Saltation in Polish

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This chapter relationally models a phonological process of saltation in Polish stops. The alternation of interest comes from Lubowicz (2002), and it involves a phonological process wherein a sound alternates with a sound less similar to it than 'necessary', as the example will make clear.

Polish has a process of velar palatalization before front vowels. It affects /k/ and /x/ fairly straightforwardly, as seen in (1) and (2).

(1) /kro**k** + it͡ɕ/ → kro**t͡ʃ** + it͡ɕ 'to step'

(2) /stra**x** + it͡ɕ/ → stra**ʃ** + it͡ɕ 'to frighten'

However, the velar /g/, in addition to undergoing palatalization, also undergoes spirantization in the same environment, as seen in (3).

(3) /va**g** + it͡ɕ/ → va**ɣ** + it͡ɕ (*va**d͡ʒ** + it͡ɕ) 'to weigh'

Note also that the palatal /d͡ʒ/ does exist in the pre-front vowel environment when it is there underlyingly, as in (4).

(4) /bri**d͡ʒ** + ik + i/ → bri**d͡ʒ** + ek 'bridge (dim)'

Note that it is in some sense counterintuitive for /g/ to alternate with ɣ, rather than with d͡ʒ, given that they are phonetically and featurally more distant.

To model this alternation, we will use word models consisting of sets of features and the binary successor relation ($\lhd$). In order to proceed, we must determine which features are relevant for the language and alternation. (One option would be to consider our strings as sequences of symbols rather than of positions with multiple phonological features; however, this approach sidesteps the actual phonological generalizations at hand, as well as being less concise at the conclusion.)

Here we shall define $\mathcal{F}$ (the set of phonological features) to be:
$\mathcal{F} = \{\texttt{vocalic}, \texttt{front}, \texttt{velar}, \texttt{palatal}, \texttt{continuant}, \texttt{F}\}$ (where F represents all other features relevant to the language (but not necessarily relevant to this alternation).

Now we want to define the acceptable transitions for words from underlying forms to surface

forms. For this, we need the following tools:

- A domain formula, φ_{dom}. In this case it is simply $\varphi_{dom} \stackrel{\text{def}}{=} \texttt{true}$.
- A copy set C of $k \geq 1$ elements which will determine the limit of the size of the surface forms in terms of copies of the underlying forms. In our case, there is no insertion of segments from input to output, so $C \stackrel{\text{def}}{=} 1$.
- The binary relation formula $\varphi_{\lhd}$, where $\varphi_{\lhd}(x, y) \stackrel{\text{def}}{=} x \lhd y$.
- Unary relation formulas for each feature in $\mathcal{F}$. Some of these are straightforward, while others will represent the palatalization and spirantization found in the Polish data.

Vowel segments do not change from the underlying to surface form, so we have straightforward definitions for them. Voicing of segments also does not change.

$$\varphi_{\texttt{vocalic}}(x) \stackrel{\text{def}}{=} \texttt{vocalic}(x) \tag{5}$$

$$\varphi_{\texttt{front}}(x) \stackrel{\text{def}}{=} \texttt{front}(x) \tag{6}$$

$$\varphi_{\texttt{voice}}(x) \stackrel{\text{def}}{=} \texttt{voice}(x) \tag{7}$$

Underlying velar segments remain velar in the surface form, unless they are followed by a front vowel.

$$\varphi_{\texttt{velar}}(x) \stackrel{\text{def}}{=} \texttt{velar}(x) \wedge \neg(x \lhd y \wedge \texttt{front}(y) \wedge \texttt{vocalic}(y)) \tag{8}$$

Underlying palatal segments remain palatal in the surface form, plus velar segments become palatal when followed by a front vowel.

$$\varphi_{\texttt{palatal}}(x) \stackrel{\text{def}}{=} \texttt{palatal}(x) \vee (x \lhd y \wedge \texttt{velar}(x) \wedge \texttt{front}(y) \wedge \texttt{vocalic}(y)) \tag{9}$$

Finally, underlying continuants remain continuants, plus the voiced velar becomes a continuant when it is in the environment for palatalization (before a front vowel).

$$\varphi_{\texttt{continuant}}(x) \stackrel{\text{def}}{=} \texttt{continuant}(x) \vee (x \lhd y \wedge \texttt{velar}(x) \wedge \texttt{voice}(x) \wedge \texttt{front}(y) \wedge \texttt{vocalic}(y)) \tag{10}$$

From an example of how this works, let us consider the alternation shown in (3) (/va**g** + it͡ɕ/ → va**ʒ** + it͡ɕ).

The underlying form /vagit͡ɕ/ is shown in Figure 1.

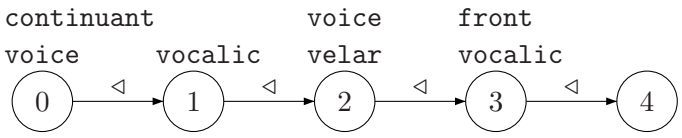

Figure 1: Word model for /vagit͡ɕ/

If we apply each of the equations (5)-(10) to the input, we get a model for the output form, [vaʒit͡ɕ], as shown in Figure 2. Note the changes which have taken place in segment 2, which changes from a velar to a palatal fricative.

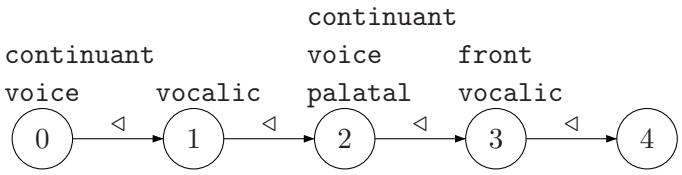

Figure 2: Word model for [vaʒit͡ɕ]

Although the model described here is perfectly adequate for producing the appropriate alternation, there one potential drawback. Namely, it seems that this pattern of saltation is an unusual one in phonology; OT captures this fact by struggling to account for it, and a rule-based account must apply to some Elsewhere Principle or multi-leveled rule structure. The transduction described here, though, is not especially structurally different from that used to describe any phonological pattern. In fact, it is very simple. While simplicity, is of course, desirable, the strangeness of a saltation pattern seems to be lost in this relational representation.

References

Engelfriet, J. and H. J. Hoogeboom (2001). Mso-definable string transductions and two-way finite-state transducers. *ACM Trans. Comput. Logic 2*, 216–254.

Lubowicz, A. (2002). Derived environment effects in optimality theory. *Lingua 112*, 243–280.

Rogers, J. and J. Heinz (2014, July). Model-theoretic phonology. Slides presented in the course of the same name at the European Summer School in Logic, Language, and Information.