

# Rörövarorsospoproråkoketot: Language Games and Swedish Phonology

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## 1 Introduction

This paper examines the phonology of language games (see Bagemihl 1988, 1995, Davis 1993, and Vaux 2011, among others), using two case studies from the Swedish language game Rörövarorsospoproråkoketot. The framework adopted here is a rule-based implementation of Substance-Free Phonology (see Bale and Reiss forthcoming, Hale and Reiss 2008, Reiss 2018, Samuels 2009, 2011, among others). I focus specifically on Standard Central Swedish (SCSw.), spoken in Stockholm and surrounding areas. It is shown that Rörövarorsospoproråkoketot can shed light on problems in Swedish phonology, as well as on issues of general theoretical relevance. Using Rörövarorsospoproråkoketot data, I argue that the newly-discovered process of pre-palatal raising (Andersson 2017a) has been phonologized. This has implications for nasal assimilation, which, because of its interaction with pre-palatal raising, must also have also been phonologized. The argument illustrates the possibility of using language games to investigate whether a process is phonetic or phonological. A formalization of nasal assimilation in terms of phonetic underspecification is proposed, following work on Japanese by Kuroda (1965) and Kochetov (2014). I also discuss the question of productive phonological opacity, hypothesized not to exist in much recent work (Green 2004, 2007, Sanders 2003, among others). Rörövarorsospoproråkoketot can shed light on this debate, as it productively extends patterns found in the regular phonology of Swedish. I show that a counterfeeding interaction in Swedish is fully productive, suggesting that opacity must be accounted for by our theories of phonology. This is in line with earlier work on language games and opacity (Al-Mozainy 1981, Sherzer 1970) and with other work in phonological theory (Ito and Mester 2003, McCarthy 1999 et seq., Vaux 2008 and others).

The remainder of this paper is structured as follows. In section 2 I present Rörövarorsospoproråkoketot, outlining how Swedish words are transformed into their language game equivalents. This involves processes of consonant reduplication as well as /ɔ/ epenthesis. In sections 3 and 4, I introduce and analyze data on four phonological processes in SCSw. 3.1 covers the apparent counterfeeding interaction between unstressed vowel shortening and vowel centralization before /r/. In 3.2 I use Rörövarorsospoproråkoketot to argue that this represents a case of productive phonological opacity. 4.1 introduces data on a transparent, feeding interaction between nasal assimilation and pre-palatal raising, while 4.2 gives a phonological analysis, motivated in part by data from Rörövarorsospoproråkoketot. Section 5 concludes the paper.

## 2 Rörövarorsospoproråkoketot

This section covers the language game Rörövarorsospoproråkoketot, popularized by Astrid Lindgren's books about Kalle Blomkvist, and learned by many Swedish-speaking children. In the game, every consonant /C<sub>i</sub>/ is replaced by the sequence /C<sub>i</sub>ɔC<sub>i</sub>/. In other words, every consonant in the SCSw. UR is copied, and the vowel /ɔ/, written < o >, is inserted between copies. As indicated by the title of the paper, the word Rörövarorsospoproråkoketot comes out as Rorövarorsospoproråkoketot, with inserted segments underlined. To the output of this algorithm are applied the regular phonological rules of SCSw. This makes Rörövarorsospoproråkoketot ideal for studies of phonological productivity, something I took advantage of when investigating SCSw. quantity

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in Andersson (2016). Stress in Rörvarspråket almost always falls on one of the inserted /ɔ/ vowels, often on the last such vowel of the word. However, in words consisting of a single open syllable, the only vowel in the original SCSw. word takes the stress. When the Rörvarspråket form is very long, a secondary stress is often present, giving rise to the second pitch accent, written with a superscript <sup>2</sup>. The second pitch accent can also surface without a secondary stress, in SCSw. and Rörvarspråket. In (1) are some examples of SCSw. and Rörvarspråket forms which illustrate the properties described above:

(1)	SCSw. UR	Rörvarspråket UR	Rörvarspråket SR	Translation
	/ˈtɑː/	/tɔːˈtɑː/	[tʰɔːˈtʰɑː]	take (verb)
	/ˈliːv/	/lɔliːˈvɔv/	[lɔliːˈvɔvː]	life
	/ˈspɑːra/	/sɔspɔpaː <sup>2</sup> ˈrɔra/	[sɔspɔpa <sup>2</sup> ˈrɔːa]	save (verb)
	/ˈjɛmn/	/jɔjɛ <sup>2</sup> ˈmɔmˌnɔn/	[jɔjɛ <sup>2</sup> ˈmɔmˌˈnɔnː]	even (adjective)

### 3 Counterfeeding

In this section we will discuss a case of apparent opacity in SCSw. The opacity judgments reported are my own, but were confirmed by a small-scale online survey of SCSw. speakers (N = 11). It is known from the literature that one of the processes investigated here, centralization, is subject to significant interspeaker variation (Wenner 2010), and it is often optional even within an idiolect. It is therefore unsurprising that the survey results revealed several different grammars. The judgments I report below do not hold for all SCSw. speakers, and instead reflect the system of the majority of the relevant survey respondents. With this in mind, we are ready to consider the data.

**3.1 Data** The first process to be examined is the optional centralization mentioned immediately above, which neutralizes the phonemic distinction between /æ/ and /ø/ to [ə] before /r/. That the process is neutralizing is suggested by non-standard spellings of [ər] with < u > (representing /ø/) where the standard spelling has < ö > (representing /æ/).<sup>1</sup> Underlying /r/ coalesces with following coronals, leaving a retroflex version of the coronal: /rt, rd, rs, rn, rl/ → [t̪, d̪, s̪, ŋ̪, l̪] (Riad 2014 and references therein). Centralization may also apply before these retroflexes. (2) gives examples of optional centralization, absence of variation for words with underlying /ø/, and application before a retroflex. In the case of optional rules, both of the possible outputs (application and non-application) are shown side by side.

(2)	UR	/ˈmœrkɪ/	/ˈbœrkɪ/	/ˈflœrt/
	Centralization (optional)	'mœrkɪ, 'mœrkɪ	-----	'flœrt, 'flœrt
	Retroflexion	-----	-----	'flœt̪, 'flœt̪
	Other rules	'mœrːkʰɪ, 'mœrːkʰɪ	'bœrːkʰɪ	'flœt̪ʰ, 'flœt̪ʰ
	SR	['mœrːkʰɪ], ['mœrːkʰɪ]	['bœrːkʰɪ], *['bœrːkʰɪ]	['flœt̪ʰː], ['flœt̪ʰː]
	Translation	dark (adjective)	can, tin	flirt (noun)

SCSw. also has a phonological process which creates new instances of [œ], namely unstressed vowel shortening (see Andersson 2016 for external evidence that such a rule is part of SCSw. phonology). Because of this rule, when /øː/ is placed in an unstressed syllable, it surfaces as [œ]:

<sup>1</sup> For example, see the spelling < murkt > for standard < mörkt > 'dark (neuter adjective)' in the following blog post: <<http://tvillingryttarna.blogg.se/2011/august/lilla-kaninen.html>>.

(3)	UR	SR	Translation
	/ˈmø:bəl <sup>2</sup>	[ˈmø:bəl]	furniture
	/mø:'ble:ra/	[mœ'ble:ra]	furnish

Unstressed /ø:r/ could now go one of two ways. One option is a feeding relationship between vowel shortening and centralization: /ø:r/ → œr (shortening) → [œr] (centralization). Another option is counterfeeding, where /ø:r/ surfaces as [œr], and never as \*[œr]. Counterfeeding is what we actually find. In (4) the underlying long /ø:/ is part of the verbal prefix /fø:r/, whose long vowel surfaces unchanged under stress (Elert 1981: 83, Riad 2014: 204).

(4)	UR	/fø:r'kʰlɑ:ra/
	Centralization (optional)	-----
	Shortening	fœr'kʰlɑ:ra
	Other rules	fœr'k <sup>h</sup> lɑ:ra
	SR	[fœr'k <sup>h</sup> lɑ:ra]
	Translation	explain

However, more data is needed before we accept that this really is counterfeeding. The examples of centralization in (2) involve stressed syllables, while in (4), the syllable containing [œr] is unstressed. So perhaps centralization applies only to stressed œ, explaining the non-application in (4). A direct test of this hypothesis would be to find forms with unstressed /œ/ before /r/, where the /œ/ cannot be analyzed as /ø:/. If centralization can apply in such forms, it must be productive in unstressed syllables. I have not found any forms relevant for testing this hypothesis. However, an indirect test can be found. Suppose that centralization applies regardless of stress. Unstressed [œr] would then be ambiguous between /ør/ and /œr/. This in turn has an impact on the expected spelling: /ør/ is written <ur(r)> while /œr/ is written <ör(r)>. If speakers allow unstressed [œr] to be derived from /œr/, we would expect the possibility of non-standard spellings where this phonetic sequence is rendered as <ör(r)>, despite a standard spelling with <ur(r)>. Such spellings are attested: for [k<sup>h</sup>øra<sup>2</sup>ˈjœm:a] 'hide-and-seeK', one finds non-standard <körragömma> (standard <kurragömma>), and for [p<sup>h</sup>øt<sup>h</sup>p<sup>h</sup>øˈri:] 'medley' there is non-standard <pottpörri> (standard <potpurri>).<sup>3</sup> These spellings only make sense if people treat unstressed [œr] as underlying /œr/, and so we cannot argue that the absence of centralization in (4) is due to the stress pattern. An alternative explanation for the data is required, and in 3.2 below, I will argue for an explanation in terms of productive phonological opacity.

**3.2 Analysis** In recent years, many linguists have attempted to account for apparently opaque interactions like the one in (4) without relying on the phonology. Examples include Anttila, Fong, Beňuš, and Nycz (2008), Green (2004, 2007), Sanders (2003), Sumner (2003), and Zhang, Lai, and Turnbull-Sailor (2006). All of these works express skepticism about the need for true phonological opacity:

[T]he Singapore English evidence supports the hypothesis that phonological opacity has only one source: the interleaving of phonology and morphology (Anttila et al. 2008: 212)

2 The [e] in the surface form may be epenthetic, giving underlying /ˈmø:bl/ (Morén-Duolljá 2013, Riad 2014 and references therein).

3 The alternative spelling can be found in Swedish blog posts as exemplified by the following for 'hide-and-seeK': <[blog.liu.se/jonnaelofssonbjesse/2016/09/28/nar-verkligheten-bankar-pa-dorren/](http://blog.liu.se/jonnaelofssonbjesse/2016/09/28/nar-verkligheten-bankar-pa-dorren/)>, and for 'medley', an example of the non-standard spelling can be found at <<http://daysofsandy.blogg.se/2007/june/pottporri.html>>.

The results suggest the possibility that *all* crosslinguistic instances of apparent opacity can be explained in terms of the phonology-morphology interface and that purely phonological opacity does not exist (Green 2004: 37, emphasis in original)

My analysis supports the hypothesis of Sanders (2003) that there is no instance of opacity in a purely phonological relationship (Green 2007: 52)

[I]f a framework even allows synchronically productive opacity, it is likely too powerful and should be restricted (Sanders 2003: 229)

This research also has implications for opacity in general, casting doubt on the assumption that speakers really do acquire opaque generalizations (Sumner 2003: iv)

This [the authors' results – SA] casts further doubt on the productivity of opaque phonological patterns (Zhang et al. 2006: 460)

As these quotes reveal, alternative explanations for apparent opacity often involve morphology and morphophonology (though see Hale and Reiss 2008: 64-65 for a phonetic explanation of an apparent chain shift in child English). The SCSw. data in (4) are also susceptible to a morphological explanation. The opacity is only observed when the sequence /ø:r/ is unstressed, a situation which is essentially limited to the single verbal prefix /fø:r/. Perhaps, then, the counterfeeding is a fact about this prefix, and not a fact about SCSw. phonology. We can investigate this hypothesis using language games, which allow us to easily test if a generalization productively applies to new words outside of their normal morphological environments.

There is a long history of providing evidence for opacity from language games. The earliest such source I am aware of is Sherzer (1970), on the opaque interaction between stress assignment and /i/ epenthesis in Guna. Al-Mozainy (1981), working on Bedouin Hijazi Arabic, is another early reference. Here I extend this methodology to SCSw. As we saw in section 2, Rörvarspråket almost always shifts stress to one of the inserted /ɔ/ vowels. This makes the stressed syllable in the SCSw. word unstressed, which triggers unstressed vowel shortening (see 'save (verb)' in (1) above). If the opaque interaction with centralization is productive, new short vowels created in this way should never undergo centralization. But if the opacity-skeptic conclusions cited above are correct, we should find that shortening feeds centralization, allowing newly-created unstressed vowels to centralize. In (5) I show that the former view is correct: the opaque, counterfeeding interaction between shortening and centralization is productive in Rörvarspråket.

(5)	SCSw. UR	/'bø:r/
	Rörvarspråket UR	/bøbø:'rør/
	Centralization	
	(optional)	-----
	Shortening	bøbæ'rør
	Other rules	bøbæ'rør:
	SR	[bøbæ'rør:], *[bøbø'rør:]
	Translation	ought to, should

The order of the rules in (5) is exactly the same as that presented in (4), and this ordering correctly predicts the ungrammaticality of \*[bøbø'rør:], where shortening and centralization are in a transparent, feeding relationship. My position on opacity, then, is that although individual cases may be reanalyzed as non-phonological, such a reanalysis is not always possible. This echoes work such as McCarthy (1999),

providing a list of various types of external evidence that opacity is psychologically real. He concludes that “the move of simply discarding all opaque generalisations is not very promising” (McCarthy 1999: 383). See also Ito and Mester (2003), who say that their research “underscores /.../ the general finding that opacity is a solid fact of phonological life” (Ito and Mester 2003: 297). Proponents of various forms of rule-based phonology are also adherents of this view (Andersson 2017b, Hale and Reiss 2008, Samuels 2009, Vaux 2008 among others), as opacity is predicted to exist by the basic mechanism of rule ordering (Hale and Reiss 2008: 67, footnote 8).

In conclusion, it is beyond reasonable doubt that phonological opacity exists, and any adequate theory of phonology must be able to capture opaque patterns. Although some have questioned this conclusion, external evidence for opacity has a long history in the linguistics literature, not always adequately addressed by skeptics. Rörövarspråket adds to this body of evidence, by showing that speakers treat a case of SCSw. counterfeeding as purely phonological, even though the internal evidence from SCSw. is equally consistent with a morphological analysis. The data can be successfully analyzed in rule-based phonology.

## 4 Feeding

In this section we are concerned with two more processes in SCSw., where it is not immediately clear that either should receive a phonological explanation. I outline the data in 4.1, and argue for a phonological analysis of both processes in 4.2.

**4.1 Data** Andersson (2017a) discusses a process of pre-palatal raising, described as an innovative feature in young middle- and upper-class speakers of SCSw. However, I have since heard a similar pattern of allophony in Värmland Swedish, and it is not clear whether the SCSw. pattern really represents an innovation. Andersson (2017a) writes the process as in (6):

$$(6) \quad \varepsilon, \alpha \rightarrow e, \emptyset / \_ \{k, g, \eta, j, i:, \iota, y:, y, e:/\}$$

That is, the short mid front vowels become tense before any of the phonemes in curly brackets  $\{\}$ . I would like to revise this description so as to exclude vowels from the triggering context for the rule, a choice explained below (7). It is also important to note that the velar stops in SCSw. are almost always palatalized (see section 4.2 for more discussion). The revised rule is then as in (7):

$$(7) \quad \varepsilon, \alpha \rightarrow e, \emptyset / \_ \{k^j, g^j, \eta^j, j\}$$

Vowels are excluded from the set of triggers as all SCSw. speakers, even those without the rule in (7), realize / $\varepsilon$ / as [e] before another vowel, as exemplified in (8). It is likely that this is part of a larger process affecting vowels other than / $\varepsilon$ /, a question that will not be explored further here.

(8)	UR	SR	Translation
	/ <sup>2</sup> 'nitʂε/ <sup>4</sup>	[ <sup>2</sup> 'nitʂε]	Nietzsche
	/nitʂε'ɑ:nski/	[nitʂε'ɑ:nsk <sup>h</sup> ]	Nietzschean

The pre-palatal raising rule in (7) interacts with a process of nasal assimilation which affects pre-consonantal /n/. Some examples of nasal assimilation are given in (9). A full formalization of assimilation is not needed to study the interaction with raising, and the details are left for section 4.2.

4 An alternative UR would be /<sup>2</sup>'nirtʂε/, producing the same SR by retroflexion (see section 3.1). I am not aware of any arguments favoring one UR over the other, and (3) simply uses the one suggested by the orthography.

(9)	UR	SR	Translation
	/hɔn <sup>2</sup> 'bu:rdɛ/	[hɔm <sup>2</sup> 'bu:ɖɛ]	she should ...
	/hɔn <sup>2</sup> 'tɑ:r/	[hɔn <sup>2</sup> 'tʰɑ:r]	she takes ...
	/hɔn <sup>2</sup> 'kʲɑn/	[hɔŋ <sup>2</sup> 'kʲhʲɑn:]	she can ...

Notice that pre-palatal raising in (7) is triggered by a following  $\eta^j$  but not by a following  $n$ . Notice also that nasal assimilation creates new examples of  $\eta^j$  from underlying  $/n/$ . A question immediately arises: what happens to underlying sequences like  $/ɛnkʲ/$ , where nasal assimilation could potentially create new contexts for raising? Do such sequences involve feeding or counterfeeding? (10) illustrates that in forms like these, the processes are in a feeding relationship:

(10)	UR	/ɛn <sup>2</sup> 'kʲɑt/
	Assimilation	ɛŋ <sup>2</sup> 'kʲɑt
	Raising	ɛŋ <sup>2</sup> 'kʲɑt
	Other rules	ɛŋ <sup>2</sup> 'kʲhʲɑtʰ:
	SR	[ɛŋ <sup>2</sup> 'kʲhʲɑtʰ:]
	Translation	a cat

The discussion so far has assumed that both raising and assimilation are phonological processes, part of ordered derivations like the one above. However, it is also possible that they represent simple phonetic coarticulatory effects, which have not yet been phonologized. This choice between phonetic and phonological analyses is the subject of the next section.

**4.2 Analysis** Here I will attempt to defend various plausible phonetic explanations for pre-palatal raising, before coming to the conclusion that a phonological analysis is preferable. Nasal assimilation is treated later in the section, as I believe that the solution to the problem of raising should inform our analysis of assimilation.

Notice that raising of  $[\varepsilon, \text{œ}]$  to  $[e, \text{ø}]$  involves raising the tongue towards the palate. The process applies before segments involving a constriction in the palatal region. A phonetic explanation is possible here: when the body aims for  $[\varepsilon, \text{œ}]$ , the tongue is pulled up towards the palate by segments which themselves require a palatal articulation. However, this explanation is insufficient. The palatalized velars  $/k^j, g^j, \eta^j/$  can trigger raising even when they surface as plain velar  $[k, g, \eta]$ . These unpalatalized realizations are often found before back vowels, so that  $/'k^j\text{œ}k^j/$  'chef' becomes  $['k^h^j\text{œ}k^h^j:]$ . In order to look at pre-palatal raising before plain velars, we need  $/\varepsilon, \text{œ}/$  followed by a velar, followed by a back vowel. This phonotactic combination is difficult to find in SCSw. words, but here we are helped by Rörvarspråket. A word like  $/'j\text{ø}:g^j/$  'lied' will become  $/j\text{ø}j\text{ø}:'g^j\text{ø}g^j/$  in Rörvarspråket. The  $/\text{ø}:/$  will shorten to  $\text{œ}$  by unstressed vowel shortening, and we will then have a sequence  $...\text{œ}g^j\text{ø}...$ , which has everything we are looking for. The full derivation of this word is shown in (11):

(11)	SCSw. UR	/'j\text{ø}:g^j/ <sup>5</sup>
	Rörvarspråket UR	/j\text{ø}j\text{ø}:'g^j\text{ø}g^j/
	Shortening	j\text{ø}j\text{ø}:'g^j\text{ø}g^j
	Depalatalization	j\text{ø}j\text{ø}:'g\text{ø}g^j
	Raising	j\text{ø}j\text{ø}:'g\text{ø}g^j
	Other rules	j\text{ø}j\text{ø}:'g\text{ø}g^j:
	SR	[j\text{ø}j\text{ø}:'g\text{ø}g^j:]
	Translation	lied

5 I write the front rounded vowel of this word using the symbol traditionally chosen in the linguistic literature on Swedish. In modern SCSw., the pronunciation is  $[\text{œ}:]$  for most people, and even approaches  $[\text{æ}:]$  for some. This notational choice makes the derivation look like it contains a Duke of York derivation in the quality of this vowel: first  $\text{ø}$ , then  $\text{œ}$ , and finally back to  $\text{ø}$ . This is nothing more than an artifact of the notation.

Notice that pre-palatal raising applies even before the plain velar [g], suggesting that a phonetic palatal gesture is not needed to trigger raising. The fact that Rörvarspråket is used also demonstrates the productivity of raising in this environment. In light of this, one could revise the phonetic explanation for raising so that palatal *or* velar gestures are triggers. Raising before velars is familiar from patterns in other languages, such as /æ/-tensing in many varieties of American English (Labov 1994, Mielke, Carignan, and Thomas 2017). However, this revised explanation will not do either: /ɸ/, a plain, unpalatalized velar for many speakers (see Ladefoged and Maddieson 1996: 171-172), never triggers pre-palatal raising:

(12)	UR	SR	Translation
	/ˈmɛfjɛt/	[ˈmɛfj:ɛtʰ] *[ˈmɛfj:ɛtʰ]	Mehmet (name)
	ˈvɛfjɔɛtski/	[ˈvɛfj:ɔɛtskʰj] *[ˈvɛfj:ɔɛtskʰj]	of or pertaining to Västergötland

A final defense of the phonetic hypothesis might be that /ɸ/ is a fricative, while /k<sup>j</sup>, g<sup>j</sup>, ŋ<sup>j</sup>/ are stops. The tongue does not need to raise as high for a velar fricative as for a velar stop, and perhaps this is responsible for the absence of coarticulatory raising in the preceding vowel. But remember from (7) that /j/, an approximant,<sup>6</sup> also triggers raising. The degree of stricture, therefore, seems to be irrelevant. The takeaway point from this discussion of raising should be that a purely phonetic definition of triggers for raising is difficult if not impossible to find. Instead, the triggers seem easiest to define in phonological terms, as all and only phonologically palatal consonants. In featural terms, they could be characterized as the class [+consonant, -back]. If the generalization about pre-palatal raising can only be stated at the phonological level, this suggests that the process has been phonologized, and is not just a coarticulatory phonetic effect (cf. Iosad 2017 on Welsh). If this is correct, there are implications for nasal assimilation. Assuming that phonetics applies after phonology, to its output, it is not possible for a phonetic process to precede a phonological one. (10) above showed that nasal assimilation must feed, and therefore precede, pre-palatal raising. This means that assimilation cannot be purely phonetic, and must also have been phonologized. Providing a phonological analysis of nasal assimilation is the goal of the rest of this section.

So far, the only data I have shown on SCSw. nasal assimilation is in (9), where /n/ always surfaces as a nasal stop. However, this is not the only possible outcome of assimilation, as shown in the impressionistic narrow transcriptions in (13):

(13)	UR	Narrow transcription	Translation
	/ɛn ˈfɑ:r/	ɛ̃ṽ ˈfɑ:r	a father
	/ɛn ˈso:s/	ɛ̃z̃ ˈso:s	a sauce
	/ɛn ra ˈkʰie:t/	ɛ̃r̃ ra ˈkʰie:tʰ	a rocket
	/ɛn ˈlœŋj:n/	ɛ̃l̃ ˈlœŋj:n	a lie
	/ɛn ˈjɔjkj/	ɛ̃j̃ ˈjɔj:kʰj	a joik/yoik
	/ɛn ˈɸɔkj/	ɛ̃ṽw̃ ˈxw̃ɔkʰj:	a shock <sup>7</sup>

Assimilation in degree of stricture is not often mentioned in treatments of SCSw. Even authors who cite examples of it, such as Riad (2014), may describe the phenomenon as assimilation only for place: “By nasal assimilation, the coronal nasal assimilates to the place of articulation of a following segment. It is thus a case of regressive place assimilation” (Riad 2014: 88). However, it seems as if /n/ may assimilate for any feature except [nasal]: /n/ always surfaces with nasality.<sup>8</sup> I propose that assimilation should be analyzed using phonetic underspecification (see Keating 1988 for the term): the surface forms in (13) have /n/

6 /j/ may also be a fricative /j/ for many speakers, but the same argument still holds.

7 The narrow transcription of this form assumes my idiolect's realization of /ɸ/ as [x<sup>w</sup>].

8 In (13) /n/ also surfaces as voiced in all environments, but I will await phonetic work before claiming that there is no voicing assimilation to following voiceless consonants.

surfacing as a feature bundle consisting of only [+nasal], underspecified for all other features. Using N as shorthand for this underspecified feature bundle, the nasal assimilation rule can then be written as follows:

$$(14) \quad n \rightarrow N / \_ [+consonant]$$

The surface forms from (13) are then as follows:

(15)	UR	SR	Translation
	/ɛn 'fɑ:r/	[ɛN 'fɑ:r]	a father
	/ɛn 'so:s/	[ɛN 'so:s]	a sauce
	/ɛn ra 'kʲe:t/	[ɛN ra 'kʲe:th]	a rocket
	/ɛn 'lœɲ:n/	[ɛN 'lœɲ:n]	a lie
	/ɛn 'jœjk/	[ɛN 'jœj:kʲ]	a joik/yoik
	/ɛn 'ʃœk/	[ɛN 'ʃœkʲ]	a shock

Phonetically, these sequences should be realized as a smooth interpolation between the preceding and following sounds, with the only requirement that there is nasality in the transition. In a form like /ɛn 'so:s/ 'a sauce', the body is effectively being told to get from an [ɛ] target to an [s] target, along some path that passes through a stage of nasality. We may start off with a target-like ɛ, followed by a nasalized  $\tilde{\epsilon}$  before the features of the [s] are apparent. As we move further away from the vowel, features from [s] may begin to creep in, giving frication and a grooved tongue shape for something like  $\tilde{z}$ . Finally the effects of the vowel and the nasality fade away and we are left with a target-like s. This situation in SCSw. can be compared with Kuroda's (1965) description of nasal assimilation in Japanese:

The phonetic realization of the nasalized consonantal mora [i.e. the moraic nasal - SA] may best be described as a nasalized continuous transition from the preceding segment to the following one. When the following segment is a consonant, the nasalized mora consonant has the same point and manner of articulation as that consonant; for example, before p, b, or m, the nasalized mora consonant is m̃, but before s it becomes a nasalized (and voiced) s̃, which we shall denote by  $\tilde{s}$ .” (Kuroda 1965: 201-202)

For Japanese, this description has been experimentally verified by Kochetov's (2014) study using electropalatographic (EPG) data. Kochetov mentions that there is some gradience in both place and manner assimilation, as expected if there is a smooth transition from the preceding vowel to the following consonant. It is worth mentioning that Kochetov's stimuli involved a language game, in order to verify that the observed assimilation patterns were productive. For SCSw., I am not aware of any experimental data confirming or falsifying the description of assimilation provided above. However, my account predicts that the patterns observed for Japanese by Kochetov should also be observed in SCSw.

If my description of SCSw. proves to be correct, we have to revisit the formulation of pre-palatal raising given in 4.1. I initially stated that the surface form of /ɛn 'kʲat/ 'a cat' was [ɛɲʲ 'kʲiatʰ:], with the [ɲʲ] triggering pre-palatal raising of the preceding vowel. But if this form is really [ɛN 'kʲiatʰ:], with an underspecified N, why is there pre-palatal raising? I propose that the underlying /ɛ/ in this form is raised not because of the nasal, but because of the /kʲ/. Raising is triggered *across* the nasal, as it lacks place features after assimilation has applied. The derivation of 'a cat' is shown in (16):

(16)	UR	/ɛn 'kʲat/
	Assimilation	ɛN 'kʲat
	Raising	eN 'kʲat
	Other rules	eN 'k <sup>h</sup> ʲat <sup>h</sup> :
	SR	[eN 'k <sup>h</sup> ʲat <sup>h</sup> :]
	Translation	a cat

Wrapping up our discussion of pre-palatal raising and nasal assimilation, I have argued that both of these processes are part of the phonology of SCSw. Pre-palatal raising seems to resist a description in purely phonetic terms, and the generalization is instead more successfully stated at the phonological level. Rörövarorsospoproråkoketot was used to make this argument, and also showed us that raising is productive. This illustrates one way of using language games to investigate the phonetics-phonology interface, and to find out whether a process is phonetic or phonological. Nasal assimilation creates new contexts where the phonological raising rule can apply, and must therefore also have been phonologized. The output of nasal assimilation was argued to be a feature bundle underspecified for everything except [nasal]. This approach makes a phonetic prediction about the gradient nature of assimilation which is as yet untested on SCSw. data. I leave this as an open prediction, allowing future research to confirm or falsify the theory outlined here.

## 5 Conclusions

In this paper, we have seen two case studies of language games in phonology, both using data from Rörövarorsospoproråkoketot to solve problems in the phonology of Standard Central Swedish. I have argued that both language-specific and general theoretical questions can be answered by considering language game data. The ability of language games to manipulate existing words in a language allows us to test the productivity of phonological generalizations, and often provides empirical evidence for the abstractions proposed by phonologists. I have used Rörövarorsospoproråkoketot to investigate four phonological processes, as well as the interactions between them. My conclusions about Swedish can be summarized as follows: 1) both nasal assimilation and pre-palatal raising have been phonologized, and 2) these rules are in a feeding relationship, while 3) the phonological rules of unstressed vowel shortening and centralization before /r/ exemplify counterfeeding. In the investigation of assimilation and raising we saw ways in which language games can shed light on the phonetics-phonology interface, specifically on the phonetic or phonological status of certain processes. The counterfeeding between shortening and centralization was brought to bear on the theoretical debate about opacity, arguing against theories which explicitly rule out the possibility of opaque interactions. It is my hope that this paper will stimulate more work on language games, and on those empirical and theoretical phenomena that they can help us understand.

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