Sieves and Herrings: For Distinctive Vowel Length in Swedish

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Abstract

This article reexamines the question of vowel and consonant length in Swedish, a hotly debated topic since at least Elert (1955). Vowel and consonant length usually depend on each other, and mutually predict each other, making the standard diagnostic of complementary distribution difficult to apply. I aim to solve this puzzle by introducing internal and external evidence not previously discussed in the literature on Swedish phonology. It is argued that the evidence favors Vowel Theory, where vowel length is distinctive, and an explicit rule-based analysis is provided. The article challenges long-standing assumptions about Swedish, such as the bimoraicity requirement on stressed syllables. The new evidence on bimoraicity suggests that Swedish quantitative phonology does not involve a teleological conspiracy aimed at producing more 'optimal' outputs, in line with the predictions of substance-free rule-based phonology.

1 Introduction[1]

This article is about vowel and consonant length in Standard Central Swedish (SCSw.), the variety of Swedish spoken in Stockholm and surrounding areas, and the native language of the author. Phonologists have debated Swedish quantity for many decades without reaching a consensus. The reason for this is that vowel and consonant length are not independent. 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	*[ˈsiːlː], ungrammatical	[ˈsɪlː] 'herring'
Short consonant	[ˈsiːl] 'sieve, strainer'	*[ˈsɪl], ungrammatical

(1) shows that every stressed CVC syllable has either a long consonant (as in [ˈsɪlː] 'herring') or a long vowel (as in [ˈsiːl] 'sieve'). Syllables where both vowel and consonant are short are ungrammatical (as in *[ˈsɪl]), as are syllables where they are both long (as in *[ˈsiːlː]). Consequently, if one knows the consonant length of the syllable, one also knows its vowel length: long consonant → short vowel, and short consonant → long vowel. However, it is also

1 Abbreviations used: adj. = adjective, com. = common gender, n. = noun, neut. = neuter gender, pass. = passive, poss. = possessive, pres. = present, pret. = preterite, v. = verb.

true that if one knows the vowel length, one knows the consonant length: long vowel → short consonant, and short vowel → long consonant. Phonologists must choose what kind of length they want to represent in speakers' mental lexicons.[2] It could be that vowel length is underlyingly represented, with consonant length derived by predictable rules. I will call this Vowel Theory throughout the article. Alternatively, consonant length could be underlying, with derived vowel length. This will be referred to as Consonant Theory. The following solutions have been the most common in the literature:

(2) The solutions

Solution	Underlying representation of [ˈsiːl] 'sieve'	Underlying representation of [ˈsɪlː] 'herring'	Selected references
Vowel length	/ˈsiːl/	/ˈsɪl/	Engstrand (1999), Linell (1978), Witting (1977)
Consonant length	/ˈsil/	/ˈsilː/	Riad (2014; henceforth R)
Consonant gemination	/ˈsil/	/ˈsill/	Elert (1955), Eliasson (1978), Eliasson (1985; henceforth E), 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). In this article, however, I will argue for Vowel Theory (row 1 in (2) above). On this view, SCSw. has 17 vowel phonemes, and a phonological process which lengthens consonants after short stressed vowels. We will look at the evidence from the literature, and conclude that Vowel Theory is preferable, even in cases where the opposite initially seems to be true. But an important part of this article also introduces new evidence for Vowel Theory. This new evidence will be relevant to evaluating the predictions made by Consonant Theory. For example, it is 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). However, I will show that SCSw. has perfect minimal pairs for vowel length, a difficult data point for Consonant Theory, which incorrectly predicts that they do not exist. I also outline my own Vowel Theoretic analysis of SCSw. in a substance-free rule-based framework (Bale and Reiss, 2018, Hale and Reiss 2008, Reiss 2018, Samuels 2011, and others), which straightforwardly predicts the new evidence. Internal and external evidence for the processes Vowel Theory needs is provided. However, although I argue for Vowel Theory, I also attempt to modify Consonant Theory to

2 In section 5.1, we will see an argument against representing both kinds of length underlyingly.

account for the new evidence throughout the article. It is my hope that this will help Consonant Theorists find possible solutions to the problems I present.

Although the empirical focus of the article is on Swedish, many aspects of the argumentation are of relevance to other languages and to theoretical phonology more generally. I argue that interjections should be subjected to the regular phonology of a language, even in cases where they seem to show exceptional behavior. I also argue that SCSw. quantitative phonology does not involve a teleological goal to produce 'optimal' bimoraic stressed syllables, as has been suggested in Optimality Theoretic analyses (Löfstedt 2010, Riad 2014). There is, then, no conspiracy between the quantitative rules of SCSw. phonology. Finally, I emphasize the importance of external evidence in justifying theoretical proposals: we will see that approaches which only consider internal evidence can easily be led astray by conflating true phonological processes with ones which are actually governed by morphology. Separating phonological and morphological processes is therefore a task whose importance should not be underestimated.

The rest of this article is structured as follows. In section 2, we examine the basic facts about vowels and consonants, and their distribution, in SCSw. Section 3 turns to Consonant Theory and the processes it requires. We will also see arguments in favor of Consonant Theory, as well as its key predictions. Section 4 challenges all major predictions of Consonant Theory, mostly using new evidence, or evidence which has not been considered in earlier treatments. It is argued that the data in this section, including minimal pairs for vowel length, are fatal to current implementations of Consonant Theory. Section 5 presents a new analysis of Swedish quantity assuming Vowel Theory, where each rule is justified by external evidence. Section 6 concludes the article.

2 Basic Facts

This section introduces the basic facts about the phones found in surface forms of SCSw., and the different ways of analyzing them. It will not be necessary to know every allophone of every phoneme, and we will not mention allophony which will not be significant later on. With this said, let's look at the Swedish vowels. In the table below, I provide 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 diphthongized in the surface form (see Eklund and Traunmüller 1997 and the references in R: 41). Throughout the article, I follow the traditional transcription system as outlined in (3), ignoring the differences in quality and diphthongization which exist in modern SCSw.:

(3) The vowels

UR (Vowel Theory)	SR (traditional)	SR (modern SCSw.)	Translation
/ˈsiːl/	[ˈsiːl]	[ˈsi^{z}ːjl][3]	sieve
/ˈsɪl/	[ˈsɪlː]	[ˈsɪlː]	herring
/ˈsyːl/	[ˈsyːl]	[ˈsy^{z}ːjl]	awl, needle

3 The superscript ^{z} here indicates that the preceding vowel is fricated (see Fant 1973, ch. 5)

/ˈsʏl/	[ˈsʏlː]	[ˈsʏlː]	sleeper (railways)
/ˈbeːt/	[ˈbeːtʰ]	[ˈbeːətʰ]	bit, pret. v.
/ˈbɛt/	[ˈbɛtʰː]	[ˈbɛtʰː]	bite, n.
/ˈløːs/	[ˈløːs]	[ˈlœːəs]	loose
/ˈlœs/	[ˈlœsː]	[ˈlœsː]	lice
/ˈɧɛːl/	[ˈɧɛːl]	[ˈɧæːəl]	reason, n.
/ˈɧɛl/	[ˈɧɛlː][4]	[ˈɧɛlː]	bark!
/ˈmɑːt/	[ˈmɑːtʰ]	[ˈmɑːətʰ]	food
/ˈmat/	[ˈmatʰː]	[ˈmatʰː]	matte
/ˈmoːl/	[ˈmoːl]	[ˈmoːəl]	goal
/ˈmɔl/	[ˈmɔlː]	[ˈmɔlː]	minor (music)
/ˈmuːt/	[ˈmuːβtʰ]	[ˈmuːβtʰ]	towards, against
/ˈmʊt/	[ˈmʊtʰː]	[ˈmʊtʰː]	type of insect
/ˈfʉːl/	[ˈfʉːβl]	[ˈfʉːβl]	ugly
/ˈfɵl/	[ˈfɵlː]	[ˈfɵlː]	full

Note that it will 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 will argue, 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, ɕ, ɧ,[5] h, m, n, ŋ, l, r, j/. Consonant Theory instead proposes nine vowel phonemes (one for each of the nine pairs above), indicated in Riad (2014) with the quality of the long vowel: /i, y, e, ø, ɛ, ɑ, o, u, ʉ/ (R: 17). When writing underlying forms in Consonant Theory, I will use the same symbols. Since Riad believes in consonant length, he is left with 34 consonant phonemes (R: 45). 34 is not a typo for 36: the two consonants /ɧ, h/ never occur in codas, so their long counterparts *[ɧː] and *[hː] do not exist in SCSw. (R: 45, with the exception of a handful of borrowed names). The word for 'sieve' would be /ˈsil/ according to Riad, and 'herring' would be /ˈsilː/.[6] Eliasson (1985) instead favors 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 moving on to detailed phonological analyses, it is worth noting the standard description of the distribution of length in SCSW. I will argue that some parts of this description are empirically incorrect, but it will nevertheless provide a useful background for discussion. All of the comments below apply only within morphemes; quantity facts across morpheme

4 This vowel is the same as that of [bɛtʰː] 'bite, n.' in SCSw. It is included it here to show that SCSw. is one of the varieties of Swedish merging the short vowel counterparts of /eː/ and /ɛː/.

5 /ɧ/ is used here for the phoneme realized as [ɧ] in onsets and [ʂ] in codas (see R: chapter 3). Some varieties of SCSw. (including my own) lack the [ʂ]-[ɕ] contrast, leading to a slightly different set of phonemes and allophones.

6 Riad actually writes /ˈsilᵘ/, with ᵘ for mora. He points out (p.c.) that he believes in 18 consonant units, with a general quantity contrast, rather than 34 separate phonemes. This will not be relevant to us.

boundaries will be discussed when relevant later in the article. Stressed open syllables (/CV/) must have a long vowel: [ˈCVː], but never *[ˈCV] (to be challenged in section 4.2). Stressed syllables closed by a single consonant (/CVC/), as shown in (1), are either [ˈCVːC] or [ˈCVCː], never *[ˈCVːCː] or [ˈCVC]. Stressed syllables with final clusters (/CVCC/) must have a short vowel: [ˈCVCːC],[7] never *[ˈCVːCC] (to be challenged in section 4.1). In all unstressed syllables, all vowels and all consonants are always short. As this description shows, long vowels and long consonants are in complementary distribution for all syllable shapes.

Also worth mentioning here are some transcription practices that I will be using throughout the article. All phonological processes will be given a name in **bold**, a prose description, and a rule-based formalization. The second (or grave) pitch accent (see e.g. R: 181-191 for a phonological analysis, and references therein) is indicated with a superscript ^{2}. Both pitch accent and stress are marked underlyingly in this article, but this is simply because any rules for the assignment of stress and pitch accent will not be relevant. Finally, I will not transcribe certain points of phonetic detail which are not relevant, such as palatalization of velar stops.

We have now seen the basic facts about quantity in Swedish. There are 17 main vowel qualities, and 18 main consonant qualities, with long vowels and long consonants being in complementary distribution. In section 3, we will begin to explore the formal sides of Consonant Theory. What phonological processes does it propose, and what predictions does it make?

3 Consonant Theory

In this section, we will see that Consonant Theory needs two main rules to account for the relevant data on quantity: **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, acknowledging that there is as yet no phonological evidence for this. But before covering this rule in any more detail, we will first consider **C_2 length**.

3.1 C_2 Length

C_2 length lengthens consonants in certain clusters. In prose, it can be stated as follows: “In a stressed syllable, lengthen the first of two or more tautomorphemic consonants.” Formally, it is $Ø \rightarrow C_i$ / V_C_iC within a morpheme. The motivation for this rule is that consonant length is predictable in this environment. There are words like [ˈmjœlːkʰ] 'milk' (underlyingly /ˈmjølk/ in Consonant Theory), but single morphemes of the type *[ˈmjøːlkʰ] “are ungrammatical” (Löfstedt 2010: 49).[8] **C_2 length** applies to words like those in (4) a), but does not apply in the words in (4)

7 Some transcribe words of this shape with a short postvocalic consonant: [ˈCVCC] (Löfstedt 2010: 12, Witting 1977: 31). I follow Riad (R: 167, fn. 8) in assuming that the often half-long consonant is fully long in the output of the phonology (i.e. the SR), but that it may be somewhat shorter in the output of phonetics (i.e. the bodily output; on this term see Hale and Reiss 2008: 83).

8 In actual fact, many words of this form exist. They are typically treated as exceptions in Consonant Theory, and will be discussed further in section 4.1.

b) since those have a morpheme boundary within the cluster.

(4) Motivating **C_2 length**

UR (Consonant Theory)	SR	Translation
a) Application		
/ˈfest/	[ˈfɛsːtʰ]	party, n.
/ˈmjølk/	[ˈmjœlːkʰ]	milk
b) Non-application before a morpheme boundary		
/ˈkɑl-t/	[ˈkʰɑːltʰ]	bare, neut.; cf. [ˈkʰɑːl] 'bare, com.'
/ˈsul-s/	[ˈsuːls]	sun, poss.; cf. [ˈsuːl] 'sun'

3.2 V Length

The second final rule we have to discuss is the more complicated one, **V length**. As I have already mentioned, vowel lengthening occurs in a number of different contexts. In the literature, there have been several proposals for how to formalize **V length**, including Teleman (1969) and Eliasson and LaPelle (1973). Both of these analyses, however, make incorrect predictions. The problem lies in separating words like /ˈvit-t/ 'white, neut.' (which surface with a short vowel) from words like /²ˈmut-ˌtɑ/ 'to receive' (which surface with a long vowel). It is true that these linguists do not explicitly discuss what happens in cases of compounding (as with 'to receive', literally 'against' + 'take'). However, their analysis of single prosodic words fails to extend to these cases. Both of these types of words have the sequence /t-t/, so the rules proposed incorrectly produce a short vowel for both of them.

Both analyses are also arguably conceptually undesirable, requiring Duke of York derivations (Eliasson and LaPelle 1973: 144; for the term see Pullum 1976). For Teleman (1969), words like 'white, neut.' have a short vowel underlyingly, and this vowel lengthens only to be shortened again in the surface form (Eliasson and LaPelle 1973: 144, fn. 15). Eliasson and LaPelle (1973) instead insert an extra consonant to prevent vowel lengthening, and which gives the observed surface geminate consonant. However, in their rule system this consonant undergoes lengthening to overlong, only to shorten down to a normal geminate again in the surface form (Eliasson and LaPelle 1973: 144).

Because of these issues with earlier analyses, I propose a new one here. Its one flaw – being convoluted – is compensated for by the fact that it is empirically adequate. Any analysis which cannot explain Swedish words is not the analysis that native speakers use. If a complicated analysis is the only one which has empirical coverage, then it is preferable to others, even if it is not economical (pace Chomsky and Halle 1968: viii-ix, Chomsky 2002: 98). With this said, we are ready to take a look at **V length**. In prose, it is: "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},[9] and d) before sequences of /r/ and a coronal consonant."

9 For the notion prosodically minimal word, see Riad (R, ch. 5) and Itô and Mester (2012).

Formally, these four vowel lengthenings can be written as follows:

(5) **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 (6) a), ii) before a single word-final consonant (6) b), but not before geminate consonants (6) c) nor before tautomorphemic consonant clusters (6) d), iii) before an optional consonant, a morpheme boundary and a different consonant (6) e), but not before identical consonants split by a morpheme boundary (6) f), iv) before an optional consonant at the end of a phonological word, even if the following consonant is identical (6) g), and v) before /r/ followed by a coronal consonant (6) h).

(6) **V length** in action

UR (Consonant Theory)	SR	Translation
a) Open syllables		
/ˈse/	[ˈseː]	to see
/ˈpeter/	[ˈpʰeːtɛr]	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/	[ˈmjœlːkʰ]	milk
e) Before an optional consonant, a morpheme boundary and a different consonant		
/ˈse-s/	[ˈseːs]	see, pass.
/ˈgʉl-t/	[ˈgʉːltʰ]	yellow, neut.
f) Not before a consonant, a morpheme boundary and the same consonant		
/ˈvit-t/	[ˈvɪtʰː]	white, neut.
g) At the end of a minimal prosodic word		
/^{2}ˈsil]$_{\omega\text{-min}}$-førˌstør-else/	[^{2}ˈsiːlfœʂˌtøːrɛlsɛ]	sieve destruction
/^{2}ˈsil]$_{\omega\text{-min}}$-ˌlɑgr-iŋ/	[^{2}ˈsiːlˌ(l)ɑːgrɪŋ][10]	sieve storage

10 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][11]	world

Having seen what **V length** does and does not do, let's look at the motivation for such a rule. Something like **V length** is clearly needed in a Consonant Theoretic description of Swedish. Since long vowels are claimed not to be underlying, they must come from a vowel lengthening rule. However, there is also motivation from alternations, second-language transfer and loanwords supporting the existence of this rule. We will focus on the alternations, as they have been very important in Consonant Theoretic argumentation. They are, for example, the sole topic of Eliasson (1985), and an important part of Riad (2014). The argument is as follows: **V length** ensures that vowels lengthen in (some) stressed syllables. If stress were somehow moved around in a word, vowel length should follow. This is exactly what is observed in what I call the 'critical' alternations (data from E: 116).

(7) The 'critical' alternations

UR (Consonant Theory)	SR	Translation
/kriˈt-ik/	[kʰrɪˈtʰiːkʰ]	criticism
/ˈkrit-isk/	[ˈkʰriːtɪskʰ]	critical

In 'critical', the stressed root has a long vowel by (5) a). 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 ask the reader to remember that 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, one could include a vowel lengthening rule to explain alternations like these. However, that would defeat 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. Yet there is no reason to think that it is long in the base form [kʰrɪˈtʰiːkʰ] 'criticism', so it is unclear why learners would propose such an analysis. The alternations are also “fully productive” (E: 120), which, Eliasson claims, cannot be explained other than by a vowel lengthening rule. As mentioned above, **V length** has also been argued to be productive in loanwords (Löfstedt 1992: 95), and as a transfer effect when Swedes speak languages like Finnish which lack vowel lengthening (Karlsson 1977, cited in Eliasson 1982: 189-190).

3.3 An additional argument, and some predictions

We will end the section on Consonant Theory with what I consider to be the most persuasive argument for this view of Swedish quantity. It is not applicable to the versions of Consonant

11 The /r/ and /d/ coalesce in a process of retroflexion. See section 4.1 for references, and for discussion of why we cannot subsume cases like these under (5) b), as lengthening before a single tautomorphemic consonant.

Theory proposed by Eliasson and LaPelle (1973) and Riad (2014), which is why it is difficult to find it in the literature. Indeed, while the facts I am about to present have been discussed, I am not aware of any linguist ever having used them to explicitly argue for Consonant Theory. The argument rests on a contrast between a morpheme /t/ and a morpheme /tt/. This cannot be expressed in Vowel Theory, where consonant length is not distinctive. The morpheme /t/ is the definite suffix for neuter nouns. The surface form varies between [ɛtʰ] and [tʰ], both within and across speakers (Riad 2003), but the grammatical forms presented here are from SCSw., and the ungrammatical forms are, as far as I am aware, not found in any variety of Swedish. Consider the following table for the neuter noun 'knee':

(8) Definite knees

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

This shows that the definite neuter suffix consists of a single /t/, and that a suffix /tt/ would give the wrong result. Next we will consider the neuter suffix for adjectives, which is /tt/ (for more suffixes which pattern this way, see R: 174). To prove its quantity, we will look at the common and neuter gender forms of 'new'. I am not aware of any variation for this suffix whatsoever.

(9) 'new' evidence

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

This shows that the neuter adjective suffix is /tt/, not /t/. We have now seen one suffix of the form /t/ and another of the form /tt/. Since Vowel Theory cannot express this difference, these data provide a very strong argument for distinctive consonant length.

In order to evaluate Consonant Theory, we would like to know what predictions it makes. Fortunately, predictions are easy to identify. Below I highlight three of the main ones:

(10) Three predictions

1. [Vː CC] sequences are generally banned in monomorphemic syllables (Löfstedt 2010: 8 and 59, Raffelsiefen 2007: 49; Lorentz 1996: 112 for Scandinavian in general, and Rice 2006: 1172 for Norwegian)[12]
2. There are no short vowels in stressed open syllables (Schaeffler 2005: 7, Witting 1977: 33 and the analyses referred to in E: 104), since every stressed syllable is heavy (bimoraic), while every unstressed syllable is light (monomoraic; Löfstedt 1992, 2010 *passim*, and R: 159 and references therein)
3. There are no perfect minimal pairs for vowel length (Eliasson 1978: 118,[13] E: 107, Eliasson 2010: 28, Riad 1992: 281 and R: 165), since vowel length is predictable from consonant length (Eliasson 1978: 118, E: 103-4 and the references therein and Löfstedt 1992: 96)

Some of these predictions are consequences of the rule system outlined above; for example, prediction 1 follows from the fact that Consonant Theoretic proposals for vowel lengthening do not include lengthening in syllables closed by clusters. Others are far more central to the theory: if prediction 3. is false, and vowel length is not predictable from consonant length, it would be impossible to maintain that there is nothing in underlying representations which signals that some vowels are long while others are short.

We have now seen the quantity rules which I propose for Consonant Theory, both of which are found in the existing literature. In addition, we have seen a general argument in favor of underlying consonant length in Swedish, and identified several important predictions of Consonant Theory. It is now time to see whether this predictions are true.

4 Evaluating Consonant Theory

The aim of this section is to show that the central predictions of Consonant Theory are false. We will see that patterns predicted to be exceptional or non-existent do exist, and must be accounted for by theories of Swedish phonology. I challenge the idea that some of these forms can be disregarded because they are interjections. Even the interjections show several clear signs of being integrated in the normal phonology of SCSw., in ways which cannot be accounted for by Consonant Theory. This suggests that interjections should be treated as part of the same phonology as other vocabulary, even when this means abandoning teleological generalizations about the phonology of a language. This is in line with non-teleological theories, like substance-free phonology, as opposed to theories where phonological processes are motivated by creating a more 'optimal' surface form.

12 This description is somewhat inaccurate. For more discussion, see section 4.1.

13 Eliasson (1978: 118) does mention "some truly marginal cases," but does not say what they are. Perhaps he is referring to data he calls paralinguistic in Eliasson (2010: 10), discussed in section 4.2.

4.1 Prediction 1: *[ˈVːCC]

We will begin with prediction 1 from (10) above: within a morpheme, [ˈVːCC] is not a possible sequence. There are well-known types of exceptions to this prediction which are not problematic for Consonant Theory. For example, words like [^{2}ˈseːbra] 'zebra' show open-syllable lengthening because [br] can form an onset: [^{2}ˈseː.bra] (R: 170). However, it is generally acknowledged that there are a handful of genuinely problematic cases. Löfstedt (2010: 59), for example, says that although this phonotactic constraint "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/" (Löfstedt 1992: 96). 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/. This is not true. Below I list a much larger set of exceptions, including nouns, adjectives, verbs, and proper names in a wide variety of phonetic environments. Words marked with % either have alternative pronunciations which do not constitute exceptions, or are so rare that some native speakers may not have them in their lexicons.

(11) The many [VːCC] words of SCSw.

UR (Vowel Theory)	SR	Translation
a) Content words with retroflexes perceived to be native		
/ˈɑːrt/	[ˈɑːʈʰ]	kind, species
%/ˈstɑːrt/	[ˈstɑːʈʰ]	start, n.
/^{2}ˈtoːrt-a/	[^{2}ˈtʰoːʈa]	cake
/ˈsnɑːrt/	[ˈsnɑːʈʰ]	soon
/ˈsmɑːrt/	[ˈsmɑːʈʰ]	smart
/^{2}ˈvoːrt-a/	[^{2}ˈvoːʈa]	wart
/ˈpoːrtɛr/	[ˈpʰoːʈɛr]	stout, n.
/ˈkɑːrt/	[ˈkʰɑːʈʰ]	unripe fruit
/^{2}ˈɑːrt-a sɛj/	[^{2}ˈɑːʈa sɛjː]	to pick up (as in *things are picking up*)
/^{2}ˈkɑːrt-a/	[^{2}ˈkʰɑːʈa]	map, n.
/^{2}ˈɑːrt-ɪ(g)/	[^{2}ˈɑːʈɪ(g)]	polite
/ˈpɑːrt/	[ˈpʰɑːʈʰ]	share, n.
/ˈfɑːrt/	[ˈfɑːʈʰ]	speed, n.
/^{2}ˈʉːr-ɑːrt-a/	[^{2}ˈʉːrɑːʈa]	to degenerate, spin out of control
%/ˈpuːrt/	[ˈpʰuːʈʰ]	gate, large door
%/^{2}ˈvɑːrsɛ/	[^{2}ˈvɑːʂɛ]	aware (as in *become aware of*)
%/^{2}ˈɧuːrt-a/	[^{2}ˈɧuːʈa]	shirt
%/^{2}ˈjuːrtrɔn/	[^{2}ˈjuːʈrɔn]	cloudberry

%/^{2}ˈɕuːrtɛl/	[^{2}ˈɕuːʈɛl]	kirtle
%/ˈkuːrt/	[ˈkʰuːʈʰ]	card
%/^{2}ˈmuːrtɛl/	[^{2}ˈmuːʈɛl]	mortar

b) Content words without retroflexes perceived to be native

/ˈmoːln/	[ˈmoːln]	cloud
/ˈɑːln/	[ˈɑːln]	ell (archaic unit of length)
/^{2}ˈɕøːln-a/	[^{2}ˈɕøːlna]	kiln
/^{2}ˈoːsn-a/	[^{2}ˈoːsna]	donkey
/^{2}ˈstøːdj-a/	[^{2}ˈstøːdja]	to support
/^{2}ˈuːdl-a/	[^{2}ˈuːdla]	to grow, trans.
/^{2}ˈøːdl-a/	[^{2}ˈøːdla]	lizard
/^{2}ˈstɛːvj-a/	[^{2}ˈstɛːvja]	to stifle
%/ˈliːnjɛ/	[ˈliːnjɛ]	line, n.
%/ˈvɛːnj dɛj/	[ˈvɛːnj dɛj]	get used to (it)!
%/^{2}ˈhɛːvd-a/	[^{2}ˈhɛːvda]	to claim, assert
/^{2}ˈvɛːdj-a/	[^{2}ˈvɛːdja]	to beg, plead
%/^{2}ˈiːdk-a/	[^{2}ˈiːdka]	to practice
/^{2}ˈɕeːdj-a/	[^{2}ˈɕeːdja]	(to) chain, n. and v.
%/ˈglɛːdj dɛj/	[ˈglɛːdj dɛj]	rejoice!
/^{2}ˈmiːdj-a/	[^{2}ˈmiːdja]	waist
%/ˈboːld/	[ˈboːld]	noble, mighty, proud etc.

c) Names of people and places

/ˈlɑːrs/	[ˈlɑːʂ]	-
/ˈvɑːlbɔrj/	[ˈvɑːlbɔrj]	-
/ˈsuːlvɛj/	[ˈsuːlvɛj]	-
%/ˈheːdvɪg/	[ˈheːdvɪg]	-
%/ˈeːdvɪn/	[ˈeːdvɪn]	-
/^{2}ˈkoːlsrʉːd/	[^{2}ˈkoːlsrʉːd]	-
/ˈɑːdlɛr/	[ˈɑːdlɛr]	-
/^{2}ˈeːdla/	[^{2}ˈeːdla]	-
/^{2}ˈsoːlna/	[^{2}ˈsoːlna]	-
%/^{2}ˈrɑːmløːsa/	[^{2}ˈrɑːmløːsa]	-
%/ˈsøːrm-ˌland/	[ˈsøːrmˌlanːd]	-

d) Loanwords and names perceived to be foreign

/ˈɕøːrtsɪl/	[ˈɕøːʈʂɪl]	Churchill
/ˈoːstɛr/	[ˈoːstɛr]	Auster (name)
%/ˈsɛːndɛrs/	[ˈsɛːndɛʂ]	Sanders (name)
%/ˈsøːrvɪs/	[ˈsøːrvɪs]	service

%/ˈskɑːrf/	[ˈskɑːrf]	scarf
/ˌɑːftɛrˈskiː/	[ˌɑːftɛˈʂkiː]	after-ski
/ˈstɛːndap/	[ˈstɛːndapʰ]	stand-up (for some also [ˌstɛːndˈapʰː])
/ˈsɑːrs/	[ˈsɑːrs]~[ˈsɑːʂ]	SARS
/ˈbɑːskɛt/	[ˈbɑːskɛtʰ]	basketball (the game)
%/ˈmoːtsart/	[ˈmoːtsaʈʰ]	Mozart
/hʊˈrɑːtsɪɵs/	[hʊˈrɑːtsɪɵs]	Horace
%/ˈgrɑːtsɪɛ/	[ˈgrɑːtsɪɛ]	pleasure
/²ˈiːsraɛl/	[²ˈiːsraɛl]	Israel
%/ˈkeːnja/	[ˈkʰeːnja]	Kenya
/ˈsvɑːlˌbɑːrd/	[ˈsvɑːlˌbɑːɖ]	Svalbard

Hopefully this makes it clear that there are far more exceptions than the two cited in Löfstedt (2010: 59). Depending on idiolectal differences, the list above shows between 42 and 64 exceptions, hardly "marginal to the system," as has been claimed in the literature (Eliasson 2010: 13). Given these attested examples, I do not fully understand why Löfstedt (2010: 49) claims that this phonotactic pattern is ungrammatical.

Individual words in the list above can be given alternative explanations, but no solution makes all (or even most) of the exceptions go away. For example, retroflexes are single segments in the SR, even though they underlyingly come from clusters (see R, ch. 4, and references therein). One might be able to say that /ˈart/ 'kind, species' becomes aʈ by retroflexion, with vowel lengthening before a single consonant (exactly as in /ˈsil/ 'sieve'). But this incorrectly predicts the absence of words with long retroflexes, like [ˈkʰvaʈʰː] 'quarter of an hour.' Riad's solution to this retroflex problem is that words like [ˈɑːʈʰ] are /ˈart/ underlyingly, while words like [ˈkʰvaʈʰː] are /ˈkvarrt/ underlyingly (see the transcriptions in R: 79).[14]

One could easily extend this solution to non-retroflex cases, such as [ˈmoːln] 'cloud' versus [ˈkʰœlːn] 'Cologne', which would be /ˈmoln/ and /ˈkølln/ respectively. Riad (p.c.) claims that this undesirable, given that there are so few [ˈmoːln]-type words. Eliasson and LaPelle (1973: 140) say it is "obviously a non-desirable result." Yet as the list above shows, there are actually quite many [ˈmoːln]-type words (11-17 even if we count only native content words; 15 in my idiolect). Why 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 must choose whether they prioritize having an economical theory over accounting for the pronunciations of Swedish words.

One could also argue that some of these long vowels are in open syllables. SCSw. syllables can begin with /sk/, so a word like [ˈbɑːskɛtʰ] 'basketball (the game)' should be syllabified [ˈbɑː.skɛtʰ], with the expected lengthening in a stressed open syllable. But that syllabification makes incorrect predictions. If a word like [ˈhɛsːt] 'horse' is underlyingly /ˈhest/, it

14 In section 3.2, I used this analysis when I included lengthening before /r/ and coronal consonants as the fourth environment of **V length**.

should get a long vowel if a vowel-initial suffix is attached to it. So /ˈhest-ar/ 'horses', should be syllabified ˈhe.star and undergo open-syllable lengthening. This is not what we see. The plural 'horses' is not *[²ˈheː.star], but instead [²ˈhɛsː.tar]. This either means that Swedish lacks onset maximization when dividing words into syllables, or that the word 'horse' should be /ˈhesst/ in Consonant Theory. I suggested the latter solution for words like [ˈkʰœlːn] 'Cologne' above for independent reasons (cf. also the transcriptions for Consonant Theory by the Vowel Theorist Witting 1977: 34).

Other alternatives include highly idiosyncratic morphemic decomposition, e.g. Riad's (R: 180) suggestion that words like [ˈbɑːskɛtʰ] 'basketball (the game)' contain a suffix *-ket* 'to do with sports/games,' also found in the Swedish words for *rac-ket* and *cric-ket*. Riad (p.c.) suggests that [²ˈuːdla] 'to grow' may be /²ˈud-l-ɑ/, with a verbal suffix /l/, which is again unmotivated: the hypothetical stem /ud/ never appears without it, and there is no meaning it could possibly have.[15]

In Eliasson and LaPelle's (1973) analysis, some of the words in (11) are accounted for; their vowel lengthening rule predicts lengthening before sequences of [-son] and [+cons, +son, +cor] (Eliasson and LaPelle 1973: 139). But out of the 64 words in (11), this still leaves us with 58 exceptions. The wording in Eliasson (2010: 13) gives the same results. While these analyses remove a few exceptions, it is still the case that none of the Consonant Theoretic analyses in the literature can account for the words in (11) above. From this we can conclude that point 1 in the list above is not true. SCSw. does allow [VːCC] clusters, and there are (at least) 40-60 of these words, and not just 2-3 as many linguists have assumed. We will now move on to predictions 2 and 3 from the list in (10).

4.2 Prediction 2: short vowels in open syllables

Recall that prediction 2 was the absence of short vowels in stressed open syllables. Lorentz (1996: 112), who is writing about Scandinavian in general, explicitly says that there are “no exceptions” to this generalization.[16] Together with other quantity facts about Swedish, this has led many researchers to conclude that every stressed syllable in Swedish is heavy (i.e. has two moras), while every unstressed syllable is light (i.e. has one mora). This generalization about the optimality of bimoraic syllables is key in many analyses of Swedish, such as Löfstedt (1992, 2010) and Riad (2014). Rice (2006) even uses the bidirectional implication stressed ↔ heavy to justify an Optimality Theoretic analysis of Norwegian (Rice 2006: 1171), which is very similar to SCSw. when it comes to quantity.

These above-mentioned analyses, however, would struggle to account for the words that do have short vowels in stressed open syllables. I cannot present a long list of such words, as in 4.1, and there are in fact very few words of this type. (12) lists some examples that I am aware of. Two of them are taken from Elert (1964: 35). Elert's work is extremely well-known and well-cited, but these words have not figured in Vowel or Consonant Theoretic treatments since then.

15 It is unlikely to be a verbalizer, since the verbal meaning is conveyed already by the infinitive ending /-a/.

16 Lorentz acknolwedges that the varieties/languages he discusses do show phonological differences. However, the only difference he discusses concerns vowels in closed stressed syllables.

(12) Come again?

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

[ˈa] means 'for' when referring to prices, as in *Två kex* [a] *5 kronor (styck)* 'Two biscuits **for** 5 SEK (each)'. It can also translate the 'to' of '10 to 20 biscuits.' [ˈva] is used to ask someone to repeat information, like *come again* in English. It is also used as a clause-final particle in declaratives. [ˈjɵ] is an adverb appearing in declarative clauses. It conveys that the speaker expects the information in the clause to be obvious or already known to the hearer; a translation might be 'of course.' It is also the first (and for some, also the second) *the* in sentences like *the slower you walk, the longer it will take you to get there*. The last three words in (12) all have semantically similar forms with a long vowel: /ˈjɑː/ 'yes (in response to positives)', /ˈjuː/ 'yes (in response to negatives)', and /ˈnoː/ 'well' (as in *well, are you coming?*).

The three forms which have long-vowel alternants might seem easy to dismiss, and indeed the short vowels of words like these have been called "paralinguistic" (Eliasson 2010: 10). They always seem to convey the same meaning as the long-vowel forms, with some added emotional content. For example, Eliasson describes [ˈnɔ] 'well' as an impatient counterpart of [ˈnoː] (E: 109). However, if the shortening is paralinguistic, we would expect it to be unaffected by linguistic constraints. And yet, note that when the /oː/ of /ˈnoː/ shortens, it does not simply become [o]. Instead, the quality shifts to give [ˈnɔ], and this is the exact same vowel quality shift that we see in morphological alternations: [ˈf**o**ːn] 'phone (linguistic term)' but [f**ɔ**nʊlʊˈgiː] 'phonology' (Eliasson 2010: 13). This is a general pattern across all such words. In section 5.2, I will argue that certain words have phonetically-shortened vowels, which all fail to show these quality alternations. Words like [ˈnɔ] 'well,' then, show evidence of containing phonologically short vowels. Moreover, as the replacement of the palatal approximant [j] with a palatal fricative [ʝ] is becoming more prestigious, words like [ˈja]~[ˈʝa] are also affected, suggesting that they participate in ongoing sound changes just like other words do.

The three words discussed above, and probably others that I have forgotten to include here, also participate in synchronic linguistic processes which are not predicted by Consonant Theory. Consider the (Vowel Theoretic) underlying form /ˈja-soː/ 'oh really?', from /ˈja/ 'yes' and /ˈsoː/ 'so.' As we will see in section 5.1, Vowel Theory has a rule lengthening consonants after short stressed vowels, correctly predicting the surface form [ˈjasːɔ] 'oh really?'. The /s/ is lengthened only because the preceding vowel is short. Consonant Theory cannot encode vowel length distinctions, and we would get the incorrect /ˈjɑ-so/ → *[ˈjɑːsɔ].

One might complain that forms like these are simply lexicalized, and are no longer synchronically complex. Riad takes gemination of an etymologically morpheme-initial consonant in the word for 'garden' as a sign of lexicalization (R: 124), and the same argument could be applied here. However, there is reason to think that this gemination pattern is not simply lexicalized. The morpheme /ˈdoː/ 'then' (as in English *now then*; cf. R: 101 footnote 20) may attach to a long-vowel form of 'yes', /ˈjɑː/, in SCSw. In the resulting /ˈjɑː-doː/ 'oh yes, sure', /doː/ is pronounced [rɔ], with the /d/ surfacing as [r] in a process affecting a restricted class of function words (see R: 100-102). In recent years, /ˈdoː/ has also begun being suffixed to /ˈja/, with the same meaning. The resulting form has the /d/ becoming a rhotic again, but as the rhotic is now after a short stressed vowel, it must lengthen (see section 5.1): [ˈjarːɔ].[17] Before this form was innovated, there was no environment in which /ˈdoː/ had a long consonant, so there was no reason for a Consonant Theoretic learner to think that it had an initial geminate, the prerequisite for generating a form like [ˈjarːɔ]. The innovation of [ˈjarːɔ] therefore suggests that there are productive alternations predicted not to occur in Consonant Theory.

Further evidence to this effect can be found in new SCSw. vocabulary. The data here come from Johanna Frändén, a soccer commentator during the European Championships in 2016. Before the championships, the player Karim Benzema was suspended from the French team. His last name, [bɛnzɛˈma] in French, was nativized by Frändén as [bɛnsɛˈma]. What is 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 cannot be a geminate in Consonant Theory, as shown below:

(13) Po**s**e**s**ive **s**

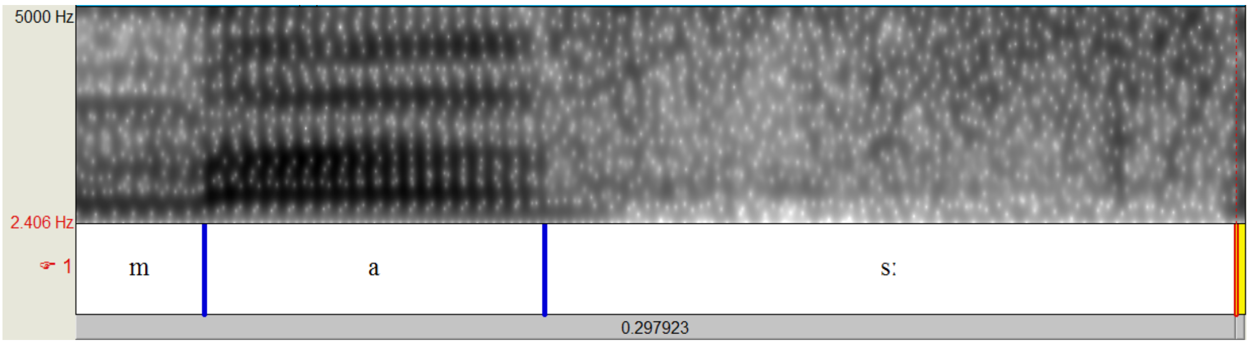
UR (Consonant Theory)	SR	Translation
/te/	[ˈtʰeː]	tea
Grammatical possessive with singleton /s/: /te-s/	[ˈtʰeːs]	tea, poss.
Ungrammatical possessive with geminate /ss/: /te-ss/	*[ˈtʰɛsː]	Intended: tea, poss.

In Consonant Theory, the possessive /benseˈma-s/ should give *[bɛnsɛˈmɑːs].[18] And yet, Frändén's possessive of [bɛnsɛˈma] was [bɛnsɛˈmasː] with a geminate [sː]. A spectrogram of her pronunciation makes it clear beyond any doubt that it contains a short vowel followed by a long consonant:

17 Analogous facts hold for /jʊ/ 'yes (in response to negatives).'

18 Or more likely *[bɛnsɛˈmaːs], with the [aː] found only in loanwords, representing an eighteenth vowel phoneme.

(14) A spectrogram



In Vowel Theory, the variation between [s] and [sː] in this suffix can be straightforwardly accounted for. When the stem ends in a long vowel, as in /ˈteː/ 'tea', the underlying short /s/ surfaces as [s]. When the stem ends in a short vowel, as in /bɛnsɛˈma/, /s/ is lengthened to [sː] (again, see section 5.1). In Consonant Theory, one would have to argue that there are two allomorphs /s/ and /ss/. But it is unclear how a child would acquire the /ss/ allomorph, given that none of the other words ending in a short stressed vowel in Swedish are nouns (see (12) above). None of them take the possessive suffix, so the crucial data leading the Consonant Theory child to set up an allomorph /ss/ is absent from the input. Therefore, Frändén's pronunciations are good evidence for the existence of short stressed vowels in open syllables in SCSw., which interact with the usual phonological patterns of the language in ways not predicted by Consonant Theory.

Some of the words in question also interact with syntactic processes. For example, [ˈjɵ], written <ju>, follows the main verb in main clauses, but precedes it in subordinate clauses, like other Swedish adverbs do. These adverb facts are illustrated in the sentences below by the placement of *faktiskt* 'actually'.

(15) 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.
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.'

The proposal which holds the most promise is Riad's (p.c.) suggestion that the words in (12) are phonologically stressless, thereby escaping **V length** in stressed syllables. Riad (2015) shows that there are independent reasons to think that Swedish has stressless words (see section 5.2). Unfortunately, this does not work either. In forms like [ˈjasːɔ] 'oh really?' and [bɛnsɛˈmasː] 'Benzema, poss.,' the long postvocalic consonant is evidence that the preceding vowel is stressed: recall from section 2 that long segments in SCSw. are, exceptionlessly, limited to stressed syllables.

The only other explanation which 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**. This approach has a significant theoretical downside. To see this, consider the following quote from Riad, explaining one of the advantages of his theory. Note that he uses Stress-to-Weight to refer to the requirement that stressed syllables be bimoraic:

> If a vowel is short in an open syllable and receives stress, it will lengthen to two moras by Stress-to-Weight ($CV_{\mu} > CV_{\mu\mu}$, phonetically CVː). 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 CVCː). 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 CVCː.CV). These are the only three cases and they always result in heavy stressed syllables. (R: 178)

He argues that it is advantageous that Consonant Theory generalizes across all of these contexts using a single constraint. But if there is counterfeeding involved, this can no longer be. In the possessive [bɛnsɛˈmasː], we are now entertaining the idea that the word begins its life without stress. **V length** fails to apply, as there are no stressed syllables. The possessive /s/ (which must be a singleton in Consonant Theory, see (13)) is then added, and the word becomes stressed. Subsequently, some version of Stress-to-Weight applies again, producing [bɛnsɛˈmasː] and not *[bɛnsɛˈmas]. This must crucially be a different constraint, because a short vowel followed by a short consonant would usually give vowel lengthening (see section 3.1). We cannot maintain the teleological generalization that a single constraint is driving a conspiracy which produces a particular 'optimal' output. I leave it to future Consonant Theorists to decide how to analyze these facts.

The conclusion of this discussion is that Swedish has open syllables with short stressed vowels. These words cannot easily be dismissed, since there is phonological evidence that the syllables are stressed, and both phonological and syntactic evidence showing that they interact with the usual linguistic system of SCSw. The data are predicted to occur if SCSw. has distinctive vowel length, but are predicted not to occur in Consonant Theory. They provide, then, a clear empirical reason to prefer a version of Vowel Theory which ignores teleological generalizations and putative conspiracies in favor of a straightforward account of the SCSw. data.

4.3 Prediction 3: absence of minimal pairs

There is 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 cannot contrast “by logical necessity.” In (33) below, I show three perfect minimal pairs for the vowel phonemes /a/ and /ɑː/, without any differences in the quantity or quality of any other segment, or any suprasegmental differences:

(16) They exist

UR (Vowel Theory)	SR	Translation
/ˈa/	[ˈa]	for (of price per item; see text below (12))
/ˈɑː/	[ˈɑː]	A (music), A (Latin), A (grade in schools)
/ˈva/	[ˈva]	come again (for elaboration, see text below (12))
/ˈvɑː/	[ˈvɑː]	to be, was/were, what (interrogative)[19]
/ˈja/	[ˈja]	yes
/ˈjɑː/	[ˈjɑː]	yes, I (first-person singular subject pronoun)[20]

Contrary to what has previously been claimed with such conviction, Swedish has perfect minimal pairs for vowel length. It naturally follows that vowel length cannot be predicted from consonant length, undermining Consonant Theory's raison d'être. Only a theory with lexical vowel length can explain these data in a satisfying way (see 4.2 for discussion of alternative treatments of the short-vowel forms).

There is one point that must be discussed in relation to minimal pairs, as well as the few words like /ˈa/ that exist in Swedish. There is 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 spirit of the following quote from Rice (2006: 1180) on a different topic: “While there may be relatively few such words /…/, 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 everyone has the minimal pairs in (16). Whatever constraint ranking or set of rules one believes in, it must be able to map some

19 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/were' and 'what' respectively, though in my idiolect, 'was/were' obligatorily lacks the final [r]: *[ˈvɑːr].

20 The subject pronoun may also be pronounced [ˈjɑːg], especially in formal registers.

underlying form to [ˈa], and some other underlying form to [ˈɑː]. Any theory which fails to do this cannot be the one used by native speakers of SCSw. I am arguing that the best theory for all the facts of Swedish quantity is one with distinctive vowel length. It correctly predicts the existence of these contrasts, as well as the alternations they cause (for which see 4.2), whereas Consonant Theory incorrectly predicts their absence. Of the two theories, only Vowel Theory offers a full explanation for a native speaker's phonological competence.

5 Vowel Theory

I now hope to have shown the need for a theory of SCSw. quantity where vowel length is distinctive. This section aims to provide an explicit formalization of what such a theory might look like. I will introduce the three necessary rules, as well as motivation for them. All rules will be supported by external evidence. Where relevant, we will also see counterarguments against certain ideas from Consonant Theory which have not yet been discussed.

5.1 C length

The first rule we will look at is **C length**, which is the Vowel Theory equivalent of Consonant Theory's **V length**. **V length** was intended to explain where long vowels came from, and **C length** is intended to explain where long consonants come from. A prose description of **C length** is 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** in (5). However, there is a complication. What if the short stressed vowel is already followed by two identical consonants? This situation arises across morpheme boundaries, and the two consonants are not lengthened further to overlong:

(17) Nothing is longer than long

UR (Vowel Theory)	SR	Translation
/ˈlɛt/	[ˈlɛtʰː]	easy, com.
/ˈlɛt-t/	[ˈlɛtʰː], *[ˈlɛtʰːː]	easy, neut.

We will restrict **C length** so that it does not apply in these contexts.[21] In prose, **C length** then becomes: "Insert a consonant C_i between a short stressed vowel and anything but C_i." How might this be formalized? It seems to me that the feature algebra of Reiss (2003) is a good solution. In this formalism, one can easily express the idea that two segments have to be different, irrespective of what features they do or do not share. While this is my preferred analysis, I will use a simpler notation in this article. C_i and C_j are [+cons] segments which have different specifications for some feature. I will write C_i and X_j, where X_j differs from C_i in some feature,

21 An alternative analysis uses a Duke of York derivation: /ˈlɛt-t/ becomes ˈlɛtʰːː by an unrestricted **C length**, and a subsequent rule of degemination produces the attested surface form. I am not aware of any motivation for such a degemination rule, which is why I do not pursue this analysis further.

which may itself be [cons]. X_j effectively means 'any *segment* but C_i' just as C_j means 'any *consonant* but C_i'. The entire rule is now: $\emptyset \rightarrow C_i$ / ˈV_$C_i(X_j)$

The motivation for **C length** ought to be obvious; it is simply where long consonants in Swedish come from. Below are a few examples of cases where **C length** applies:

(18) **C length**

UR (Vowel Theory)	SR	Translation
/ˈsɪl/	[ˈsɪlː]	herring
/ˈfɛst/	[ˈfɛsːtʰ]	party, n.
/²ˈmata/	[²ˈmatːa]	mat, carpet
/aˈtak/	[aˈtʰakʰː]	attack, n.

Notice that in some cases, such as /²ˈmata/ 'mat, carpet,' **C length** differs from approaches based on markedness, which predict open-syllable lengthening (R: 177). This approach to SCSw. quantity predicts that consonant lengthening should be productive whenever a stressed short vowel precedes. A number of facts support this prediction. Perhaps the weakest evidence comes from morphological alternations. In (18) 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 in this conjugation as the infinitive and imperative ending. This gives [ataˈkʰeːra] '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, and so undergoes lengthening. But in the verb, the suffix bears the stress, and the /k/ is no longer in a position where **C length** can apply.

(19) 'Attack!'

/aˈtak/	[aˈtʰakʰː]	attack, n.
/ataˈk-eːr-a/	[ataˈkʰeːra]	attack!/to attack

The attentive reader may have 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. (19) shows that there is also consonant length moving with stress. This could be used as an argument for Vowel Theory in an analogous way. The end result would be that some alternations favor Vowel Theory, and others Consonant Theory. No side really wins the battle of joint quantity and stress movement.

Even so, Consonant Theorists have placed a lot of importance on the 'critical' alternations. This is puzzling, since we have just seen that no theory has the upper hand. It is even more puzzling when one considers that both Eliasson (1985) and Riad (2014) cite both kinds of alternations. Eliasson has even noticed that the 'attack' alternations are problematic, and says that this "may at first seem like a drawback" to his theory (E: 112). Even so, Eliasson's article criticizes Vowel Theory for an analysis which is identical to his own, only targeting vowels instead of consonants.[22] There is not a word in Eliasson (1985) about how the identical problems for his own theory might be solved.

It is also worth mentioning that counterparts to the 'critical' alternations are found in languages like German and English, which lack both morpheme-internal long consonants and vowel-lengthening rules like **V length**. From this we can conclude that the existence of 'critical' alternations in Swedish is insufficient as an argument for long consonants and **V length**. Some German and English data are given below.

(20) Meanwhile outside of Sweden

SR	Translation
a) Standard German (see also Wiese 2000: 287-296)	
[ˈkʰan**a**da]	Canada
[kʰaˈn**a**ːdɪʃ]	Canadian
b) General American	
[ˈkʰeən**ə**ɾə]	Canada
[kʰəˈn**eɪ**ɾiən]	Canadian

Fortunately, morphological alternations are not the only pieces of evidence in favor of **C length**. We saw in section 4.2 that consonant lengthening applies across morpheme boundaries in derivations like /ˈja-soː/ → [ˈjasːɔ], and that there was some evidence that this is productive. **C length** is also productive under so-called corrective focus, as pointed out by Riad (2015: 228). This is found in utterances of the type: “No I said [X], not [Y],” where [X] and [Y] are given extra stress to emphasize how they differ from each other. For example, take the words [pʰrʊˈsɛnːtʰ] 'percent' and [pʰrɛˈsɛnːtʰ] 'present, n.'. Under corrective focus, these words are pronounced as follows: “No, I said [ˈpʰrʊsːˌɛnːtʰ], not [ˈpʰrɛsːˌɛnːtʰ]”. The /s/ lengthens automatically when the extra stress is added. Applying vowel lengthening here, as **V length** would appear to predict, is ungrammatical: *[ˈpʰruːˌsɛnːtʰ], *[ˈpʰreːˌsɛnːtʰ].

C length is also productive in the *rövarspråket*, a language game whose output undergoes “the regular phonological rules of SCSw.” (Andersson 2018: 1). After every consonant, the vowel /ɔ/ and a copy of the consonant is inserted. In my variety of *rövarspråket*, stress may fall on any of the inserted /ɔ/ vowels. As stress is shifted from one /ɔ/ vowel to another, **C length** automatically lengthens the consonant after the stressed vowel:

(21) *Rövarspråket*/[rɔrœvɔva^{2}ˈrɔrːsɔspɔprɔrɔkɔkɛˌtʰɔtʰː]

a) 'glass' in SCSw.

UR	SR	Translation
/ˈglɑːs/	[ˈglɑːs]	glass

22 As we will see in section 5.2, however, my analysis of the 'critical' alternations is morphological rather than phonological.

b) 'glass' in *rövarspråket*

Stress	SR	
Initial	[²ˈgɔgːlɔlaˌsɔsː]	-
Medial	[gɔg²ˈlɔlːaˌsɔsː]	-
Final	[gɔglɔlaˈsɔsː]	-

The external evidence from *rövarspråket* matches the predictions of **C length**, with lengthening after every short stressed vowel. Finally, I wish to highlight some comments from survey of 200 speakers of SCSw., carried out in central Stockholm in the summer of 2016. The single question asked was: “How do the pronunciations of [ˈsiːl] ('sieve') and [ˈsɪlː] ('herring') differ?”. 176 respondents identified the difference as being in the vowel. One might think that this is good evidence for Vowel Theory, but these answers could have been influenced by many other factors. Phonetically, vowel length differences are more salient than differences in consonant length (Linell 1978: 127-128), and the Swedish education system uses the terms long and short vowel, for example. Therefore, we will ignore the main results, and focus instead on some of the comments people gave during the survey.

(22) Some comments
a) During survey
”There's a difference in the vowel. [ˈsiːl] starts with [ˈsiː], but [ˈsɪlː] starts with [ˈsɪ]”
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 Consonant Theory, there is 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 [ˈsiːl] vs [ˈsɪlː], the contrast between single and geminate *l* is always present. So if people are considering whether that contrast exists, no matter what level of representation they examine, they should find a difference.[23]

Instead, the comments in (22) seem to reflect native speakers' general surprise when 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. That exact same surprise is seen with Swedish consonant length. It must be admitted that there are speakers who can hear a difference in consonant length (Anders Holmberg, p.c.). However, this is not a problem for Vowel Theory, as those speakers might be considering the surface form, or the spelling (where the *l*s are the only difference). So unlike Consonant Theory, Vowel Theory can explain those who are sensitive to consonant quantity as well as those who are not.

23 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 am not considering such redundant solutions.

We have now considered some of the motivation for **C length**, and found both internal and external evidence in favor of the rule. Some of the evidence presented here seems to be very difficult to explain in Consonant Theory, as noted in previous sections. We have also concluded that the 'critical' alternations are not good enough as evidence for Consonant Theory. Moreover, even if they had constituted good evidence, we have now seen the 'attack' alternations, which in that case would provide equally good evidence for Vowel Theory. I suggest that future research assign a much more marginal role to these alternations in arguments about SCSw. quantity. We are now ready to consider Vowel Theory's next rule.

5.2 V short

The next rule is **V short**, which is probably the simplest rule we will have to consider. In prose, it is: “Unstressed long vowels shorten.” Formally, that would be V: → V in unstressed syllables. Such a rule might be one way of explaining the 'critical' alternations in Vowel Theory, as shown below:

(23) 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/ seen in the noun form. **V short** guarantees that the first underlying long vowel in 'criticism' surfaces as short, while the derived form shows the underlying long quantity of this vowel. However, I will argue that a non-phonological account of the 'critical' alternations is to be preferred for a number of reasons. Specifically, I propose morphological lengthening before the /-ɪsk/ suffix, as well as in any other contexts that trigger this lengthening.

This will help 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 for many people [graˈmatːɪskʰ] 'grammatical', rather than %[graˈmɑːtɪskʰ].[24] Since Riad has a productive vowel lengthening rule, he concedes 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 [kʰrɪˈtʰiːkʰ] 'criticism' are automatically assigned a stem with a long vowel, /kriːt/. Secondly, there are forms where the stem has a long consonant, and therefore a short vowel, but where the /-ɪsk/ form nevertheless shows vowel lengthening:

(24) Morphology, not phonology

SR	Translation
[mʊsamˈbɪkʰː], *[mʊsamˈbiːkʰ]	Mozambique
[mʊsamˈbiːkɪskʰ], ??[mʊsamˈbɪkːɪskʰ]	Mozambican

24 However, the prescriptively unacceptable form [graˈmɑːtɪsk] is also used by many people.

[sɔvˈjɛtʰː], *[sɔvˈjeːtʰ]	the Soviet Union[25]
[sɔvˈjeːtɪskʰ], ??[sɔvˈjɛtːɪskʰ]	Soviet, adj.

In Consonant Theory, the noun must have an underlying long consonant, but the adjective form must have an underlying short consonant. These alternations, then, cannot be produced from a single underlying form. I propose that there is a morphological process lengthening the vowel before /-ɪsk/, which explains why there may be exceptions, as well as forms which cannot receive a phonological explanation. We also know from section 5.1 that German and English show similar alternations without having phonemic consonant length, so for these languages, something like a morphological solution is independently necessary. Consequently, a morpheme-specific lengthening process within Vowel Theory seems to be a preferable explanation of the data.

So far I have presented arguments that some data do not require **V short** to be successfully explained. What, then, is the motivation for the rule? The answer is that some of these vowel length alternations really do appear to be phonological. They are productive in newly formed words, even outside of well-defined contexts like "before /-ɪsk/". Riad (R: 170) gives a good example:

(25) Melodies

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

This word for 'environmental melody' is clearly a blend of the words 'environment' and 'melody'. The long vowel in 'environment' has to be underlying, as there is no affix to trigger morphologically conditioned lengthening, and vowels do not lengthen in stressed open syllables (see section 4.2). And the short vowel in 'environmental melody' cannot be created by a morphological rule, since learners of Swedish are never exposed to words in the environment "preceding a truncated part of the word for 'melody.'" This justifies a phonological rule of vowel shortening. It is an open question which suffixes are like /-ɪsk/ (morphological vowel lengthening), and which are like 'environmental melody' (phonological vowel shortening). This will not be pursued further here.

A piece of external evidence for **V short** was actually presented in section 5.1. In the discussion of the language game *rövarspråket*, we said that stress may 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 SCSw. word, are unstressed. Therefore, we would predict that these vowels shorten by **V short**, and that is exactly what the data show. The word for 'glass' in *rövarspråket* is repeated here to illustrate this. As the stress placement is irrelevant, I have arbitrarily used initial stress for the *rövarspråket* form:

25 Some also have [ˈsɔvːjɛtʰ]. [sɔvˈjeːtʰ] is grammatical only with the meaning 'a person from the Soviet Union.'

(26) *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]	glass

Löfstedt, who believes in Consonant Theory, mentions what he considers to be more evidence for vowel shortening. Shortened long vowels, to the exclusion of lexically short vowels, may appear with 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). Relevant forms here are ones such as 'grindery/place for grinding', which are roughly [slipɛˈriː], but never *[slɪpɛˈriː]. However, I interpret the vowels in question as still being fully long in the output of phonology (i.e. the SR). Phonetically, they often seem to appear as half-long, giving rise to transcriptions with the IPA half-long diacritic in the literature (e.g. R: 202). At least in rapid speech, they may be fully short, while at slower speech rates, they may be fully long. I take it that the surface forms contain fully long vowels, which may be shortened phonetically in rapid speech. This gives the variable phonetic length which we observe. While Löfstedt's proposal is interesting, then, it does not provide evidence for **V short**, since **V short** does not apply.

It is worth fleshing this out in a bit more detail. The data are as follows: we have [ˌsliːpɛˈriː] 'grindery', never *[slɪpɛˈriː], but both [maˌɧiːnɛˈriː] and [maɧɪnɛˈriː] 'machinery.' The root 'machine' is lexically unstressed, /maɧiːn/, not /maˈɧiːn/ (R: 203). Stress is optionally added to it before the suffix is added. If stress is added, we get [maˌɧiːnɛˈriː], with the stress protecting the vowel from **V short**. If stress is not added, we get [maɧɪnɛˈriː], 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 does not lose its stress.

Riad (2015: 86-87) finds it problematic that a word with two stresses is not given second pitch accent. This is obligatory in compounds, and seems to be the default when two stresses come together. However, we know independently that there are other exceptions, in words like [ˈkʰreːaˌtʰiːv] 'creative' and many others like it (see Riad 2015: 226-229).[26] This word has two prosodic words, required to explain the two long vowels. And yet, this word does not receive the second pitch accent. I suggest that words with the suffix /ɛˈriː/ constitute a new class of exceptions to the rules of second pitch accent.[27]

In conclusion, regardless of the analysis of the 'critical' alternations, we have seen that

26 Compounds with 'berry' and some given names constitute other well-known exceptions: [ˈbloːˌbɛːr] 'blueberry', rather than *[^{2}ˈbloːˌbɛːr], and [ˈmajːˌbrɪtʰː] 'Maj-Britt (given name)' rather than *[^{2}ˈmajːˌbrɪtʰː].

27 Perhaps the two classes of words could even be unified under a single analysis. Riad (2015: 226-229) suggests that words like 'creative' are actually phrases, and shows that the pitch pattern is the same as for some phrases. It seems likely that words in /ɛˈriː/ are also phrases, with the stress on the second element rather than the first.

one still needs a phonological rule of vowel shortening in SCSw. I have provided both internal and external evidence for **V short**, along with analyses of related phenomena using morphology and phonetics rather than phonology. There is an important point illustrated by the data considered in this section: not everything which looks like phonology should in fact be accounted for by a phonological analysis. Before adopting a phonological explanation, it is worth checking whether alternative analyses in terms of phonetics or morphology can do the same job. With respect to the 'critical' alternations, we have seen that there are forms which crucially cannot be given a phonological analysis in either Vowel Theory or Consonant Theory. One could complicate the theory of SCSw. quantitative phonology to attempt to account for these forms, but when the role of morphology is considered, no modification complications of the theory are needed.

5.3 Shortening after Long Vowels

The third and final rule needed in Vowel Theory is **Shortening after Long Vowels** (**SLV** for short). In prose, **SLV** is: "Shorten a consonant after a long vowel." Formally, it is: $C_i \rightarrow Ø$ / V:_C_i The need for this rule is slightly controversial; only some of the data actually support **SLV**'s predictions, while other data contradict it. The key question is: "What is the outcome of an underlying form /V:C_iC_i/?"[28] It should be obvious that **SLV** predicts [V:C_i], with shortening after the long vowel. Consonant Theory makes a different prediction here. As long vowels are not underlying, the question is instead what happens to the sequence /VC_iC_i/. This will lead to a surface form [VC_i:]. As mentioned above, the data appear to support both options, depending on which morphological context one considers:

(27) Confusion
Support for Consonant Theory
a) Neuter /t/

Consonant Theory's prediction	Vowel Theory's prediction	Translation
/ˈvit/ → [ˈviːtʰ]	/ˈviːt/ → [ˈviːtʰ]	white, com.
/ˈvit-t/ → **[ˈvɪtʰː]**	/viːt-t/ → ***[viːtʰ]**	white, neut.

b) Preterite /de/

Consonant Theory's prediction	Vowel Theory's prediction	Translation
/ˈblød/ → [ˈbløːd]	/ˈbløːd/ → [ˈbløːd]	bleed!
/^{2}ˈblød-de/ → **[^{2}ˈblœdːɛ]**	/^{2}ˈbløːd-de/ → ***[^{2}ˈbløːdɛ]**	bled

28 These sequences can only arise across morpheme boundaries, since there are no tautomorphemic geminate consonants in Vowel Theory.

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, poss.

d) Present /r/

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

The forms in bold are the crucial ones, and as the asterisks show, only Consonant Theory correctly predicts a) and b), while only Vowel Theory correctly predicts c) and d). It appears that whichever theory one subscribes to, there will always be some contexts which are simply morphological exceptions. In Vowel Theory, I have to propose that is a morphological process of vowel shortening before suffixes like neuter /t/ and preterite /dɛ/. So the derivation for [ˈvɪtʰː] 'white, neut.' runs /ˈviːt-t/ → ˈvɪt-t (morphological shortening) → [ˈvɪtʰː] (other rules). Meanwhile, the possessive form of 'rose' has /ˈruːs-s/ → [ˈruːs] by the regular phonology, including **SLV**. Certain suffixes have a diacritic feature which triggers vowel shortening, while other suffixes lack it. The Consonant Theory explanation would presumably be identical, but with the diacritic feature on the complement set of suffixes.

However, there is a way to tell which contexts constitute morphological exceptions. In first-language acquisition, there is often a difference between regular phonological operations and irregular morphological ones. An English-speaking child might give the simple past of 'keep' as *keep*[t] rather than *kept*. The child has acquired the past tense morpheme and its allomorphy, but has not yet learned 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 lexical items, and which has to be learned for each word/suffix. This predicts that, just as with English *keeped*, one sometimes fails to see the irregular morphological process applied. In other words, suffixes like the neuter /t/ should sometimes fail to cause vowel shortening. The acquisition data cited in Linell (1978: 126) confirm this prediction. In the table below, it can be seen that children sometimes produce precisely those ungrammatical forms in (27) a) and (27) b) which Vowel Theory predicts:

(28) How to say *keeped* in Swedish

UR (Vowel Theory)	SR (target)	SR (observed)	Translation
a) The neuter suffix /t/			
/ˈviːt-t/	[ˈvɪtʰː]	[ˈviːtʰ]	white, neut.
b) The preterite suffix /dɛ/			
/^{2}ˈblød-de/	[^{2}ˈblœdːɛ]	[^{2}ˈbløːdɛ]	bled

While adults never use the ungrammatical forms in (27) a) and (27) b), children do. This gives striking confirmation that a) and b) are the morphological exceptions, and that in the regular phonology of SCSw., /VːC_iC_i/ becomes [VːC_i], as in (27) c) and (27) d). This motivates a phonological rule **SLV**. This has implications for an argument in section 3.3. Remember that the strongest argument for Consonant Theory I could find involved data showing a contrast between /t/ and /tt/. The /tt/ morpheme I used to make this argument was the neuter adjectival suffix in [ˈvɪtʰː] 'white, neut.' We have now seen external evidence that such forms only exist because of a diacritic mark on the suffix. The regular form would be *[ˈviːtʰ], as in (27) a) above. Consequently, there is no phonological contrast between /t/ and /tt/. There is one /t/ which does not cause shortening and another which does: morphology rather than phonology.

This case is a good demonstration of the limitations of internal evidence in phonology. The data in (27) are what they are, and they are not magically going to change in favor of either theory. But by using acquisitional data we can tease out the exceptions from the regulars. In this particular case, solving this problem also helped refute one of the strongest arguments for Consonant Theory in section 3. This highlights the fact that the use of external evidence in phonology can be crucial in evaluating theories when internal evidence does not suffice. With **SLV** out of the way we are done surveying the rules of Vowel Theory, and the evidence used to motivate them.

6 Conclusion

In this article, we have examined two theories of Swedish quantity, Vowel Theory and Consonant Theory. We have seen the phonological processes of Consonant Theory, the motivation for them, and some further arguments in favor of distinctive consonant quantity. The main predictions of Consonant Theory have been evaluated, and it has been shown that careful consideration of new empirical evidence reveals them to be false. SCSw. does allow tautomorphemic [VːCC] forms, and short stressed vowels in open syllables. These facts suggest that SCSw. does not require all stressed syllables to be bimoraic. The generalization about bimoraicity has driven a phonological conspiracy in previous treatments of SCSw., but the new data considered here reveal that such teleological generalizations cannot be maintained. Such a result is predicted by substance-free rule-based theories, where there is no notion of processes conspiring to produce a more 'optimal' output. The data also challenge the common practice of treating interjections as marginal or exceptional to the phonological system. Empirical evidence from SCSw. suggests that even seemingly exceptional forms should be generated by the regular phonology of the language.

In section 5, I presented a version of Vowel Theory, a different interpretation of the facts of SCSw. phonology which straightforwardly predicts the data considered in this article. However, while phonological theories should clearly account for all of the relevant data, we must also be careful to avoid overreach. In many cases, I have also argued that data from the literature are best explained outside of the phonological system. Some alternations show clear signs of being part of the morphology, while other forms are best explained by phonetic processes. In some cases the division of labor between different parts of the grammar cannot be decided based on internal evidence alone; I have shown that external evidence from first-language acquisition provided a solution to a problem of vowel shortening, which in turn removed one of the strongest arguments for Consonant Theory. This illustrates the general importance of evaluating phonological theories using external evidence.

To conclude, we have seen arguments for Vowel Theory, counterarguments to Consonant Theory, and new data on SCSw. These new data have a big impact on which theory of length we choose, and they clearly favor Vowel Theory. I have tried my best to improve on the Consonant Theoretic analyses of SCSw. in the literature, and I hope that Consonant Theorists will find this article helpful. However, my conclusion is that Vowel Theory is correct: the words for 'sieve' and 'herring' are phonologically distinguished in the vowel and not the consonant.

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