now have to be replaced with the correct predictions of Vowel Theory. 1) There are long vowels in closed syllables, even before two or more consonants within a morpheme. 2) There are short vowels in open stressed syllables. 3) Not every stressed syllable in Swedish is heavy. 4) There are minimal pairs for vowel length. 5) Vowel length is not predictable from consonant length. So Vowel Theory and Consonant Theory differ in empirical coverage, meaning that we don't have to use conceptual arguments to decide between the two. I also want to emphasise how important it is that analyses account for all of the facts. I can only hope that all of the data presented here are discussed in future analyses of Swedish quantity, and that the data I've taken from Elert (1964: 35) don't go ignored for another half a century.

7 Conclusions

In this article, we've looked at two theories of Swedish quantity, Vowel Theory and Consonant Theory. We started out by examining the phonological processes of Consonant Theory, the motivation for them, and saw some other arguments in favour of distinctive consonant length. In section 4, we went on to introduce Vowel Theory, a different take on Swedish phonology. I gave internal and external evidence for all of its rules. **C length** was the source of long

34 The pronunciation [ˈvɑː] is the dominant one for all three words in spoken SCSw. In formal registers [²ˈvɑːra], [ˈvɑːr] and [ˈvɑːd] are used for 'to be', 'was' and 'what' respectively.

consonants in Swedish, and we saw that it was productive even in the possessive clitic /s/, which Consonant Theory struggled to account for. I didn't use **V short** in the way Consonant Theorists suggest, as an explanation for the 'critical' alternations. But we still needed it to account for some newly coined words, and the language game *rövarspråket* gave us external evidence for it. With **SLV**, it looked like we would only be able to hypothesise that it existed, since there were many exceptions to its predictions. But thanks to forms from children's speech, we were able to show that those exceptions were due to morphology and not phonology.

We also looked at some counterarguments to the points in section 3. For example, we looked at the claim that there was a contrast between /t/ and /tt/ in two suffixes. The child speech we've just talked about turned out to refute that argument. We concluded that there were two suffixes, both /t/ phonologically, but one of them had a diacritic feature which eventually caused it to be realised as a geminate. We also spent quite a lot of time on the 'critical' alternations, arguing that they didn't allow us to decide between our two theories. We also found 'critical'-type alternations in languages without consonant length, so having 'critical' alternations turned out to be quite a weak argument for consonant length in the first place.

In section 5, we looked at the arguments from section 3 that hadn't already been answered. We saw that those were generally unconvincing as well. Some of them were based on incorrect typological generalisations, and others might've been true of the Swedish spoken 200 years ago, but aren't true if you look at Swedish today. And we saw justification for treating long and short vowels as separate phonological units, since there are phonological rules targetting only short vowels.

But the most important part of my argumentation for Vowel Theory was in section 6. Almost all of the evidence presented in this section was new, and hasn't been discussed in the literature on Swedish until now. Section 3 argued that the limited distribution of vowels was an advantage of Consonant Theory, but section 6 showed that the distribution isn't actually limited in the way Consonant Theory predicts. We found a long list of both native and borrowed words with [Vː CC] clusters, for example. But even though there weren't many previous analyses to build on, we were able to find a Consonant Theoretic solution, by changing our assumptions about possible underlying forms.

It was more difficult when we came to words with short stressed vowls in open syllables. They turned out to pose big challenges to Consonant Theory, where **V length** predicts that no such words exist. Every explanation for them was unsuccessful in some way, and even though there aren't many words of that shape, the few words that do exist are a good evidence for Vowel Theory. It was these words that led us to perfect minimal pairs for vowel length too. Some think that minimal pairs would be logically impossible in Swedish, but they demonstrably exist. Only a theory with distinctive vowel length can predict and explain that fact. At the end of the section, we concluded that a lot of Consonant Theory's major predictions are actually false. But Vowel Theory had no problem explaining any of the new data, and in fact predicted these new facts to exist in the first place.

So we've seen arguments for Vowel Theory, counterarguments to Consonant Theory, and data on SCSw. that have never been discussed before. These new data had a big impact on which theory of length we choose, and they clearly favoured Vowel Theory. I've tried my best to improve on the Consonant Theoretic analyses of Swedish already out there, and I hope Consonant Theorists find this article helpful. But we'll have to conclude that Vowel Theory is correct. The representations of pronunciation in the brains of native speakers of Standard Central Swedish have 17 vowels.

8 References

Boeckx, Cedric, Norbert Hornstein and Jairo Nunes. 2010. Control as Movement. Cambridge: Cambridge University Press.

Bruce, Gösta. 1993. On Swedish lexical stress patterns. PHONUM 2. Umeå University. 41-50.

Eddington, David, Rebecca Treiman and Dirk Elzinga. 2013. Syllabification of American English: Evidence from a Largescale Experiment, Part I. Journal of Quantitative Linguistics 20:1. 45-67.

Eklund, Ingegerd and Hartmut Traunmüller. 1997. Comparative study of male and female whispered and phonated versions of the long vowels of Swedish. Phonetica 54. 1-21.

Elert, Claes-Christian. 1955. Svenska fonem och deras strukturella relationer. Nordisk Sommeruniversitet 1954, Moderne Videnskab; orientering og debat IV. Copenhagen: Munksgaard. 140-144.

Elert, Claes-Christian. 1964. Phonologic studies of quantity in Swedish. Uppsala: Almqvist & Wiksell.

Elert, Claes-Christian. 1970. Ljud och ord i svenskan. Uppsala: Almqvist & Wiksell.

Eliasson, Stig. 1978. Swedish Quantity Revisited. In Eva Gårding, Gösta Bruce and Robert Bannert (eds.). Nordic Prosody: Papers from a Symposium. Travaux de l'institut de linguistique de Lund XIII). Department of Linguistics, Lund University. 111-122.

Eliasson, Stig. 1982. Transfer as Evidence for Phonological Solutions. Studia Anglica Posnaniensia 14. 185-196.

Eliasson, Stig. 1985. Stress Alternations and Vowel Length: New Evidence for an Underlying Nine-Vowel System in Swedish. Nordic Journal of Linguistics 8:2. 101-129.

Eliasson, Stig. 2010. German and Swedish Quantity: A Comparison. In Antje Dammel, Sebastian Kürschner and Damaris Nübling (eds.). Kontrastive Germanistische Linguistik, Teilband 1. Zürich/New York: Georg Olms Verlag. 5-55.

Eliasson, Stig and Nancy LaPelle. 1973. Generativa regler för svenskans kvantitet. Arkiv för nordisk filologi 88. 133-148.

Engstrand, Olle. 1999. Swedish. In Handbook of the International Phonetic Association. Cambridge: Cambridge University Press. 140-142.

Frid, Johan. 2001. Swedish word stress in optimality theory. Lund Working Papers in Linguistics 48. 25-40.

Frändén, Johanna. 2016. Commentator in UEFA Fotbolls-EM 2016: Frankrike - Island, Kvartsfinal: Frankrike-Island. Recorded using Audacity 2.1.2 using Windows WASAPI, from the

SVT video available at: <http://www.svtplay.se/video/9006130/uefa-fotbolls-em-2016-frankrike-island/uefa-fotbolls-em-2016-kvartsfinal-kvartsfinal-1> [Accessed 4th July, 2016]. The video will be available until 30th December, 2016.

Hale, Mark and Reiss, Charles. 2008. The Phonological Enterprise. Oxford: Oxford University Press.

Hellberg, Staffan. 1974. Graphonomic Rules in Phonology: Studies in the Expression Component of Swedish. Gothenburg: Acta Universitatis Gothoburgensis.

Itô, Junko, and Armin Mester. 2012. Recursive prosodic phrasing in Japanese. In Toni Borowsky et al. (eds.). Prosody matters: Essays in honor of Elisabeth Selkirk. London: Equinox. 280-303.

Kager, René. 1999. Optimality Theory. Cambridge: Cambridge University Press.

Karlsson, Fred. 1977. Några anteckningar om svenskans kvantitet. Turku: Åbo Akademi University.

Kiparsky, Paul. 1982. Explanation in Phonology. Dordrecht: Foris.

Kloster-Jensen, Martin Alexander. 1962. Long Consonant after Short Vowel. In Antti Sovijärvi and Pentti Aalto (eds.). Proceedings of the Fourth International Congress of Phonetic Sciences. Held at the University of Helsinki, 4 – 9 September 1961. The Hague: Mouton & Co.

Leinonen, Therese Nanette. 2010. An Acoustic Analysis of Vowel Pronunciation in Swedish Dialects. PhD Thesis, University of Groningen.

Linell, Per. 1978. Vowel Length and Consonant Length in Swedish Word Level Phonology. In Eva Gårding, Gösta Bruce and Robert Bannert (eds.). Nordic Prosody: Papers from a Symposium. Travaux de l'institut de linguistique de Lund XIII). Department of Linguistics, Lund University. 123-136.

Lorentz, Ove. 1996. Length and Correspondence in Scandinavian. Nordlyd 24. 111-128.

Löfstedt, Ingvar. 1992. Swedish Segment Length and Structure Preservation. Studia Linguistica 46:2. 93-127.

Löfstedt, Ingvar. 2010. Phonetic Effects in Swedish Phonology: Allomorphy and Paradigms. PhD Thesis, UCLA.

MacWhinney, Brian. 2000. The CHILDES Project: The database. Mahwah: Lawrence Erlbaum Associates.

McCarthy, John J. 2007. Hidden Generalizations: Phonological Opacity in Optimality Theory. London: Equinox.

Plunkett, Kim and Sven Strömqvist. 1992. The acquisition of Scandinavian languages. In Dan I.

Slobin (ed.). The crosslinguistic study of language acquisition: Volume 3. Hillsdale: Lawrence Erlbaum Associates. 457-556.

Pullum, Geoffrey K. 1976. The Duke of York gambit. Journal of Linguistics 12. 83-102.

Raffelsiefen, Renate. 2007. Morphological word structure in English and Swedish: the evidence from prosody. In Geert Booij et al. (eds.). On-line Proceedings of the Fifth Mediterranean Morphology Meeting. Fréjus, 15-18 September 2005. University of Bologna. 209-268.

Reiss, Charles. 2003. Quantification in Structural Descriptions: Attested and Unattested Patterns. The Linguistic Review 20. 305-338.

Riad, Tomas. 1992. Structures in Germanic Prosody: A diachronic study with special reference to the Nordic languages. PhD Thesis, Stockholm University.

Riad, Tomas. 2003. Bestämdhetssuffixens form och tvåstavigheten. Grammatik i fokus 1. 145-152.

Riad, Tomas. 2014. The Phonology of Swedish. Oxford: Oxford University Press.

Riad, Tomas. 2015. Prosodin i svenskans morfologi. Stockholm: Morfem.

Rice, Curt. 2006. Norwegian stress and quantity: The implications of loanwords. Lingua 116. 1171-1194.

Schaeffler, Felix. 2005. Phonological Quantity in Swedish Dialects: Typological Aspects, Phonetic Variation and Diachronic Change. PHONUM 10. PhD thesis, Umeå University.

Stemberger, Joseph Paul. 1995. Phonological and Lexical Constraints on Morphological Processing. In Laurie Beth Feldman (ed.). Morphological Aspects of Language Processing. Hillsdale: Lawrence Erlbaum Associates. 247-267.

Strömqvist, Sven, Ulla Richthoff and Anders-Börje Andersson. 1993. Strömqvist's and Richthoff's corpora: A guide to longitudinal data from four Swedish children. Gothenburg Papers in Theoretical Linguistics 66.

Svenska Akademiens Ordbok. Available online at: <http://www.saob.se/> [Accessed 25th May, 2016]

Teleman, Ulf. 1969. Böjningssuffixens form i svenskan. Arkiv för nordisk filologi 84. 163–208.

Vaux, Bert. 1997. The Forty Vowels of Musa Dagh. Talk presented at the Ford Foundation Indo-European Seminar.

Wenner, Lena. 2010. När lögnare blir lugnare – En sociofonetisk studie av sammanfallet mellan kort ö och kort u i uppländskan. Uppsala: Uppsala University.

Wiese, Richard. 2000. The Phonology of German. Oxford: Oxford University Press.

Witting, Claes. 1977. Studies in Swedish Generative Phonology. Studia Philologicae Scandinavicae Upsaliensa II. Uppsala University.