Umlaut and lowering are not phonological in Swiss German*

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Bromberger and Halle (1989) argued that phonology relies on rule ordering and is therefore fundamentally different from syntax. However, recent advances within the framework of Government Phonology (GP) show that phonology is even more syntax-like than previously assumed. This paper supports the latter view by showing that an example that seems to support Bromberger and Halle's view (Kiparsky 1968) is factually wrong on many accounts and does thus not prove the necessity of rule ordering. A secondary aim of this paper is to show how a restrictive theory can be used to predict which phenomena do and do not occur in human languages. In a final section, alternative treatments of umlaut and lowering are sketched out.

Keywords: *Government Phonology, phonology-syntax relationship, rule ordering, Swiss German*

1   Introduction

Bromberger and Halle (1989) claimed that phonology is fundamentally different from syntax (and the rest of linguistics), because phonology depends on the use of rewrite rules and their extrinsic ordering, while other linguistic modules do not. Government Phonology (henceforth GP, for references cf. section 5 below) has always taken a different stance on this, and according to the latest developments in the theory (cf. Kaye and Pöchtrager 2009, Pöchtrager 2006, Živanovič and Pöchtrager 2010 among others) there are even less differences between syntax and phonology than previously assumed.

Why should phonology be so different from all the other linguistic modules? The null-hypothesis surely is to assume that all modules should be similar, rather than have one of them stand out. Hence the burden of proof lies with those who claim that one of the modules, namely phonology, is different. The only synchronic argument Bromberger and Halle (1989) mentioned to support their claim is the (in)famous case of Canadian Raising, where two dialects are said to differ in their respective ordering of the two relevant rules (flapping and raising). Kaye (1990, in press) shows in great detail why this argument does not hold. However, the phonological literature provides a few more examples that seemingly support Bromberger and Halle's idea. In this paper I will discuss one of those examples that relies on rule ordering and therefore seems to support B&H's view: the example of Swiss German umlaut and lowering put forth by Kiparsky (1968). At this example my alarm bells stated ringing immediately and red lights were flashing[1]: my phonological theory told me that there was something very wrong. Something like this example could not possibly exist according to my theory. Now these are the interesting examples, of course, therefore I started to look more closely. It turned out quickly that the two rules involved are factually wrong. I will spend large parts of this paper showing why the phenomena under discussion are impossible according to GP, or

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[1] This metaphor is of course J. Kaye's.

in other words, what made my alarm bells ring in the first place. It lies in the nature of this discussion to rely heavily on GP definitions and assumptions. However, the actual findings do not hinge on the actual theory used. It is a fact that the rules do not properly reflect the data, and are therefore wrong. For a more detailed argumentation that is theory-independent I refer to Sutter (to appear).

An anonymous reviewer has pointed out that "in the 1960's there was a certain idea of what belongs to the domain of phonology, and this idea has changed radically in the course of the past decades. Some things that were considered phonological then (e.g. Umlaut in German, the Great Vowel Shift, Ablaut in the English strong verb system and many othrs) are no longer [...] considered phonological[…]." If this were true, my argument would indeed be "shooting at a straw man", as said reviewer put it. Although I am aware that umlaut has been called morphological before (cf. Rieder 2000 and references in Wiese 1996), I know of no theory (apart from GP) which excludes umlaut on a principled basis. I am aware, however, of a number of publications in a very recent framework (Optimality Theory, to be precise) that argue *in favour* of a phonological treatment of umlaut (e.g. Féry 1994, Klein 2000, Trommer 2009 for German, Hermans & van Oostendorp 2008 for a dialect of Dutch). The case, at least for umlaut in German(ic), is far from being as clear as this reviewer put it.

The same anonymous reviewer wrote: "There is no point in contrasting two *theories* in such a way, especially at such a great temporal distance" (emphasis original). I could not agree less: science involves evaluating other (older) approaches and comparing them to the current one. As long as examples of the older model are still used in modern textbooks and quoted in scholarly discussions, the temporal distance between the advent of the respective theories loses its importance. It is our task as phonologists to prove that those examples (and, as a consequence, the theory they are couched in) fail, and that our approach has a higher level of explanatory adequacy.

There are, thus, two lines I will follow in this paper: First and foremost, I will show that a purported case of rule ordering is in fact no argument for Bromberger and Halle's view that phonology is different from syntax, because the apparently supportive example is wrong on many accounts.

Secondly, I will show how a theory can be used effectively to separate the wheat from the chaff: if said theory is restrictive enough, it will predict those things to be possible that do occur in human languages. And also, it will deem impossible those things that do not occur in any language.

This paper is organised as follows: in the next section I will introduce Kiparsky's example that seems to prove the necessity of rule ordering. In section 3 I will provide more relevant data for both umlaut and lowering. In section 4 I will very briefly show why the rules proposed by Kiparsky are wrong – independently of the theory that is used. Section 5 explains how the theory I use can exclude both rules from the possible phonological processes on a principled basis. Section 6 will sketch out alternatives for the treatment of lowering and umlaut, before this paper closes with a short summary of the major points.

If not indicated otherwise, all data are taken from my native dialect, which is spoken in an area that lies between those where the Kesswil and Schaffhausen dialects are spoken (see next section), sharing boarders with both of them. I will refer to this dialect as Swiss German. Although the exact realisation of some items might vary across the three dialects, the conclusions drawn are of a more general nature and true for all of them.

2   Kiparsky's example

Kiparsky (1968) argues that the microvariation found in plural forms of certain words of the Swiss German dialects of Schaffhausen and Kesswil in north-eastern Switzerland can easily be accounted for by reversely ordering two rules (cf. (1) below). According to rule 1 (umlaut) a vowel is fronted in an umlaut-inducing environment, while rule 2 (lowering) states that a back mid vowel (*o*) will be lowered (to *ɔ*) before a coronal obstruent or *r*. These two rules are in a bleeding relation in Schaffhausen: both underlying forms *boge* and *bode* undergo umlaut, with the result *böge* and *böde*, respectively. Now neither of these forms is a valid input for the second rule, lowering, because only *o* can undergo lowering. In Kesswil, the rules are reversely ordered, and lowering takes place first: the *o* in *bode* is lowered to *ɔ*, but the *o* in *boge* is not, because it is not in pre-coronal position. Umlaut takes place next, and because plural is an umlaut-inducing environment, both the underlying *o* in *boge* and the lowered *ɔ* in *bɔde* are umlauted. The difference between the dialects of Schaffhausen and Kesswil are, according to Kiparsky, a consequence of this reverse ordering: The plurals of the words *boge* are the same – *böge* – but the plurals of underlying *bode* are different – *böde* in Schaffhausen and *bɔ̈de* in Kesswil.

(1) **Schaffhausen**   **Kesswil**   (Kiparsky 1968: 178-179)

underlying	*boge*	*bode*	underlying	*boge*	*bode*
umlaut	*böge*	*böde*	lowering	–	*bɔde*
lowering	–	–	umlaut	*böge*	*bɔ̈de*
surface	*böge*	*böde*	surface	*böge*	*bɔ̈de*

   Koutsoudas et al. (1974) have shown that restrictions on possible surface forms can account for the facts, and there is no need to extrinsically order the rules in this example. I will argue that the problem lies much deeper: Both rules are in fact wrong. I will show why and where they went wrong below, but let me first introduce some more data for both umlaut and lowering.

3   Swiss German Data

I will start with providing more data on umlaut and the distribution of *o* and *ɔ*. For umlaut, I will introduce four so-called umlaut-inducing environments: nominal and verbal diminutives, verbalisers and nominal plural. This list is by no means exhaustive, but provide common places to encounter umlaut. In the case of lowering, I will provide examples for *o* and *ɔ* in both coronal and non-coronal environments.

3.1   Umlaut: nominal diminutives

Diminutives of nouns are formed by adding the suffix -*li* to a stem. The resulting diminutive nouns denote endearment more often than smallness, and the Swiss are notorious for using them extensively. The diminutive -*li* is very productive, it can be attached to a wide variety of nouns.

   The words in (2)a) are common words of Swiss German and frequently used with and without the diminutive. Those in (2)b) are examples of recent loans that also show

umlauted vowels in the diminutive. The word *t:ü:li* was originally used by IT people almost exclusively, but it is increasingly common beyond these circles.

While the words in (2)c do not show umlaut in the diminutive, the one in (2)d has two ways of forming a diminutive. People use them interchangeably, there is no difference in meaning between the two forms.

(2) a. *ʃatə ~ ʃɛtəli*   'thread ~ id.-DIM.'
     ʃokəl ~ ʃökəli   'bird ~ id.-DIM.'
     rɔs: ~ rös:li   'horse ~ id.-DIM.'
     hu:s ~ hü(:)sli   'house ~ id.-DIM.'
     paum ~ pɔimli   'tree ~ id.-DIM.'
  b. *t:u:l ~ t:ü:li*   'tool (IT) ~ id.-DIM.'
     kxompju:t:ɵ ~ kxompjü:t:ɵli   'computer ~ id.-DIM.'
     t:elefo:n ~ t:elefö:ntli   'telephone ~ id.-DIM.'
  c. *pupi ~ pupəli*   **püpəli*   'childish person ~ id.-DIM.'
     jok:əl ~ jok:əli   **jök:əli*   'klutz ~ id.-DIM.'
  d. *aut:o ~ aut:ö:li ~ ɔit:əli*   'car ~ id.-DIM. ~ id.'

3.2   Umlaut: verbal diminutives

Verbs also have diminutives in Swiss German. Although this is not productive in Standard German, we find a number of fossilised forms. Non-linguists do not necessarily see a connection between them. (Words given in German orthography.)

(3) *(*traufen) ~ träufeln*   '* ~ to trickle' (cf. Traufe 'eaves')
     kochen ~ köcheln   'to boil ~ to simmer'
     streichen ~ streicheln   'to smooth sth out ~ to stroke'
     tropfen ~ tröpfeln   'to drip ~ to trickle'

In Swiss German, the verbal diminutive suffix *-(ə)lə*, is still productive, but not as ubiquitous as the nominal diminutive. Its meaning can be one of endearment or of doing something only half-heartedly.

(4) a. *patə ~ pɛtələ*   'to bathe ~ id.-DIM.'
     xɔx:ə ~ xöx:ələ   'to cook ~ id.-DIM.'
     ʃo:nə ~ ʃö:nələ   'to spare ~ id.-DIM.'
     t:urnə ~ t:ürnələ   'to do gymnastics ~ id.-DIM.'
     ʃlauf:ə ~ ʃlɔif:ələ   'to loop sth ~ id.-DIM.'
  b. *faksə ~ fɛksələ*   'to fax ~ id.-DIM.'
  c. *ʃtak:ə ~ ʃtak:ələ*   **ʃtɛk:ələ*   'to stutter ~ id.'
     ka:kə ~ ka:kələ   **kɛ:kələ*   'to teeter ~ id.'

Again, words in (4)a are common words, more or less frequently used in the diminutive. Although not exactly as productive as the nominal diminutive, the verbal

diminutive suffix can also be attached to recent loan words, cf. (4)b. The words in (4)c are examples for verbal diminutive without umlaut.[2]

3.3   Umlaut: verbalizers

There are several ways of deriving verbs from nouns, one of them results in a verb that expresses something along the lines of 'do something in/with/like X'. Although not as productive as the above, it can be used to create new words that are readily understood. As in the examples above, words in (5)a are common, as are the related verbs. (5)b exemplifies nouns that have entered the language relatively recently but can be verbalised. The second example contains front vowels only and is therefore not subject to umlaut. I include it as additional evidence that this verbaliser is indeed used with new words. The verb in (5)c is not commonly known, but is readily understood to mean 'do something like a Matter' (Matter being a family name). However, in my extended family it took on a more specific meaning, after my cousins called Matter: *mat:ələ* is avoiding to eat the last piece of cake, meat, bread, etc. by eating only half of it, then half of the rest, and so on, until it becomes impossible to divide the rest any further.

(5)   a. *fat:ɐ ~ fɛt:ələ*   'father ~ play father[3]'
         fot:o ~ föt:ələ   'photo ~ take pictures'
         tsmɔrkə ~ tsmȫrkələ   'breakfast ~ have breakfast'
         sunə ~ sünələ   'sun ~ sunbathe'
         sau ~ sɔiələ   'pig ~ eat like a pig/be untidy'
      b. *kxompju:t:ɐ ~ kxompjü:t:ələ*   'computer ~ play/work on a computer'
         ɛs:əmɛs: ~ ɛs:əmɛs:lə   'text message ~ to text'
      c. *mat:ɐ ~ mat:ələ*   *mɛt:ələ*   'surname ~ do sth like a Matter'

It is important to note that while the recent loans in (5b) seem to suggest that umlaut is productively applied to new examples, the spontaneous creation of (5c) shows that umlaut does not necessarily apply with each new use of this verbaliser.

3.4   Umlaut: nominal plural

As in Standard German, there are several ways of forming a plural, the suffix to be used depends on the inflectional class. The list below shows several words with a -Ø suffix (6)a, with the suffix *-ɐ* (a central, rounded vowel) (6)b and *-ə* (6)c. Recent loans don't usually have plurals with umlaut (6)d, and although the variant *lɛp:t:ȫp:* with an umlauted vowel is not acceptable for all speakers, I have encountered it several times in normal conversations with native speakers. (6)e shows plurals without umlaut.

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[2] According to the *Schweizerisches Idiotikon* (Antiquarische Gesellschaft 1939), the verb *štak:ə* is attested in the form *staggeⁿ* (Vol. 10, col. 1553) for dialects of the investigated area, even though it is not in use today in the dialect presented. Similarly, *ka:kə* is attested as *gägeⁿ* (Vol.2, col. 137), but rare today.

[3] As in *miət:ələ unt fɛt:ələ* 'to play house'.

(6) a. *špaːsː ~ špɛːsː-Ø*　　　　　　　'jest-SG. ~ PL.'
　　　 soːn ~ söːn-Ø　　　　　　　 'son-SG. ~ PL.'
　　　 ʃɔːf ~ ʃ̌öːf-Ø　　　　　　　　 'sheep-SG. ~ PL.'
　　　 hunt ~ hünt-Ø　　　　　　　 'dog-SG. ~ PL.'

　　 b. *platː ~ plɛtː-ɐ*　　　　　　　'leaf-SG. ~ PL.'
　　　 holts ~ hölts-ɐ　　　　　　　'wood (material)-SG. ~ PL.'
　　　 xɔrn ~ xörn-ɐ　　　　　　　'grain-SG. ~ PL.'
　　　 štruːx ~ štrüːx-ɐ　　　　　　'shrubbery-SG. ~ PL.'

　　 c. *fatːɐ ~ fɛtːɐr-ə*　　　　　　 'father-SG. ~ PL.'
　　　 tːɔxtɐ ~ tːöxtɐr-ə　　　　　　'daughter-SG. ~ PL.'
　　　 muatːɐ ~ müatːɐr-ə　　　　　 'mother-SG. ~ PL.'

　　 d. *kxompjuːtːɐ ~ kxompjuːtːɐ-Ø*　'computer-SG. ~ PL.'　*kxompjüːtːɐ*
　　　 tːelefoːn ~ tːelefoːn-Ø　　　　'telephone-SG. ~ PL.'　*tːeleföːn*
　　　 lɛpːtːɔpː ~ lɛpːtːɔpː-Ø / lɛpːtːɔpː-s　'laptop-SG. ~ PL.'

　　 e. *štunt ~ štunt-Ø*　　　　　　 'hour-SG. ~ PL.'　　　DIM.: *štüntli*
　　　 xunt ~ xunt-ə　　　　　　　 'patron-SG. ~ PL.'　　DIM.: *xüntli*
　　　 koːf ~ koːf-ə　　　　　　　　'kid-SG. ~ PL.'　　　 DIM.: *köːfli*
　　　 štrɔːsː ~ štrɔːsː-ə　　　　　　'street-SG. ~ PL.'　　DIM.: *štröːsːli*
　　　 pːuːɐ ~ pːuːr-ə　　　　　　　'peasant-SG. ~ PL.'　 DIM.: *pːüːɐli*

Note that there is nothing inherent to the stems in (6)e that prevents them from being umlauted: they all show umlauted vowels in the diminutive.

3.5　Lowering: coronal environments

According to Kiparsky's rule of lowering, a back mid vowel is lowered in the context before a coronal obstruent or *r*. We would therefore expect to find no *o* before coronals, but only *ɔ*. In fact we find both *o* and *ɔ* in this context:

(7) a. *ɔrtə*　'order'　　　b. *oraŋš*　'orange (adj)'
　　　 kɔtːə　'godmother'　　 *otːɐ*　'otter'
　　　 hɔsə　'trousers'　　　 *blos*　'just'
　　　 jɔtlə　'to yodel'　　　 *otɐ*　'or'
　　　 pːɔštə　'to shop'　　　 *oštə*　'east'

This shows that the lowering rule makes false predictions, it is not even observationally adequate.

3.6　Lowering: non-coronal environments

The open back rounded vowel *ɔ* is also found in non-coronal contexts. It could be argued that in a model that generates surface forms from (historically older?) underlying forms, such as the one adopted by Kiparsky, these *ɔ*'s should be the result of lowering just as the ones in coronal environments. However, as I do not see how the knowledge of historical facts about a language should be relevant for a syncronic model, I will not pursue this point any further. The data below are merely provided for completeness' sake.

(8) *rɔkːə*   'rye'   *ʃɔkːi*   'chocolate'
     trɔfːə   'hit-PastPart.'   *klɔfːə*   'walk-PastPart.'
     nɔpːə   'knop'   *ʃɔpːə*   'baby bottle'
     ɔxs   'ox'   *lɔxː*   'hole'

After having presented more data from Swiss German, I will now point out some weaknesses of Kiparsky's example.

4   Where they went wrong

I will point out very briefly a few problems with Kiparsky's rules. For a more detailed analysis of these point see Sutter (to appear).

4.1   Lowering

To introduce his rule of lowering, Kiparsky presents a very restricted set of data that is, according to him, representative of both the Schaffhausen and the Kesswil dialects (Kiparsky 1968, 178, his spelling):[4]

(9)   Retention of *o*:
             before *l*: *foll*, *holts*, *gold*
             before labials: *grob*, *ops*, *hobəl*, *xnopf*, *dobə*, *ofə*, *xopf*
             before velars: *xoxxə*, *xnoxxə*, *rokx*, *kflogə*, *bogə*
         Lowering to *ɔ*:
             before r: *hɔrn*, *tɔrn*, *ʃɔrə*
             before dentals and palatals: *rɔss*, *xrɔttə*, *lɔsə*, *ksɔttə*, *bɔdə*, *pɔʃt*

The rule he proposes is the following (Kiparsky 1968, 178):

(10) $\begin{bmatrix} V \\ \text{-high} \\ \text{+back} \end{bmatrix} \rightarrow \quad [\text{+low}] \quad / \underline{\quad} \begin{bmatrix} \text{+consonantal} \\ \text{-grave} \\ \text{-lateral} \end{bmatrix}$

This rule might fit the restricted set of data Kiparsky presents, but this set can easily be extended such that the rule no longer holds, as has become obvious in (7) above: it is easy to find words with coronal obstruents (what he calls dentals and palatals, p. 178) that are preceded by *o*, not *ɔ*. For additional problems with these data see Sutter (to appear).

4.2   Umlaut

The umlaut rule as given by Kiparsky is problematic as well. His example of Swiss German does not state the exact umlaut rule, but only references an earlier discussion of

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[4] Kiparsky does not gloss his examples. Their translations, in order of appearance: full, wood (material), gold, crude, fruit, plane (tool), button, upstairs, fireplace, head, to cook, bone, skirt, flown, arc, horn, thorn, to scratch, horse, toad, to listen, cooked, floor, post office.

umlaut (in Old High Germanic and the Prignitz dialect of Low German) in the same paper. The rule Kiparsky references is the one given in (11) below:

(11) Umlaut rule for Low German (Kiparsky 1968, 176)
      V → [-back] / …

The first obvious problem is that the rule does not include a context. As Kiparsky notes (p. 176): "I leave open here the question of what exactly the environment of umlauting in modern German is, which is irrelevant for present purposes." This rule, as stated here, is therefore not verifiable.

The second problem is that of the proposed change: a vowel becomes [-back] in a non-specified context. As I will show in more detail in section 5.3.1, this might well be true for the alternations *a/ɛ*, *o/ö*, and *u/ü*, but not for *au/ɔi*. The rule does not reflect the observed patterns of vowel correspondences, and has therefore to be rejected because it does not even achieve observational adequacy.

In the light of the other problems I see with this rule this may only be a minor issue: Swiss German does not belong to the Low German, but to the Upper German dialect family.

These problems are independent of the phonological theory used. However, in the next section I will pretend to be unaware of these problems to showcase how a restrictive theory can predict the failure of the example.

5   The predictions of Government Phonology

> One of the perennial questions of phonological theory is the proper delimitation of its domain. That is, any phonological theory must be explicit about which phenomena should be included in the domain of phonological description and which should not. (Wiese 1996, 113)

This statement is still valid today, although the viewpoint has shifted away from description to explanation. Government Phonology (Harris 1994, Kaye 1989, 1995, 2000, Kaye, Lowenstamm and Vergnaud 1985, 1990 to name but a few) makes clear statements about what should and should not be included. It contains a number of conditions that have to be met by phenomena in order to be part of the phonological domain. These conditions were not designed specifically to exclude certain phenomena, but to make the resulting theory as restrictive as possible, while still capturing the patterns that recur time and time again in the world's languages. In what follows I will introduce two of these conditions on phonological processes (i.e. the Non-Arbitrariness Principle and the Minimality Hypothesis) in some detail, and test both phenomena (lowering and umlaut) against them. There are other conditions as well (cf. Kaye 1995, 313, Kaye and Pöchtrager 2011), and only the satisfaction of all of them makes a phenomenon a phonological process: all of these criteria are necessary, but none of them is sufficient on its own. However, as the rules proposed by Kiparsky clearly violate the two conditions introduced below, this is sufficient to rule them out as phonological processes.

Apart from these conditions, the theory also has a very restrictive set of possible mechanisms – "all phonological phenomena can be described in terms of putting things together or taking them apart" (Kaye 1989, 11). In other words: elements can be linked to a skeletal position, or they can be de-linked. In an ideal world, a phonological theory

can express exactly those processes that satisfy the conditions for phonological processes, and vice versa: every phenomenon that can be expressed does fulfil the requirements for a process. This gives independent evidence for the (non-)phonological nature of a process, because the conditions mentioned above and the possible mechanisms are formulated independently from each other. I will therefore also shortly talk about the expressibility of umlaut and lowering.

5.1 The Non-Arbitrariness Principle

According to the Non-Arbitrariness Principle "[t]here is a direct relation between a phonological process and the context in which it occurs" (Kaye, Lowenstamm and Vergnaud 1990, 194). Put differently: There has to be a connection between a process (what happens?) and its context (where does it happen?). This does not only require a process to have a trigger, but also that this trigger be the immediate cause of the process at hand. In other words: The context in which the process takes place has some property that is directly responsible for the process. It could be said that a process does not take place *in* a certain context, but *because* of that context.

This is in stark contrast to SPE-type rules: The generic rule as given in (12) basically translates to "anything goes to anything in any context." There is no connection whatsoever between *what* happens and *where* it happens.

(12) Generic rule
      $A \rightarrow B \:/\: C \:\_\_\_\: D$

5.1.1 Arbitrariness tested: Umlaut
Although the umlaut rule in (11) above is formulated in an arbitrary way, this does not make the phenomenon per se arbitrary, but is a consequence of the theory it is phrased in.

Umlaut is commonly seen as the fronting of a stem vowel, or, more generally speaking, the assimilation of a stressed vowel to a following vowel (cf. Pompino-Marschall 2000, 757). In GP this could only be expressed as the spreading of an **I** element, and the changes we observe (*a* changes to *ɛ*, *o* changes to *ö*, *ɔ* to *ɔ̈*[5] and *u* to *ü* – disregarding *au* to *ɔi* for the moment) support this view. The trigger we are looking for has to be an **I** element. As umlaut is observed in derived forms only[6], its trigger must be found in the suffix. I will investigate each of the environments from section 3 and see whether the trigger can be found there.

The suffix for nominal diminutives is -*li*, which indeed contains an **I** element in the *i*. The Non-Arbitrariness Principle is thus satisfied so far. Both the verbal diminutive and the verbaliser have the suffix -*(ə)lə*. The exact status (and melodic make-up) of *ə* has to be further examined, but from what we know it seems highly improbable that it does contain an **I** element. There is certainly no **I** element in the *l*. The plural comes in different guises: -*Ø*, -*ɐ*, and -*ə*. The latter, as we have seen before, most probably does not contain an **I** element. The second one, *ɐ*, is also still being examined, but even less

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[5] According to Kiparsky there is no umlaut from *ɔ* to *ɔ̈*, but *ɔ̈* is always the result of lowering *ö*. Nothing hinges on this distinction.
[6] More on this in section 5.2.1 Minimality tested: Umlaut.

likely to contain an **I** element, and it is outright impossible to find one in a phonologically empty suffix[7].

What we find is that although there is a possible trigger in nominal diminutives, the chance to find one in all other suffixes ranges from highly improbable to outright impossible.

5.1.2 Arbitrariness tested: Lowering

Lowering is a term from articulatory phonetics, not from phonology. The mechanisms involved in lowering, say, *i* to *e* are very different from the ones in lowering *ɔ* to *a*. This can be seen easily from the prototypical 7-vowel system represented in (13) below:[8]

(13)   *i*   (.**I**)   *u*   (.**U**)
       e   (**A.I**)   *o*   (**A.U**)
       ɛ   (**I.A**)   *ɔ*   (**U.A**)
             a   (.**A**)

As we are investigating a case of lowering *o* to *ɔ*, we are looking at role switching, or, more specifically, the promotion of **A** to be the head of the phonological expression. Remember that according to Kiparsky's rules lowering happens before coronal obstruents and *r*. The property that sets coronals apart from all other consonants is the presence of an **A** element. This **A** can be the head of the phonological expression (for the stops and the nasal *n*) or an operator (for fricatives, *r* and *l*) (cf. Kaye 2000). Although it is tempting to see a connection – it is **A** that gets promoted to head status and **A** that is the relevant context – this is not what we call a causal relationship. There are three major issues with this: (i) why should the presence of an **A**, regardless of its role as head or operator, influence the role of an element in a preceding phonological expression? (ii) how can the **A**s in the expression (**A.I**) be prevented from being promoted as well? Or, in less theoretical words, why is it only *o* that is lowered, but not *e*? (iii) the lowering rule excludes the coronals *l* and *n* from triggering lowering, although they, too, contain an **A** element.

It should be clear now that the simple presence of an **A** element in the context is not possibly the trigger for the lowering as described by Kiparsky. There is no trigger that would satisfy the Non-Arbitrariness Principle.

5.2   The Minimality Hypothesis

The Minimality Hypothesis states that "[p]rocesses apply whenever the conditions that trigger them are satisfied" (Kaye 1992, 141). This means that there are no different levels or strata of phonology in which only a certain subgroup of processes applies, with other processes applying at other levels or strata. In fact, any kind of rule ordering is excluded: whether a process applies or not depends solely on the context. Whenever the trigger of

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[7] Postulating a floating **I** element leads to circularity in this case: we would need two similar suffixes, one with a floating **I** element that triggers umlaut, and one without a floating element for the cases without umlaut. However, we can only conclude which roots take the suffix with a floating **I** from the observation of umlaut and vice versa. There is no external evidence for such a floating element. This analysis has therefore to be rejected.

[8] I refer the reader to the literature mentioned at the beginning of the section, especially Harris (1994) and Kaye (2000) for an introduction to element theory.

the process is present, that process will automatically apply. This has the simple but far-reaching consequence that any phonological process is exceptionless. The data in section 3 has already provided examples for exceptions, let me summarise them again below.

5.2.1 Minimality tested: Umlaut
For umlaut, we have seen exceptions in all four environments I have introduced. Some of the data is repeated below for ease of reference.

(14) *xuə ~ xüəli*   'cow ~ id.-DIM.'   *pupi ~ pupəli*   'infantile ~ id.DIM.'
       patə ~ pɛtələ   'to bathe ~ id.-DIM.'   *štakːə ~ štakːələ* 'to stutter ~ id.'
       fatːɐ ~ fɛtːɐlə 'father ~ play father⁹'   *matːɐ ~ matːɐlə*   'surname ~ do sth
                                                                      like a Matter'
       hunt ~ hünt-Ø   'dog-SG. ~ PL.'   *štunt ~ štunt-Ø*   'hour-SG. ~ PL.'

We would expect to find **püpəli*, **štɛkːələ*, **mɛtːɐlə*, **štünt* if umlaut were excetionless.

But the Minimality Hypothesis makes an even stronger prediction: GP does not recognise different cycles of phonological derivation with processes applying in some cycles, but not in others. Therefore, all processes are predicted to apply to lexical forms as well as derived forms. If the nominal diminutive ending *-li* triggers umlaut, we expect all words ending in *-li* to be umlauted, regardless of the meaning of that *-li*. This can easily be tested. There are at least three reasons for a word to end in *-li*: (i) in a nominal diminutive, as discussed, (ii) in shortened forms that have an *i* added to a truncated stem that ends in *l*, (iii) if the stem ends in *-li*. Examples of (i) were given in section 3.1. Examples for (ii) and (iii) are given in (15)a) and (b) respectively. We find umlaut in none of of these forms.

(15) a. *muli*   'mule'   from *muːltːiɐ*   b. *prokːəli* 'broccoli'
         xuli   'biro'   from *xukəlšriːpɐ*   *prunsli*   'kind of cookie'
         pːuli   'pullover'   from *pːuloːvɐ*   *juli*   'July'
         xnopli 'garlic'   from *xnoplaux*   *alkxaːli* 'alcali'

The same case can be made for other suffixes of the umlaut-inducing kind: All words that end in *-(ə)lə* (as in the verbal diminutive and the verbaliser) and *-ə*, *-ɐ* and *-Ø* (as in the plural) are predicted to be umlauted, regardless of the morphological or semantic content (if any) of these final segments. It is more than obvious that this is not the case, especially in the case of *-Ø* – it would mean that umlaut has to apply to all the words in the language.

Umlaut obviously does not satisfy the Minimality Hypothesis. In the next section we will apply the same kind of reasoning to lowering.

5.2.2 Minimality tested: Lowering
The killer case for lowering would be to find o before coronal obstruents or r, because they should, according to the lowering rule, all be lowered to ɔ. The data from (7) is repeated here as (16) for convenience. In the best case, the rule grossly overgenerates. As it stands, it is empirically wrong, regardless of the theoretical framework.

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⁹ As in *miɐtːɐlə unt fɛtːɐlə* 'to play house'.

(16)	before r	*ɔrtə*	'order'	*oraŋš*	'orange (adj)'
	before s	*hɔsə*	'trousers'	*plos*	'only, just'
	before š	*p:ɔštə*	'to shop'	*oštə*	'east'
	before t:[10]	*kɔt:ə*	'godmother'	*ot:ɐ*	'otter'
	before t[11]	*jɔtlə*	'to yodel'	*otɐ*	'or'

It is obvious that not all *o*s are lowered in the relevant context. There is nothing to add to this.

5.3   Expressibility

The two conditions mentioned above – the Non-Arbitrariness Principle and the Minimality Hypothesis, provide us with easily testable predictions: If there is a local trigger that can be causally related to the phenomenon, and if that phenomenon is exceptionless, we are dealing with phonological processes. Let me repeat here that there are more conditions like that (Kaye 1995, Kaye and Pöchtrager 2011), and that all of them are necessary properties of phonological processes, but none of them is sufficient by itself. This allows for triangulation to make sure that it is not a single overly restrictive or ill-designed criterion that excludes a phenomenon from being phonological. If a phenomenon satisfies all but one criterion, this is an indicator that the theory is wrong or incomplete and it will have to be changed (cf. Pöchtrager 2006 for such a radical redesign).

There is one more point to keep in mind. A theory of phonology is well-designed if it can express exactly the set of phenomena it independently defines as phonological. Again, if a phenomenon satisfies all criteria, but is not expressible, the theory is too restrictive or the criteria are too lose. On the other hand, if a phenomenon is expressible by the theory but it does not satisfy one or more of the criteria, the theory is not restrictive enough. The same is true if the theory is able to express phenomena that are not attested in any human lnaguage. In all of these cases some part of the theory will have to be changed.

5.3.1 Expressibility: Umlaut
Umlaut seems easily expressible at first sight: There is an **I** element that spreads leftwards from somewhere near the right edge of the word. But there are problems as soon as we try to be more formal: (i) the source of **I**, (ii) the target of **I**, (iii) deriving *ɔi* from *au*, (iv) the formalisation of the environment.

I will shortly turn to each of these problems now. (i) In most cases it is not clear where **I** comes from. I have dealt with this in section 5.1.1., no more needs to be said. (ii) It is just as unclear, where this **I** spreads to. In most cases it spreads just one nuclear position to the left, as we expect it to (cf. (17)a and most of the other examples in this paper). In other cases, however, it skips one position (cf. (17)b)).
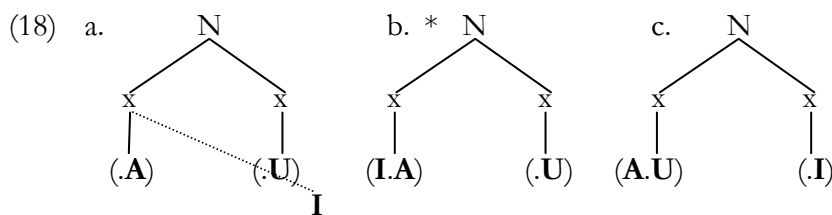
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[10] This is spelled as *t* in most sources.
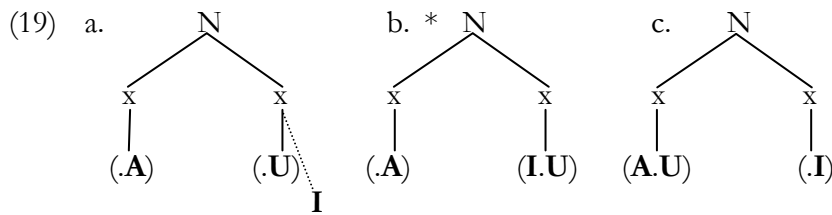[11] This is spelled as *d* in most sources.

(17) a. *plat: ~ plɛt:-ɘ*   'leaf-SG. ~ PL.'
          xɔx:ə ~ xȫx:ələ   'to cook ~ id.-DIM.'
          tsmɔrkə ~ tsmȫrkələ   'breakfast ~ have breakfast'
          sunə ~ sünələ   'sun ~ sunbathe'
          paum ~ pɔimli   'tree ~ id.-DIM.'
      b. *fokəl ~ fökəli*   'bird ~ id.-DIM.'
          kxompju:t:ɘ ~ kxompjü:t:ɘli   'computer ~ id.-DIM.'
          kxompju:t:ɘ ~ kxompjü:t:ɘlə   'computer ~play/ work on acomputer'
          fat:ɘ ~ fɛt:ɘr-ə   'father-SG. ~ PL.'
          t:ɔxtɘ ~ t:ȫxtɘr-ə   'daughter-SG. ~ PL.'
          muət:ɘ ~ müət:ɘr-ə   'mother-SG. ~ PL.'
      c. *aut:o ~ aut:ö:li ~ ɔit:əli*   'car ~ id.-DIM. ~ id.'

The rule seems to be to spread to the stressed nucleus (the head of the domain). There are two problems with this: (a) the example of (17)c shows that this does not always hold: both forms, *'aut:ö:li* and *'ɔit:əli* 'car-DIM.' are possible and used interchangeably, and in both cases it is the first nucleus that bears stress. (b) For the **I** element from near the right edge of the domain to spread to the stressed nucleus, the two positions are required to be adjacent on some level of representation. However, there is no external evidence to justify a level that contains just the domain head and the nucleus that is the source of the **I** element. Proposing such a level would be pure stipulation. Because the stipulated level is solely needed for the treatment of umlaut, and umlaut is the only phenomenon that relies on such a level, any argumentation would be circular and has therefore to be rejected.

(iii) It is impossible to derive *ɔi* from *au* by way of adding an **I** element. The diphthong we start out with consists of an **A** element as the head of the diphthong and an **U** element. We expect the spreading **I** to target the head of the diphthong, indicated by the dashed line in (18)a. The resulting diphthong is shown in (18)b, its realisation would be *ɛu*. But what we observe is *ɔi* instead, represented in (18)c. Going from (18)b to (18)c is not expressible in GP. One reason for that is that linking and de-linking of elements can never be contingent on any other operation, therefore two elements can not swap place.

(18) a.   N   b. * N   c.   N
           ╱   ╲   ╱   ╲   ╱   ╲
          x   x   x   x   x   x
          │   │   │   │   │   │
        (.**A**)   (:**U**) (**I.A**) (.**U**) (**A.U**)   (.**I**)
                      I

If the **I** element (unexpectedly) was to target the right member of the diphthong, the problems are similar (cf. (19)a–c) below): Again, it is impossible to reach the representation of the actual outcome in (19)c.

(19) a.

```
        N                    b. *   N                    c.   N
      /   \                      /    \                     /    \
     x     x                    x      x                   x      x
     |     |                    |      |                   |      |
   (.A)  (.U)                 (.A)   (I.U)              (A.U)    (.I)
           \
            I
```

Generally, this kind of "cocktail-approach" to elements (add all ingredients, shake well, distribute across available positions ad libitum) is not part of GP's inventory of possible operations. It is therefore not possible to derive *ɔi* from *au* by means of adding an **I** element.

(iv) The problem of the environment has been lurking in every corner. Kiparsky did not specify an environment claiming that it is "irrelevant for present purposes" (Kiparsky 1968, 175). It has become clear from the data I have provided in section 3 that the relevant environments are morphologically defined, not phonologically. This is by no means a new discovery: umlaut in German(ic) has been described as morphological often (e.g. Rieder 2000, references in Wiese 1996), and there is no reason to believe Swiss German should be any different. However, according to the phonology-morphology interface proposed in Kaye (1995), phonology is blind to morphology: The meaning of a suffix cannot have a bearing on how that suffix is treated by phonology.

It has become clear that umlaut is not as straightforward as it seems at first sight: it is impossible to formalise in a restricted theory of phonology.

5.3.2 *Expressibility: Lowering*

As with umlaut, there are difficulties in formalising lowering. These problems are strongly connected to the ones discussed in the section on arbitrariness. Let me just repeat the main points: (i) it is only *o* (**A.U**) that is lowered, but not *e* (**A.I**). (ii) here there is no identifiable trigger, there is no reason for the process to take place.

5.4   Conclusion

In this section I have presented a list of reasons (by no means exhaustive) that lead GP to the prediction that processes like the ones proposed by Kiparsky (1968) for Swiss German cannot possibly exist. As I have shown in section 4, this is in perfect accordance with the result of a closer inspection of the rules and the data they are based on: The rules were shown to be facually wrong, just as GP predicted. The question therefore remains: what are umlaut and lowering, if not phonological processes? I will sketch out an answer to this question in the next section.

6   Alternatives

Native speakers apply umlaut to words that have entered the language only recently, so it must be something that is alive in the language today. But what is it, if not phonological? To answer this question, let me take a de-tour to English:

In English there is a suffix *-en* to form verbs from adjectives ((20)a) below). But, as the examples in (20)b show, it cannot be applied to any adjective.

(20) a. *red*   *redden*   b. *blue*   **bluen*
    white   *whiten*   *green*   **greenen*
    quick   *quicken*   *cold*   **colden*

How does a speaker of English know whether this suffix can be used with a certain adjective or not? Although the suffix can only be attached to words that end in an obstruent, it is surely not a question of phonology. This, along with many other, similar cases provides evidence for a word-building module in language – a module that joins roots and suffixes together to form new words. A module that permits the suffix *-en* to be attached to *red*, *white* and *quick*, but never to *blue*, *green* or *cold*. It is that same module that makes sure that *keep* + PAST is realised as *kept*, and that *mouse* + PL. is *mice*. And obviously it is also the same module that is responsible that *pfau* + PL. is *pfauə*, but *pfau* + DIM. is realised as *pfɔili*. The two stems *pfau-* and *pfɔi-* are not derived from one another, or from a common source. They are both entries in the psychological lexicon, just as *mouse* and *mice* are both separate entries. The similarity between the two stems simply helps retrieving them (for reasoning for phonology as an addressing system to the psychological lexicon cf. Kaye 1995)

The case for lowering is much easier: It is no more than an illusion. Both *o* and *ɔ* are present in the vowel inventory of Swiss German, and in most cases neither is derived from anything, let alone from each other. Instead, words lexically contain either open *ɔ* or closed *o*.

7   Summary

In the face of a purported case of rule ordering, this paper set out to prove that this is not a counterargument to GP's stance that rule ordering does not exist in phonology. This provides an important argument against Bromberger and Halle's (1989) claim that phonology is different from other linguistic modules, and supports thus the view that phonology and syntax are indeed similar. The evidence at hand, namely Kiparsky's example of microvariation in two dialects of Swiss German, was shown to be irrelevant, because both rules it relies on are factually wrong. It was also shown how a restrictive theory will predict such mismatches. Any theory needs to define what belongs to the domain of phenomena it can explain. In the best case, a triangulation of several arguments excludes circularity. Two conditions on phonological processes and an independent clue – expressibility – showed that neither umlaut nor lowering as proposed by Kiparsky could be possible processes. An alternative treatment of the two phenomena was sketched out: words lexically contain either an open *ɔ* or a closed *o*, there is no process of lowering before coronal obstruents. Umlaut is not a phonological process either. It is an illusion that arises from an independently motivated word building module that joins roots and suffixes to form new words. The different roots have separate entries in the psychological lexicon, and are not derived from a common source.

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