SPECIFICITY IN RULE TARGETS AND TRIGGERS: TWO *v*'s IN HUNGARIAN*

Charles Reiss
Concordia University

This paper introduces key concepts of Substance Free Logical Phonology (LP: Bale et al. 2014; Bale and Reiss 2018; Reiss 2021; Dabbous et al. 2025), and applies them to an analysis of the different behaviors of segments that surface as [v] in Hungarian. All data and the idea of relying on an underlying representational distinction between two *v*'s are based on the excellent presentation of Siptár and Törkenczy (2000, henceforth ST). My goal is to highlight the subtle feature logic involved in LP rules by developing an LP alternative to ST's analysis.

1. Voicing in obstruent clusters

Hungarian exhibits a superficially complex process of reciprocal voice neutralization. In a sequence of two obstruents, the first takes on the voicing value of the second. This leads to situations where a root like /kalap/ surfaces sometimes with final [p] and sometimes with final [b], but so does a root like /rab/. The two must have different final segments underlyingly because before a sonorant, like /n/, or word-finally, the roots have different final consonants: if there is at least one environment in which they behave differently, they must be underlyingly distinct.

(1) Hungarian reciprocal voicing (ST:§4.1.1)

	nom.sg.	iness.sg	dat.sg.	abl.sg.	
a.	kalap	kala[b]-ban	kalap-nak	kalap-tól	'hat'
	rés	ré[z]-ben	rés-nek	rés-től	'slit'
	kút	kú[d]-ban	kút-nak	kút-tól	'well'
	zsák	zsá[g]-ban	zsák-nak	zsak-tól	'bag'
b.	rab	rab-ban	rab-nak	ra[p]-tól	'captive'
	víz	víz-ben	víz-nek	ví[s]-től	'water'
	kád	kád-ban	kád-nak	ká[t]-tól	'tub'
	meleg	meleg-ben	meleg-nek	mele[k]-től	'warmth'
c.	szem	szem-ben	szem-nek	szem-től	'eye'
	őr	őr-ben	őr-nek	őr-től	'guard'

This process, whereby obstruents take on the voicing of the following obstruent, might be modeled with a single rule in a traditional rule-based notation.

*Special thanks to Rim Dabbous and Kyle Gorman for helping with conceptual and notational issues. The whole LP approach is a group effort involving students and colleagues, and I am indebted to them all.

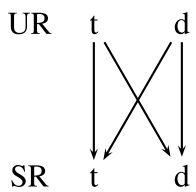
Actes du congrès annuel de l'Association canadienne de linguistique 2024.
Proceedings of the 2024 annual conference of the Canadian Linguistic Association.

(2) Reciprocal voice neutralization (traditional notation, to be revised)

$$\left[-\textsc{Sonorant}\right] \rightarrow \left[\alpha\textsc{Voice}\right] \;/\; \_\_ \begin{bmatrix}-\textsc{Sonorant}\\ \alpha\textsc{Voice}\end{bmatrix}$$

This pattern of reciprocal neutralization can be illustrated using underlying /t/, as in /kút/ ‘well’, and /d/, as in /kád/ ‘tub’, in a *segment mapping diagram* (SMD).

(3) Reciprocal neutralization SMD:



The vertical arrows show identity mappings of /t/ to [t] and /d/ to [d], whereas the diagonal arrows show the reciprocal neutralizations of /t/ to [d] and /d/ to [t].

LP contains no such feature changing rules, rules that can, say, turn the $-$VOICED value of /t/ directly into the $+$VOICED value of [d]. Instead, LP deconstructs all intrasegmental changes into combinations of rules built on two basic operations, set subtraction, which can remove features from segments, and unification, which can insert features into segments. LP thus formalizes suggestions by several scholars, including Poser (1982), Inkelas and Cho (1993), and ST, that feature changing is effected by a sequence of rules that delete features and rules that insert features.

Before introducing these operations, we note that LP differentiates set theoretic *types* through the use of different kinds of brackets. The rule target in (2) is actually a natural class of segments—in set theoretic terms, the rule targets any segment that is a superset of the set containing the features listed in the natural class characterization. In other words, the rule targets any segment that has the valued feature $-$SONORANT as a member. Equivalently, the natural class of targets is the set of segments that are supersets of the set $\left\{-\textsc{Sonorant}\right\}$. In contrast, the structural change of a rule does not refer to a class of segments, but rather to which features are changed. This distinction is reflected in (4) by the use of curly brackets for the rule’s change. So, the rule target refers to a set of sets of valued features, whereas the change refers to a set of features.[1]

(4) Reciprocal voice neutralization (revised bracket notation)

$$\left[-\textsc{Sonorant}\right] \rightarrow \left\{\alpha\textsc{Voice}\right\} \;/\; \_\_ \begin{bmatrix}-\textsc{Sonorant}\\ \alpha\textsc{Voice}\end{bmatrix}$$

---

[1]To be clear, “$-$SONORANT” is a valued feature; “$\{-\textsc{Sonorant}\}$” is a set of valued features and possibly denotes a segment; and “$[-\textsc{Sonorant}]$” is the natural class of obstruents. See Bale and Reiss 2018; Reiss 2021, *inter alia* for further discussion. A complication related to the use of α-notation is ignored here (see Bale et al. Submitted).

However, even this formulation is rejected in LP because we deconstruct the arrow '$\rightarrow$' of traditional rules.

In order to model Hungarian we first assume a rule built on standard mathematical set subtraction, given in (5).

(5) Part 1 (deletion)

$$\begin{bmatrix}-\textsc{Sonorant}\end{bmatrix} \setminus \{\alpha\textsc{Voice}\} \;/\; \_\_ \begin{bmatrix}-\textsc{Sonorant}\\ -\alpha\textsc{Voice}\end{bmatrix}$$

This rule deletes the voicing value of an obstruent if it is followed by an obstruent with the opposite voicing value.[2]

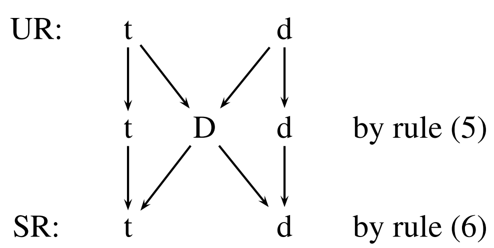
The next part of the reciprocal neutralization process is the unification-based rule. In this simple case, unification will work like set union. After the application of the preceding rule, all clusters of obstruents will either be consistent in voicing, like /db/ or /pt/, or else the first member of the cluster will lack a value for VOICE. Using /D/ to denote a coronal stop unspecified for voicing after the application of rule (5), such obstruent clusters will be of the form /Db/ or /Dt/, etc. Such cases will surface as [db] and [tt], with parallel clusters in other places of articulation.

(6) Part 2 (insertion)

$$\begin{bmatrix}-\textsc{Sonorant}\end{bmatrix} \sqcup \{\alpha\textsc{Voice}\} \;/\; \_\_ \begin{bmatrix}-\textsc{Sonorant}\\ \alpha\textsc{Voice}\end{bmatrix}$$

Clearly, the rules must be ordered such that (5) precedes (6), so that deletion of incompatible features precedes assimilation. Given this two-step process, we can give a more fine-grained SMD.

(7) Hungarian SMD via LP rules



[2] An alternative would subtract the set $\{+\textsc{Voi}, -\textsc{Voi}\}$ from any obstruent followed by another obstruent.

(i) Part 1 (deletion)—alternative version

$$\begin{bmatrix}-\textsc{Sonorant}\end{bmatrix} \setminus \{+\textsc{Voice}, -\textsc{Voice}\} \;/\; \_\_ \begin{bmatrix}-\textsc{Sonorant}\\ -\alpha\textsc{Voice}\end{bmatrix}$$

Segments in LP must be consistent sets of features—they must not contain both $+$F and $-$F for any feature F. However, the structural change of a rule is not a segment, and it may be a set containing opposite values, as in (i). We will use this possibility below when we delete all valued features.

The subtraction-based rule (5) creates derived underspecified segments like /D/. Then the unification rule (6) provides a VOICE value for underspecified segments.

2. One Hungarian *v*

It turns out that Hungarian has two segments whose behaviour is only partially consistent with that of segments like /t/ and /d/ with respect to reciprocal neutralization. The Hungarian segment corresponding to the letter *v* (or rather some cases of the letter *v*—see below) undergoes voicing assimilation to a following voiceless segment like /t/, but it differs from other surface voiced obstruents like /b, d, g, z, ʒ/ in that it does not *trigger* voicing of a voiceless obstruent to its left. In other words, *v* corresponds to a segment that is *mutable* in target position, and inert or *quiescent* in trigger position, to use terms introduced in other LP literature such as Gorman and Reiss (Submitted). I derive this behavior (Reiss 2021) by positing that the underlying segment, /V/, has no value for VOICE, but is otherwise identical to the surface forms [f, v], the labiodental fricatives. The Hungarian segment corresponding to orthographic *h* and *ch* is also "exceptional" with regard to voicing assimilation, but is like a mirror image of *v*: *h/ch* is *inalterable*—it does not get affected by a following voiced obstruent; but it does trigger voicing assimilation in preceding obstruents, and is called *catalytic*. This paper summarizes the discussion of *v* in Reiss (2021).

Data illustrating the interaction of *v* with other consonants appears in (8) using, using the symbol /V/ instead of the /v/ in ST.[3]

(8) *v* is a target of assimilation, but not a trigger

- Target: *hívsz* /Vs/ ⇝ [fs] 'you call', *óvtam* /Vt/ ⇝ [ft] 'I protected'; *révbe* 'to port', *bóvli* 'junk', *sav* 'acid'
- Non-trigger: *kvarc* /kV/ ⇝̸ [gv] 'quartz', *pitvar* /tV/ ⇝̸ [dv] 'porch'; *medve* 'bear', *olvas* 'read', *kova* 'flint', *vér* 'blood'

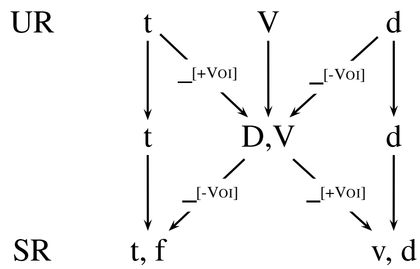
We see in (8) that *v* surfaces as [f] before a voiceless obstruent, as in *óvtam* 'I protected', where /Vt/ ⇝ [ft]. So *v* apparently acts like other obstruents, such as /z/, in undergoing voicing assimilation. Since we assume that *v* is /V/ without a specification for VOICED, the transformation from /V/ to [f] is a feature-filling process, and thus effected by the unification based rule (6). The deletion rule (5) does not affect /V/ since there is no VOICED feature to delete. To be clear, all of the input forms in (8) are written with /V/ instead of /v/ under the assumptions I adopt here. For example, for *óvtam, sav, pitvar*, we assume /oːVtɔm, sɔV, pitVɔr/.

The SMD in (9) shows the derivation of /V/ to both [v] and [f] by the same two rules we posited above. Again, deletion rule (5) applies vacuously, since /V/ has no voicing

[3] The squiggly arrow '⇝' should be read as 'leads to', meaning that the form on the lefthand side, which may be either a UR or a subsequent form in the derivation, comes out via the application of one or more rules as the form on the righthand side, which is a later stage of the derivation, and is potentially the SR. The negated form '⇝̸' implies that no subsequence (including the full sequence) of the rules maps the representation on the lefthand side to the one on the righthand side.

value. The voicing of the following obstruent is indicated by the environments denoted '__p' vs. ' __b'. This value is filled onto the segment corresponding to underlying /V/ by rule (6) at this point in the derivation.

(9) *v* as *target* (output agrees with following obstruent, e.g., *óvtam* [ft])



Rule (5): V has 'nothing to lose' by subtraction

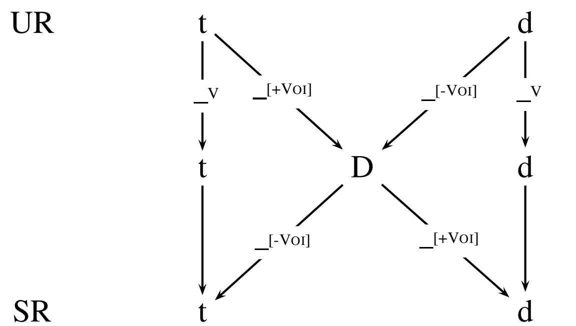
Rule (6): V gets a value by unification, like (derived) D

Note that turning an underlying /V/ into an [f] involves rule (6). The same rule is responsible for turning /D/ derived from underlying /d/ into a [t] in the right environment, and a /D/ derived from underlying /t/ into a [d] in the right environment. Rule (6) is thus independent of the subtraction rule (5)[4] —the application of (6) does not need to track what happened previously to a form going through a derivation, in fact, our model does not allow such transderivational tracking, which is why notions like Structure Preservation (Kiparsky 1985) and contrast preservation constraints (Flemming 2004) have no place in Logical Phonology.

Now consider what happens when /V/ is in the position of a potential trigger for voicing assimilation, on the right side of a cluster. A voiceless obstruent before a *v* does not get voiced, as shown in (8) and forms like *hat-van* [tv] 'sixty'. This is because /V/, lacking a VOICE value, does not trigger deletion of −VOICE by rule (5) in a preceding voiceless obstruent. This rule deletes the voicing value on a segment only if conflicts with the value on the next segment, and the absence of voicing on *v* cannot conflict with either +VOICE or −VOICE. The voiceless obstruents that precede *v* remain specified as voiceless. The subsequent feature filling rule (6) applies vacuously—the preceding obstruent has a value of its own, and, in any case, there is no value to copy from *v*. The forms *sav*, *kova* and *vér* in (8) just show that /V/ surfaces as +VOICED when it is not in a cluster.

[4]Subtraction rules without unification rules model debuccalization, which is a type of derived surface underspecification (Benz and Volenec 2023). So, the two rule types are logically independent and independently necessary.

(10) SMD for *v* as a non-*trigger*



Rule 5: No subtraction before V, b/c there's no mismatch

Rule 6: No feature-filling before V: /t, d/ keep input values

The two rules account for the outcome of obstruent clusters which do not contain *v*; for clusters with *v* as an affected target in the left side of an obstruent cluster; and for the (unaffected) outcome of other obstruents in clusters with a *v* on the right side.

The system of two rules developed thus far fails to account for a *v* that is not to the left of another obstruent. This includes *v* before a vowel or other sonorant, or at the end of a word. Such a *v* surfaces with a +VOICED specification, that is, as [v]. A general fill-in rule for segments derived from underlying /V/'s that have not received a +VOICED specification is given in (11)—no context is needed.

(11) Remaining V undergoes non-vacuous unification with $\{+\text{VOICE}\}$
$\left[\ -\text{SONORANT}\ \right] \sqcup \{+\text{VOICED}\}$

We have not discussed the full nature of unification-based rules here, instead referring to other published discussion, but here it is sufficient to note that a unification rule applies vacuously if the feature it 'tries' to insert is already present in the target segment; and it applies non-vacuously, if the target is not already specified for the feature in question. The crucial situation to appreciate is where unification fails—where the result of adding the valued feature in question, say $+$F to the target would result in a set of features that is not consistent, containing $+$F and $-$F. In this case, the semantics of rules posited by LP ensures that rule application is vacuous and the target is mapped to itself. To be concrete, the application of rule (11) to a form containing /p/, which is $-$VOICED leaves the /p/ unchanged.

3. Segments and natural classes: the circle notation

As seen above, segments in LP are represented as *sets* of valued features, using normal set theoretic brackets, whereas natural classes list features in square brackets to denote sets of sets of features, that is, sets of segments. Suppose that all the features relevant to vowels are provided here, then the segments /i/, /e/ and /I/ correspond to the sets of features in (12).

(12) Segments /i/, /e/ and /I/as sets of features

$$/\text{i}/ = \left\{\begin{array}{c} +\textsc{Syllabic} \\ -\textsc{Back} \\ -\textsc{Round} \\ +\textsc{High} \\ -\textsc{Low} \\ +\text{ATR} \end{array}\right\} \qquad /\text{e}/ = \left\{\begin{array}{c} +\textsc{Syllabic} \\ -\textsc{Back} \\ -\textsc{Round} \\ -\textsc{High} \\ -\textsc{Low} \\ +\text{ATR} \end{array}\right\} \qquad /\text{I}/ = \left\{\begin{array}{c} +\textsc{Syllabic} \\ -\textsc{Back} \\ -\textsc{Round} \\ -\textsc{Low} \\ +\text{ATR} \end{array}\right\}$$

So, /I/ is unspecified with respect to the feature HIGH. In LP, it is crucial to distinguish the representation of /I/, given in curly brackets in (12) from the representation of the natural class that contains all three vowels, as in (13).

(13) The natural class containing /i, e, I/

$$\left[\begin{array}{c} +\textsc{Syllabic} \\ -\textsc{Back} \\ -\textsc{Round} \\ -\textsc{Low} \\ +\text{ATR} \end{array}\right] = \{\text{i, e, I}\}$$

The interpretation of the square brackets is just "the set of segments whose members are each a superset of the set of features {+SYLLABIC, -BACK, -ROUND, -LOW, +ATR}." Now, a given language may or may not contain /I/ in its vowel inventory, but in either case, the natural class that contains /i/, /e/ and potentially /I/ will be the same—it will use all and only the features that define /I/.

Instead of making use of potentially unwieldy feature matrices to define segments and natural classes, I introduce a notational shorthand. A circled segment symbol, such as $\textcircled{\text{i}}$ stands for the list of features that constitute the segment. Thus, writing the segment symbol "/i/" (with or without slashes) is equivalent to writing $\{\textcircled{\text{i}}\}$, and also equivalent to writing out the full set of features that constitute this segment. The features denoted by $\textcircled{\text{i}}$ can also be used to denote the natural class that contains just the vowel /i/.

(14) Singleton natural class

$$\left[\begin{array}{c} +\textsc{Syllabic} \\ -\textsc{Back} \\ -\textsc{Round} \\ +\textsc{High} \\ -\textsc{Low} \\ +\text{ATR} \end{array}\right] = [\textcircled{\text{i}}] = \{\text{i}\}$$

Things get more interesting when we consider underspecified segments. The crucial point is that it is impossible to refer to the natural class that contains just the segment /I/, as defined above. This is because an expression like $[\textcircled{\text{I}}]$ refers to the set of segments that are supersets of the set of features $\{\textcircled{\text{I}}\}$, and this contains the segments /i, e, I/. The impossibility of referring to unmarked segments to the exclusion of marked ones is an old problem in the literature (Lees 1961; Lightner 1971; Reiss 2003a). As mentioned above, LP has solved this problem using unification. The circle notation will prove useful in the ensuing discussion of a second *v* in Hungarian.

4. The other Hungarian *v*

The underspecification account given above for Hungarian *v* may appear fairly *ad hoc*. For this reason, it is interesting to see that the solution offered for the analysis of 'exceptional' behavior with respect to voicing assimilation can be leveraged for another puzzle of Hungarian phonology. The language appears to have another segment that sometimes surfaces as [v], but which must be distinct from the /V/ posited above. This segment appears as the initial segment of several suffixes when they follow a stem-final vowel, including the translative *vá/vé* and instrumental *val/vel*. When attached to a stem ending in a vowel, the *v* surfaces as [v], as in *só-val* [v] 'with salt'. However after a stem final consonant, this segment appears to undergo total assimilation, and a geminate version of the stem final consonant surfaces, for example, *csap-val* yields *csappal* [pː] 'with a faucet' (see ST: §8.2).

The *v* of these two suffixes must be contrasted with that of other suffixes: "There are 'non-alternating v-suffixes' as well (such as *-van* '-ty': *hat-van* 'sixty', deverbal noun-forming *-vány/-vény*: *lát-vány* 'sight', deverbal adverb-forming *-va/-ve*: *lop-va* 'stealthily'), which are [v]-initial after vowel-final stems, but whose initial /v/ is unchanged/retained even after consonant-final stems" (ST: 269). I assume that this latter group contains the /V/ proposed above, which also appears in many roots, such as *kvarc* 'quartz'. Since this new kind of *v* undergoes total assimilation, phonological intuition might suggest that it be highly underspecified, in particular, relatively less specified than the /V/ considered above. Perhaps counterintuitively, set theoretic logic forces us to posit that the fully assimilating *v* contains at least one feature not found in /V/. A simple analysis is available if we assume that the only difference between the two is that this new segment is a fully specified /v/, in contrast with the /V/ posited above, which lacks a voicing specification.

As we saw above, the LP model uses set subtraction to remove features from a segment. Crucially, this entails that a *set* remains, even if all its members (e.g. valued features) are deleted—the deletion of a segment is not the same as deletion of all the features from a segment set (Reiss 2025). Now the universal set of all valued features is the Cartesian product $\mathscr{W} \times \mathscr{F}$, where $\mathscr{W} = \{+,-\}$ and $\mathscr{F}$ is the set of features. Let's call this set of all valued features $\mathscr{A}$. Then the LP version of deleting all features of /v/ after a consonant can be expressed as in (15).[5]

(15) $[\textcircled{v}] \setminus \mathscr{A}$ / [+CONS] ___

This rule targets the singleton natural class containing just *v*'s that are fully specified /v/, so there is no need for lexical conditioning to control the behavior of the two *v* segments—natural class logic lets us target /v/ without targetting /V/. The result of applying set sub-

[5]The set $\mathscr{A}$ is a set of valued features, but it is not a segment, so it can contain both +LABIAL and −LABIAL, for example (see fn. 2).

traction of $\mathscr{A}$ from any segment is the empty set, $\{\}$. If we had targeted the natural class defined by the features of /V/, namely [$\textcircled{V}$], this would have (wrongly) included both segments corresponding to v, that is, /V/ and /v/. Once (15) applies, underlying /v/ to the right of a $+$CONSONANTAL segment has lost all its features, but /V/ keeps its features. The empty set of features from /v/ is now the target of the assimilation process that creates geminates. At this point the intuition that assimilation applies to underspecified segments does hold: we have mapped /v/ to the empty set segment, but /V/ has retained all its underlying features.

5. Singleton set restriction and compound unification notation

Now we have to be able to fill in the empty set created by (15) with all the features of the preceding consonant. How are we going to now target the massively underspecified $\{\}$ segment without targeting all others? Before answering that question we discuss a restriction on the second argument of unification rules.

It is tempting to propose a rule like (16) in which a single unification operation copies all the relevant features, leading to a geminated consonant.

(16) Creating a geminate with one non-singleton unification rule

$$[\,] \sqcup \left\{ \begin{array}{l} \alpha_1\text{VOICE} \\ \alpha_2\text{CONS} \\ \ldots \\ \alpha_k\text{LAT} \end{array} \right\} / \left[\begin{array}{l} \alpha_1\text{VOICE} \\ \alpha_2\text{CONS} \\ \ldots \\ \alpha_k\text{LAT} \end{array} \right] \_\_$$

However, for reasons discussed by Bale et al. (2020) I assume that the second argument in a phonological unification rule, the 'structural change', is always a singleton set. In other words, only one feature can be inserted into a segment by a particular rule. Intuitively, this accounts for the apparent absence of assimilation processes that are "all or nothing". If a single conflict leads to unification failure then no features would assimilate. This appears not to occur.

(17) **Singleton set restriction on unification (SSR)**: The second argument of unification in a phonological rule, the one that corresponds to the structural change, is always a singleton set.

In brief, the SSR allows us derive the following result. If the SSR did not hold, then unification of a segment set S with a non-singleton set T would fail in case any member of T conflicted with (was the opposite of) any element of S. In other words, unification would have to be 'all or nothing'.[6] If, instead, target segments unify iteratively with each element of T, then non-conflicting features will be unified into the target, but conflicting features will result in a vacuous identity mapping. For example, contrast the potential rule applications using unification in (18) and (19).

[6] This logic is similar to 'sour grapes' (McCarthy 2011) discussions in the OT literature, but paradigmatically, within segments, instead of syntagmatically, in terms of various places in a segment string.

(18) $\{+F,+G\} \sqcup \{-G,+H\} \rightsquigarrow \{+F,+G\}$

- Unification fails so target is unchanged.

(19) $\{+F,+G\} \sqcup \{+G,+H\} \rightsquigarrow \{+F,+G,+H\}$

- Unification applies non-vacuously.

Note what happens if we break the potential process in (18), where there was unification failure, into two rules that conform to the SSR—either order works.

(20) Adding in features obeying the SSR

a. First unify with {−G}

{+F, +G } $\sqcup$ {−G} $\rightsquigarrow$ {+F, +G}: unification failure.

Now unify with {+H}

{+F, +G} $\sqcup$ {+H} $\rightsquigarrow$ $\boxed{\{+F, +G, +H\}}$: unification is non-vacuous.

b. First unify with {+H}

{+F, +G} $\sqcup$ {+H} $\rightsquigarrow$ {+F, +G, +H}: unification is non-vacuous.

Now unify with {−G}

{+F, +G, +H} $\sqcup$ {−G} $\rightsquigarrow$ $\boxed{\{+F, +G, +H\}}$: unification failure.

The identical boxed expressions in (20ab) show that the order does not matter. Even if unification with {−G} applies first and fails (20a), the process continues to apply unification with {+H}. Phonologically speaking, becoming +H is not dependent on becoming -G. The processes are independent. We assume that feature-filling is never ‘all or nothing’, a possibility that would be allowed if we did not adopt the SSR.

This logic extends beyond separate unification with two singleton sets to any number of such sets. For illustration, assume a case with three singleton sets, {+F}, {+G}, {−H} and an initial target set *R*. We can express the final outcome by a series of phonological unification rules thus:

(21) $((R \sqcup$ {+F}$) \sqcup$ {+G}$) \sqcup$ {−H}

So *R* first unifies with {+F}, and the output of that rule unifies with {+G}, and the output of *that* rule unifies with {−H}. In each case, if logical unification fails, the first argument is passed on to the next application, by the semantics of phonological unification rules.

The logical operation of unification is commutative: for two sets *A* and *B*, it is always the case that $A \sqcup B = B \sqcup A$. Thus, the order in which we apply unifications with each singleton set does not matter. However, the interpretation of phonological rules built from unification gives priority to the first argument: in a rule, if the operation $A \sqcup B$ is undefined, then the output of the *rule* is defined to be *A*. Since *A* is the target of the rule and also the output in such a case, this is a type of vacuous rule application.

We'll refer to this process of unifying an initial set with a set of singleton sets as *compound unification* denoted by $\bigsqcup$, a larger version of the unification symbol. In this light, a potential rule that does not obey the SSR as in (22a) must be reformulated as a set of rules denoted with the compound unification symbol as in (22b).

(22) Notation for multiple consecutive unification rules

PROHIBITED BY SSR	SET OF RULES	INTERPRETATION of (b)
a. $R \sqcup \left\{ \begin{array}{c} +\text{F} \\ +\text{G} \\ -\text{H} \end{array} \right\}$	b. $R \bigsqcup \left\{ \begin{array}{c} +\text{F} \\ +\text{G} \\ -\text{H} \end{array} \right\}$	c. $((R \sqcup \{\text{+F}\}) \sqcup \{\text{+G}\}) \sqcup \{\text{-H}\}$

The interpretation of this rule is given in (22c), under the assumption that each instance of unification here is embedded in a phonological rule—that is, if logical unification $X \sqcup Y$ is undefined, then a phonological rule application of the form $X \sqcup Y$ yields X. Note that compound unification is *not* a theoretical enhancement. It is merely a notational convenience to denote a set of iterative unifications applied to an initial target—presumably the grammar orders these iterations, but the analyst cannot infer the ordering.

Obviously this formalism can be generalized. For example, to create a geminate by total assimilation, an empty segment set can undergo compound unification with the members of the preceding segment. This will be denoted as in (23), using ω_i to denote metalanguage variables whose domain is $\{+, -\}$.[7]

(23) $$\{\} \bigsqcup \left\{ \begin{array}{l} \omega_1\text{VOICE} \\ \omega_2\text{CONS} \\ \dots \\ \omega_k\text{LAT} \end{array} \right\} / \left[\begin{array}{l} \omega_1\text{VOICE} \\ \omega_2\text{CONS} \\ \dots \\ \omega_k\text{LAT} \end{array} \right] \_\_$$

The interpretation of compound unification in (23) is given in (24).

(24) $$(_k \dots (_1\{\} \sqcup \{\omega_1\text{VOICE}\})_1 \sqcup \{\omega_2\text{CONS}\})_2 \dots \{\omega_k\text{LAT}\})_k \;/ \left[\begin{array}{l} \omega_1\text{VOICE} \\ \omega_2\text{CONS} \\ \dots \\ \omega_k\text{LAT} \end{array} \right] \_\_$$

So, the target segment, in this case the empty segment { }, first unifies with the singleton set containing the first valued feature of the segment to the left, say $\{\omega_1\text{VOICE}\}$, then the output of this application unifies with the singleton set containing the second valued feature of the segment to the left, say $\{\omega_2\text{CONS}\}$, and the process continues until the final valued feature, say ω_kLAT, is reached. We call such an iterative set of rules a *compound rule*.

In (23) and (24), compound unification applies to an intial target segment {}. However, as we know, there is no way to refer to a natural class containing just such an underspecified segment. Instead we need an expression like (25) with a natural class target.

[7] Note that (23) is not a rule, since the target is not a natural class expression in square brackets—it is an example of rule application to one segment, the segment corresponding to the empty set.

Remember to pay attention to all the brackets—square brackets for target and environment natural classes and curly brackets for the structural change.

(25) $$[\ ] \sqcup \left\{ \begin{array}{l} \omega_1\textsc{Voice} \\ \omega_2\textsc{Cons} \\ \ldots \\ \omega_k\textsc{Lat} \end{array} \right\} / \left[\begin{array}{l} \omega_1\textsc{Voice} \\ \omega_2\textsc{Cons} \\ \ldots \\ \omega_k\textsc{Lat} \end{array} \right] \_\_$$

Of course, this means that the compound rule applies unification to *every* segment. This rule would apply partial assimilation to all the features for which each segment in the target position is underspecified to the segment to its left. We will beow see how natural class logic complicates the derivation of Hungarian forms—we have to be sure that we don't fill in valued features where we need underspecification to persist.

In (25), since we are modeling total assimilation (gemination), there will be one unification rule for each feature in $\mathscr{F}$, the universal feature set. However, a particular compound unification rule might apply to a subset of the universal feature set, so that k will be smaller than the cardinality of $\mathscr{F}$. For example, partial assimilation can be modeled with a set of unification rules involving some subset of $\mathscr{F}$, such as the features traditionally called *place of articulation* features, like LABIAL, CORONAL and VELAR. We will see an example of this below.

6. Final statement of rules and derivations of clusters

We are now ready to propose a set of rules that will correctly derive the surface forms of the two Hungarian *v*'s purely phonologically. There is a complication that must be handled by breaking the gemination process into two parts. Note that in a form like *csap-val* ⇝ *csappal*, the underlying /v/ ends up −VOICED. However, in the same environment, an underlying /V/ surfaces +VOICED, as in *hat-van*. There appears to be an ordering paradox. If the gemination compound rule precedes the feature-filling rule in (6), then /V/ would wrongly become −VOICE and surface as [f], since unification failure would then stop (6) from having any effect—a unification rule cannot *replace* a contrary value. On the other hand, if (6) precedes the compound rule, then /v/ of *hatvan*, which has become the empty set segment { } by the rule (15) subtracting $\mathscr{A}$ from /v/, would end up −VOICE by the compound rule, by assimilation to *t*.[8] The solution is to break the compound rule into two parts: one compound rule carries out *almost* all of the assimilation involved in gemination, aside from that of VOICE, whereas progressive voicing fill-in happens only when all other features, *e.g.,* place and manner features, are already shared, basically a form of 'parasitic assimilation' (Jurgec 2013). The default fill-in of +VOICE by rule (11) must happen after underlying /v/ has undergone voicing assimilation. The rules are given all together in order below.

[8]Of course, we can't have the default rule for /V/ precede rule (15), because that would neutralize the difference between /V/ and /v/.

(26) Delete all features of [ⓥ] after a consonant:
[ⓥ] $\setminus \mathscr{A}$ / [+CONS] ___

(27) Delete leftmost VOICE value in a cluster:
$$[-\textsc{Sonorant}] \setminus \{\alpha\textsc{Voice}\} \;/\; \_\_ \begin{bmatrix}-\textsc{Sonorant}\\ -\alpha\textsc{Voice}\end{bmatrix}$$

(28) Fill-in rightmost VOICE value in a cluster:
$$[-\textsc{Sonorant}] \sqcup \{\alpha\textsc{Voice}\} \;/\; \_\_ \begin{bmatrix}-\textsc{Sonorant}\\ \alpha\textsc{Voice}\end{bmatrix}$$

(29) Create partial CC geminate with $k-1$ unification rules (Every F but VOICE):[9]
$$[\ ] \sqcup \begin{Bmatrix}+\textsc{Cons}\\ \alpha_1\textsc{Lab}\\ \dots\\ \alpha_{k-1}\textsc{Lat}\end{Bmatrix} / \begin{bmatrix}+\textsc{Cons}\\ \alpha_1\textsc{Lab}\\ \dots\\ \alpha_k\textsc{Lat}\end{bmatrix} \_\_$$

(30) 'Parasitic' voicing assimilation:[10]
$$\begin{bmatrix}+\textsc{Consonantal}\\ \alpha_1\textsc{Labial}\\ \alpha_2\textsc{Coronal}\\ \alpha_3\textsc{Dorsal}\end{bmatrix} \sqcup \{\alpha_4\textsc{Voice}\} \;/\; \begin{bmatrix}+\textsc{Consonantal}\\ \alpha_1\textsc{Labial}\\ \alpha_2\textsc{Coronal}\\ \alpha_3\textsc{Dorsal}\\ \alpha_4\textsc{Voice}\end{bmatrix} \_\_$$

While this rule looks complex, note that the logic is identical to that of so-called *parasitic vowel harmony* in which harmony with respect to a feature F occurs between two segments only in case they agree with respect to some other feature G.

Finally, we repeat here the default fill-in rule needed to ensure that /V/ surfaces +VOICED when it does not receive a value from an adjacent segment.

(31) Remaining V undergoes non-vacuous unification with {+VOICE}:
$$[\ -\textsc{Sonorant}\ ] \sqcup \{+\textsc{Voiced}\}$$

With these rules, we can derive all the clusters containing /v/ and /V/ in combination with other obstruents.

[9]There are a few options for handling the feature CONSONANTAL.

[10]This rule can also be stated using the kind of quantified expressions discussed in Reiss (2003b).

(32) /v/ and /V/ in Hungarian

UR	p-v	p-V	V-t	p-b	b-v	d-V	V-v
(26)	p{ }				b{ }		V{ }
(27)				Pb			
(28)			ft	bb			
(29)	pP				bP		VV
(30)	pp				bb		
(31)		pv				dv	vv
SR	pp	pv	ft	bb	bv	dv	vv
e.g.	csappal	lopva	óvtam	kalabban	rabbal	oldva	savval

Note that even an input cluster /V-v/ will be correctly treated and surface as [vv], as in *savval* 'with acid'. The voicing of both *v*'s is provided by (31), the default fill-in rule—the parasitic voicing rule (30) has no effect on the VV cluster it gets from underlying /V-v/ because both of the /V/'s lack a voicing value.

7. Conclusions

LP allows us to model superficially complex intrasegmental changes with combinations of just two simple set theoretic operations, set subtraction and unification. LP exploits set theoretic logic to understand whether segments can or cannot be targeted by a rule system built on natural classes. The 'exceptionality' of some Hungarian *v*'s with regard to voicing assimilation, and the difference between the *v*'s that do and those that do not undergo total assimilation to a preceding consonant can both be handled by paying attention to the *specificity* of target and trigger representations. The segment /V/ is mutable (in target position) but quiescent (in trigger position) with respect to the simple voicing assimilation process of rules (27) and (28) because it lacks an underlying voicing value. The segment /v/ is fully specified, but becomes completely mutable when it alone is targeted to lose all its features. This segment does not appear to the left of other consonants—it only occurs as the first segment of certain suffixes, so its behavior as the first member of a cluster cannot be known. Underlying /V/ is catalytic with respect to all features other than VOICE, since it 'transmits' all those features to the empty set segment { }, which just happens to derive from /v/. This work clearly grows out of Inkelas' groundbreaking work on 'inalterability as prespecification' (Inkelas and Cho 1993; Inkelas 1995). With the mechanisms provided by LP, we have applied Inkelas' basic idea to explain apparent exceptionality in both potential targets and triggers without recourse to morphological structure, cophonologies, rule exception features, indexed constraints and the like (Inkelas et al. 1997). Further discussion of this approach, with analyses of several languages, is provided in Gorman and Reiss (Submitted).

References

Bale, Alan, M Love, and Charles Reiss. Submitted. Variable subsumption and logical phonology.

Bale, Alan, Maxime Papillon, and Charles Reiss. 2014. Targeting underspecified segments: A formal analysis of feature changing and feature filling rules. *Lingua* 148: 240–253.

Bale, Alan, and Charles Reiss. 2018. *Phonology: A formal introduction*. Cambridge, MA: MIT Press.

Bale, Alan, Charles Reiss, and David Ta-Chun Shen. 2020. Sets, rules and natural classes: { } *vs.* [ ]. *Loquens* 6(2): e065.

Benz, Johanna, and Veno Volenec. 2023. Two logical operations underlie all major types of segmental alternations. Paper presented at the 30th Manchester Phonology Meeting, Manchester, UK.

Dabbous, Rim, Kyle Gorman, and Charles Reiss. 2025. Tutorial on substance-free logical phonology. https://ling.auf.net/lingbuzz/008746.

Flemming, Edward. 2004. Contrast and perceptual distinctiveness. In *Phonetically based phonology*, ed. Bruce Hayes, Robert Martin Kirchner, and Donca Steriade, 232–276. Cambridge: Cambridge University Press.

Gorman, Kyle, and Charles Reiss. Submitted. Metaphony in Substance Free Logical Phonology. https://lingbuzz.net/lingbuzz/008634.

Inkelas, Sharon. 1995. The consequences of optimization for underspecification. In *Proceedings of the north east linguistic society 25*, ed. Jill Beckman, 287–302. University of Massachusetts, Amherst: GLSA.

Inkelas, Sharon, and Young-Mee Yu Cho. 1993. Inalterability as prespecification. *Language* 69(3): 529–574.

Inkelas, Sharon, Orhan Orgun, and Cheryl Zoll. 1997. *Derivations and constraints in phonology (I. Roca, ed.)*, chap The implications of lexical exceptions for the nature of grammar. Oxford: Oxford University Press.

Jurgec, Peter. 2013. Two types of parasitic assimilation. *Nordlyd* 40(1): 108–135.

Kiparsky, Paul. 1985. Some consequences of Lexical Phonology. *Phonology Yearbook* 2: 85–138.

Lees, Robert. 1961. *The phonology of modern standard Turkish*, *Indiana University Publications, Uralic and Altaic Series*, vol. 6. Bloomington: Indiana University.

Lightner, Theodore M. 1971. On Swadesh and Voegelin's 'a problem in phonological alternation'. *International Journal of American Linguistics* 37(4): 227–237.

McCarthy, John J. 2011. Autosegmental spreading in optimality theory. In *Tones and features: Phonetic and phonological perspectives*, ed. John A Goldsmith, Elizabeth Hume, and Leo Wetzels, vol. 107, 195–222. Berlin: De Gruyter Mouton.

Poser, W. 1982. Phonological representations and action-at-a-distance. *The structure of phonological representations* 2: 121–158.

Reiss, Charles. 2003a. Deriving the feature-filling/feature-changing contrast: An application to Hungarian vowel harmony. *Linguistic Inquiry* 34(2): 199–224.

Reiss, Charles. 2003b. Quantification in structural descriptions: Attested and unattested patterns. *The Linguistic Review* 20(2-4): 305–338.

Reiss, Charles. 2021. Towards a complete Logical Phonology model of intrasegmental changes. *Glossa* 6(1): 107.

Reiss, Charles. 2025. Delete the rich: On the non-existence of 'weak' schwa deletion. https://ling.auf.net/lingbuzz/008747.

Siptár, Péter, and Miklós Törkenczy. 2000. *The phonology of Hungarian*. Oxford: Oxford University Press.