MSCs in Positional Neutralization: The Problem of Gapped Inventories*

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1 Introduction

Most constraint-based frameworks embrace Richness of the Base (Prince and Smolensky 1993/2004): the assumption that no interesting generalizations are stated as constraints on the lexicon (a.k.a. Morpheme Structure Constraints, or MSCs). The main argument against MSCs is that they introduce duplication into the theory. When the same constraints define the shapes of morphemes and restrict derived words, the latter, surface-oriented constraints should be sufficient. Unlike MSCs, surface-oriented constraints are less abstract, and are independently necessary. This echoes earlier criticisms of MSCs (e.g., Shibatani 1973, Clayton 1976): they are redundant and abstract.

This paper revisits MSCs in the context of positional neutralization. As I demonstrate, positional neutralization presents an analytic problem when the affected contrasts are gapped. Analyzing such neutralization without MSCs runs into duplication. My specific focus is on Russian voicing, which was Morris Halle's (1959) original battleground against structuralism—which he, incidentally, also criticized for having a duplication problem. By treating contrastive oppositions differently from non-contrastive ones, structuralism fails to capture the generalization that Russian voicing assimilation works on all obstruents alike, whether they contrast for voicing phonemically (/b/ vs. /p/) or are obligatorily voiceless (e.g., /ʧ/). My concern is not the undergoers; rather, it is the lack of certain contrasts predicted by the popular Positional Faithfulness account of voicing neutralization in Optimality Theory (Steriade 1999, Lombardi 1999, Padgett 2002, Rubach 2008, Beckman et al. 2009). I show that even though this account captures the phonetics and typology of voicing contrasts, it has a problem with Russian: certain consonants need to be handled twice in the analysis. As an alternative, I argue for MSCs against those consonants in the lexicon.

Unlike other analyses, my account explains facts such as the handling of loanword [ʤ], which is borrowed as a CC cluster in Russian, and which behaves as though it is never represented as an affricate in the system. Activity in loanword adaptation is sometimes presented as an argument against MSCs: if loanwords are adapted to avoid some configuration, there must be a rule; an MSC alone would not be enough (e.g., Clayton 1976). For the Russian case, this argument does not

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quite work. As is common, Russian loanword adaptation employs rules different from anything evidenced in the native phonology. Moreover, the patterns of adaptation are inconsistent, defying a uniform grammatical account. I argue that the patterns support the existence of a MSC in the lexicon, but should not be connected to grammatical rules for resolving the violations.

The key facts are in (1)–(3). Russian has a voicing contrast in most obstruents, and this contrast is neutralized word-finally (devoicing):[1]

(1) Word-final devoicing; contrast before vowels and sonorant consonants

	UR	Nom.Sg	Dat.Pl	Gloss
a.	/kot/	kot	kot-am	'cat'
b.	/got/	got	got-am	'Goth'
c.	/kod/	kot	kod-am	'code'
d.	/god/	got	god-am	'year'

Russian also has regressive assimilation in obstruent sequences. Affricates are obligatorily voiceless except in assimilation contexts: thus, [ʤ] never occurs in presonorant position, but it does occur as an allophone of /ʧ/ in assimilation (see (2d)). The alternation [noʧ-noʤ] only ever goes in the direction shown in (2); there are no morphemes that have the alternation [noʧ] ∼*[noʤ-am], which requires the UR */noʤ/.

(2) Regressive voicing assimilation to the last pre-sonorant consonant

	UR	Irrealis	Nom.sg	Dat.pl	Gloss
a.	/kot/	kod bɨ	kot	kot-am	'cat'
b.	/got/	god bɨ	got	got-am	'Goth'
c.	/mozg/	mozg bɨ	mosk	mozg-am	'brain'
d.	/noʧ/	noʤ bɨ	noʧ	noʧ-am	'night'

When [ʤ] is borrowed, it is usually split into two segments, [d] and [ʐ] (see (3)). The sequence is heterorganic, with [d] being dental and [ʐ] retroflex. I argue that analytically, the sequence must be two underlyingly voiced obstruents, just like /zg/ in /mozg/ 'brain': [dʐ] devoices word-finally as any two-consonant sequence would, and in presonorant position and in regressive assimilation position, its parts voice or devoice as other consonant sequences would. The sequences behave as if they are never represented as affricates.

(3) Loanword adaptation: no [ʤ]

a.	*word-initial*: ʤ→ CC	dʐɨp	'Jeep (Engl.)'	
b.	*word-final*: ʤ → CC	imitʂ	'image (Engl.)'	not *imiʧ
c.	*assimilation context*: ʤ→ CC	imidʐ bɨ	'image Irr.'	not *imiʤ bɨ

The remainder of the paper starts with an overview of the problem in the context of complementary distribution vs. positional neutralization. Then I turn to Halle's argument (§3.1). I analyze voicing neutralization using MSCs in §3.2. I then consider the complexities of the Russian consonant inventory, and in particular the behavior of [ʣ], [ɣ], and [ʒʒ] (§3.3). The goal is

[1] Unless otherwise indicated, all examples are my own.

to make a theoretical contribution as well as an empirical one: Halle's (1959) presentation of the facts is incomplete and does not reflect the present state of the language. Moreover, some of the facts prove problematic for alternative analyses. Section 4 presents the loanword adaptation facts and argues that they are problematic for the rich base assumption. In §5, I turn to alternatives, which include specific markedness constraints (Hall 2007), comparative markedness, and Stratal OT (Mackenzie 2022).

2 Neutralization and Morpheme Structure Constraints

In rule-based phonology, one of the roles of MSCs is to define the phonemic inventory of a language (Halle 1959, Stanley 1967, et seq.). It is commonplace for certain sounds to occur as allophones but to not have contrastive status. Rule-based analyses exclude such sounds from URs, which implies MSCs (even if they are not overtly stated). Rules then introduce restricted sounds only in certain positions. Another role of MSCs in analyzing neutralizations is that they allow rules to be simpler. Since rules often encode instructions for input-dependent changes, the more restricted the inputs, the broader the rules can be.

By contrast, in OT, many common distributions do not require MSCs, as I show next. It is positional neutralization that presents the analytic problem, and only when the affected contrasts are gapped.

2.1 Distributions that do not require MSCs

Consider the textbook example of vowel nasalization: nasal vowels occur only in assimilation environments but are banned otherwise, [pa, mã] vs. *[pã], *[ma] (see, e.g., McCarthy 2002a:83). In a rule-based account (following the SPE, Chomsky and Halle 1968), nasal vowels might be assumed to be absent (i.e., banned) from the UR (/pa, ma/ but not /mã/) and derived by a contextual nasalization rule. In OT, UR bans are not needed for analyzing such cases. Surface distributions are a matter of markedness and faithfulness rankings only. The OT grammar in (4a) derives the surface inventory [pa, mã] from the rich base /pa, ma, pã, mã/. The general schema for complementary distribution is in (4b):

(4) Ranking for complementary distribution of nasal and oral vowels:

a. $*NV_{oral} \gg *\tilde{V} \gg$ Ident

b. $\textsc{Mark}_{spec} \gg \textsc{Mark}_{general} \gg$ Faith

One attraction of this approach is that it uses formally simple constraints: the general constraint legislates feature co-occurence, and the specific constraint governs bigram sequencing. Another attraction is that both constraints are perceptually grounded and receive robust typological support. Third, the ranking tells an intuitive story: "no nasal vowels, except near nasal consonants." In contrast to rule-based treatments that insist on setting up a unique UR, the account in (4) does not have to decide which vowel is the underlying one, sidestepping the often difficult logic that is usually external to the analysis. In a rule-based framework, it is just as easy to set up a rule deriving oral vowels from nasal-only URs, so the decision to posit oral UR vowels usually recruits considerations such as typology.

Pertinent to the concerns of this paper, the analysis in (4) also avoids the duplication problem because it does not need to assume a constraint against nasal vowels in the UR, and it also does not need to sneak in limitations on inputs via representational assumptions (e.g., "only consonants can be specified for nasality contrastively in the input"). There is no duplication here; the analysis works and is elegant.

Positional neutralization is similarly unproblematic under the rich base assumption, provided the affected contrasts do not have gaps. For example, in Nancowry, stressed syllables contrast oral and nasal versions of [i, e, ɛ, æ, u, ə, a, u, o, ɔ], but unstressed syllables only allow [i, e, ə, a, u] (Radhakrishnan 1970, 19). McCarthy (2002a, 88) posits the following ranking for Nancowry:

(5) Ranking for positional neutralization without gaps

a. Ident-*ó*-[nasal]≫*Ṽ≫Ident

b. Pos-Faith≫Mark≫Faith

Under this ranking, inputs such as /batã/ and /bata/ will map faithfully (assuming final stress), but /bãta/ will neutralize to [batá]. There is no need to restrict the distribution of nasal and oral vowels in the input, or to guess what becomes of the hypothetical nasal vowels in unstressed positions. Since we do see vowels in those positions, and they are always oral, the direction of neutralization is determined by the system. As we will see in the next section (and also in §5.5), this is not true when the system involves gaps.

2.2 Positional neutralization with gaps

The problem arises in cases where a contrast involves a gap, and the gap is filled in assimilation environments. A classic case is nasal place assimilation, which often creates allophones confined to assimilation contexts: [m] and [n] have a free distribution except in place-assimilated clusters (**mt, *np*, etc.), but [ŋ] occurs only before [k, g]. Such languages include Standard Italian (Bertinetto and Loporcaro 2005), Lithuanian (Kenstowicz and Kisseberth 1979, p. 216), and Turkish (Kornfilt 2013, p.486). As with the vowel nasalization example, analyzing the *basic* distribution does not require MSCs. In the absence of alternations, we guess that in non-assimilation environments, underlying /ŋ/ maps to, say, [n]:

(6) Nasal place assimilation, analyzed without MSCs: /taŋ/ is a rich base input

		NasPlaceAssim	*ŋ	Ident[place]
/pan-ka/	a.☞ paŋka		*	*
	b. panka	*!W	L	L
/taŋ/	c.☞ tan			*
	d. taŋ		*!W	L

But this analysis is incomplete: it is silent on the direction of assimilation. Why not change the oral consonant's place instead, as in /pan-ka/ → [panta]? Jun (1995) argues that plosives carry place cues better than nasals, since the plosive is in prevocalic position. This perceptual property is encoded in a positional faithflness constraint, Ident-Onset (Beckman 1997, i.a.). Ident-Onset must outrank *[ŋ] to allow assimilation to create velar nasals—otherwise assimilation would be

progressive (as in (7c)) just in case the onset is velar. The problem is that this ranking is incompatible with the assumption that /ŋ/ maps to [n] except in assimilation contexts. Once the analysis is augmented with positional faithfulness, onset [ŋ] sneaks back in from the rich base:

(7) Direction of nasal place assimilation requires positional faithfulness

			NasPlaceAssim	Ident-Onset	*ŋ	Ident[place]
/pan-ka/	a.☞	paŋka			*	*
	b.	panka	*!W		L	L
	c.	panta		*!W	L	*
/ŋat/	e.	nat		*!W	L	*W
	f.☞	ŋat			*	

The obvious way to save the situation is to plug the gap with more positional markedness, e.g., by ranking a constraint against *onset* [ŋ] above Ident-Onset. On the upside, *ŋ/onset might be independently necessary: [ŋ] often has a distribution different from other nasals; English is a familiar example (Chomsky and Halle 1968 et seq.). On the downside, this approach does not generalize. Nasal place assimilation often creates segments such as [ɱ], or [ɲ], which have less subtlety to their distribution than [ŋ]. They are absent except in assimilation environments. This analysis would have to use multiple markedness constraints just for the gapped segments in the environment protected by the positional faithfulness constraint, and rank them in an order that mirrors the positional/general faithfulness order:

(8) Duplication in the analysis, needed for handling gaps in the contrastive system

*ŋ/Onset≫ Nasal-Place-Assimilation, Ident-Onset[place]≫*ŋ ≫ Ident-[place]

If the argument for the rich base is that it avoids the duplication problem, then cases like this defeat it; surely it is more elegant to have a single MSC against velar nasals at the UR level. One of the selling points of Optimality Theory is that "the constraints provided by Universal Grammar are simple and general; interlinguistic differences arise from the permutations of constraint-ranking" (Prince and Smolensky 1993/2004, p.6). But in this case, constraints on restricted allophones cannot be simple or general. Intuitively, the distribution is simple: [ŋ], etc. are banned except where nasal place assimilation requires them. In this analysis, however, the prohibitions on these segments must be stated twice: both below and above positional faithfulness.

It is a well-known feature of positional faithfulness constraints that they determine positions of static contrast as well as determine direction of assimilation. This is a feature, not a bug, and trying to solve the problem by getting rid of positional faithfulness is unlikely to work (see §5.4, §5.5.3). Nor is it likely that the answer lies in splitting Ident into constraints that bundle manner and place faithfulness, as suggested by a reviewer: NasPlaceAssim, IdentObs[place] ≫*ŋ≫ IdentNas[place]. There are various issues that this alternative would have to resolve. The generalizations about direction of place of assimilation in NC clusters hold pretty robustly even when the consonants in the clusters are not faithful to their underlying manner features. For example, in Tswana, onsets determine the place of nasals even when the onsets are unfaithful to their underlying manner: [ɸula] 'shoots' ∼ [m-pʰula] 'shoot me', [rut'a] 'teaches' ∼ [n-tʰut'a] teach me' (Gouskova et al. 2011). In Japanese, nasal codas assimilate to following onsets even when the codas are underlyingly non-nasal: /job-/ [jo̲b-u] 'call-pres' ∼[jo̲n-da] 'call-past', cf. [ʃin-u]

'die-pres' ∼ [ʃin-da] 'die-past' (Martin 1975). Onsets can even determine place of the following nasal, as in German [geb-m̩] 'give', [tʀɑ:g-ŋ̩] 'carry' (Wiese 1996). Positional faithfulness to onsets predicts all of these patterns.

Is there a way to reconcile the analysis of complementary distribution and this positional gap problem? The alternative I advocate is to bring back MSCs. Removing /ŋ/ from the input in an Italian-style grammar removes the need to guess as to its fate in the system, and it also simplifies the analysis of neutralization. In the analysis in §3, adding MSCs allows for an elegant and unified analysis of Russian and Polish: they have the same input-output grammars (regressive assimilation, final devoicing), even if their specific inventories differ.

While I will devote effort to motivating MSCs in the case of positional neutralization with gaps, I will not offer a definitive proposal on whether MSCs should be used in other cases, such as complementary distributions or positional neutralization without gaps (though see Rasin and Katzir 2016). MSCs are justified whenever the analyst has to guess about the fate of unseen segments. But they are not necessary in Nancowry-style positional neutralization, since the grammar suggests the direction of assimilation. In §5.5.3 I discuss root-affix positional asymmetries, whose analysis also benefits from entertaining hypothetical inputs of affixes that contain segments seen in roots (a limited rich base). Likewise, MSCs are not needed for complementary distribution, even if they do no harm. Indeed, if we assume that MSCs are drawn from the pool of plausibly universal markedness constraints, they solve the problem that lacks a principled solution in rule-based analyses: how to decide which segments to rule out from URs. Typologically, nasal vowels are marked, justifying both the MSC and the surface markedness constraint *Ṽ. If the URs are limited to oral vowels only, /pa, ma/, the ranking $*NV_{oral} \gg$ IDENT easily derives the distribution [pa, mã, *pã, *ma]. The difference between MSCs in rule-based theories and this updated approach to MSCs is that the MSC can be drawn from the set of markedness constraints. If the constraint is an MSC, it bans certain things from the lexicon, without specifying how to remove them. If it is a constraint in the grammar, it interacts with faithfulness.

2.3 Morpheme Structure Constraints, not Rules

Early discussions of MSCs debated whether they should be construed as rules or constraints. Rules supply instructions for removing the offending structure. Constraints simply ban the structure, leaving multiple avenues for removing it. Halle (1959) and Stanley (1967) disagreed on this point: in Halle's original formulation, Morpheme Structure Rules were formally similar to regular phonological rules that legislated redundancies (e.g., if [+strident], then [−voiced]). But Halle's MSCs could also be feature-changing (e.g., if [+strident, +voiced], then become [−voiced]). Stanley proposed to formulate all MSCs as "redundancy rules", which are essentially constraints: they specify what feature combinations and sequences may occur, but not instructions for removing offending structures. Translating this into OT terms, we would say that MSCs are markedness constraints that do not interact with faithfulness, because they hold at a level where no mappings happen.

An alternative to this view is Stratal OT (§5.5), where the role of MSCs is subsumed by the stem level. There, markedness and faithfulness constraints filter the rich base. My approach and the alternative agree on the need to filter the input before neutralization applies. The disagreement lies in whether the analysis takes a guess about what happens to the illicit segments. My analysis is agnostic of their fate: I would argue that neither the analyst nor the learner has a way of figuring

out what happens to /ŋ/ in Standard Italian, or to /ʤ/ in Russian. The evidence for learners not knowing the fate of ROTB inputs is inconsistent behavior in borrowing, which I attribute to conventional rules (§4). Russian cannot lexicalize a loanword with /ŋ/, but it also does not have a single set of grammatical instructions for removing it. As I show in §5.5, however, the specifics of Russian preclude an internally consistent analysis in Stratal OT. Both the native phonology and the loans involve heterogeneous sets of segments; no one mapping can be justified analytically. There is evidence for a constraint, but no evidence that it lives in a coherent ranking.

3 Plugging the gaps in positional neutralization

I now turn to Russian. As explained in §3.1, Russian voicing supplied the earliest argument for MSCs and was instrumental in Halle's framing of the duplication problem. I present my update to the basic OT analysis of Russian in §3.2. Section 3.3 delves deeper into the distribution of the gapped segments, both to provide an accurate description of contemporary Russian and to clarify which facts the alternatives have to confront.

3.1 Halle's argument

The duplication problem in Russian voicing phonology was first spotted by Halle in his criticism of the structuralist phonemic level (Halle 1959, Anderson 1985). As shown in (9), Russian voicing assimilation affects all obstruents, whether they contrast for voicing (/k/∼/g/) or not, /ʧ/. In a structuralist treatment, contrastive distinctions are represented differently from non-contrastive ones. So, Halle points out, the voicing assimilation rule must be stated twice—once at the phonemic level, to cover contrastively voiced phonemes, and then again, to cover non-contrastively voiceless segments such as /ʧ/. A simple generalization is missed:

(9) Duplication in the structuralist analysis of Russian voicing

morpho-phonemic level	/ʐetʃ li/	/ʐetʃ bɨ/	/mok li/	/mok bɨ/
[−voice] → [+voice] / ___[+voice]				
phonemic level	{ʐetʃ li}	{ʐetʃ bɨ}	{mok li}	{mog bɨ}
/ʦ, ʧ, x/ →[+voice]/___[+voice]				
phonetic level	[ʐetʃli]	[ʐeʤbɨ]	[mokli]	[mogbɨ]
	'burn Q'	'burn Irr.'	'soaked Q'	'soaked Irr.'

Halle's analysis (1959, 61–63) includes a morpheme structure rule that requires /ʦ, ʧ, x/ to be unspecified for contrastive voicing at the UR level, as well as a phonological rule of voicing assimilation for obstruent clusters. My analysis is similar to Halle's: I also assume that at the UR level, certain segments are banned /ʤ, ʤ, ɣ, ʒʒ/, although this claim requires some caveats (see §3.3.3,§3.3.4). Two-consonant sequences such as /dz/, /dʐ/ are allowed in the UR.

Halle's argument for MSCs is strikingly similar to the one levied by Prince and Smolensky for Richness of the Base (and by extension, against MSCs). MSCs pose a duplication problem in cases where morphemes obey the same restrictions as words. As I will show, though, the popular account of Russian voicing in OT also runs into a duplication problem. The difference lies in where the duplication happens: in the constraint/rule system, or between the rule system and the MSCs.

My analysis is cast in OT for several reasons. First, within rule-based analyses, the need for MSCs is usually taken for granted, and the argument would be preaching to the converted. Not so in OT approaches, which either take Richness of the Base (ROTB) for granted or explicitly argue for it (Davidson et al. 2004, Jarosz 2006a,b, Tessier and Jesney 2014). Second, the OT analysis of Russian voicing is appealing: it has robust typological support and is grounded in the phonetics of contrast. Consequently, it is a rare point of near-universal agreement in OT. And yet this analysis has a problem with facts known since Halle (1959), something that has largely gone unnoticed in the literature on voicing neutralization (one notable exception is Hall 2007, discussed in §5.2). One of my goals is to revive the argument, and to contribute some descriptive depth to it. Ultimately, I believe the point about MSCs holds regardless of whether the grammar of mappings is construed in rule- or constraint-based terms.

3.2 A constraint-based analysis of Russian voicing with MSCs

The analysis of voicing neutralization in Russian follows similar lines in many OT treatments (Lombardi 1999, Steriade 1999, Padgett 2002, Rubach 2008, Beckman et al. 2009, Padgett 2012). It is uncontroversial that the voicing contrast is limited to presonorant position.[2] This arises through the interaction of *ObsVoice with a positional and a general Ident (see (10)–(12)).

(10) *ObstruentVoice: Assign a violation mark for a segment associated with [−son] and [+voice].

(11) Ident[voice]: Assign a violation mark for every pair of segments *x, y* if $x \Re y$ and if *x* has a different value for the feature [voice] than *y*.

(12) Ident-Preson[voice]: Assign a violation mark for every pair of segments *x, y* if:

(i) $x \Re y$ and if *x* has a different value for [voice] than *y*, and

(ii) y occurs before a [+son] segment.

The ranking is in (13): voiced stops contrast in presonorant position but devoice word-finally.

(13) Contrast in voiced obstruents preserved in presonorant position:
Ident-preson[voice]≫*ObstruentVoice≫Ident[voice]

		Ident-preson[voice]	*ObsVoice	Ident[voice]
/bok/ ‘side Nom.Sg’	a.☞ bok		*	
	b. pok	*!W	L	*W
/kod/ ‘code Nom.Sg’	c.☞ kot			*
	d. kod		*!W	L

[2]While in broad strokes, these analyses agree, there are a lot of consequential details I am skirting over, such as whether *ObsVoice should assign violations for each segment or for each feature (with different consequences in case features are shared, Lombardi 2001, Petrova et al. 2006), whether features are objects in correspondence or attributes of segments (Lombardi 2001), and whether Ident-Preson[voice] (or Ident-Onset) is well-defined when applied to a rich input (Jesney 2011). Inventory gaps are problematic regardless of how these conflicts are resolved.

To enforce assimilation, AGREE[voice] must dominate IDENT[voice] and *OBSVOICE, assuming that each obstruent in a cluster such as [db] violates *OBSVOICE (see (15)). AGREE is undominated: voicing always assimilates. IDENT-PRESON[voice] is also undominated: it ensures that the presonorant obstruent determines voicing of the cluster. The ranking derives the right results for sequences of multiple obstruents /mozg bʲi/ → [mozg bʲi] 'brain IRR.', /vosk bʲi/ [vozg bʲi] 'wax IRR.', /mozg to/ [mosk to] 'brain TOPIC', without embellishments.

(14) AGREE[voice]: Assign a violation for a sequence of two [−son] consonants whose specifications for [voice] differ.

(15) Regressive voicing agreement in obstruent clusters: {IDENT-PRESON, AGREE[voice]} ≫*OBSVOICE≫IDENT[voice]

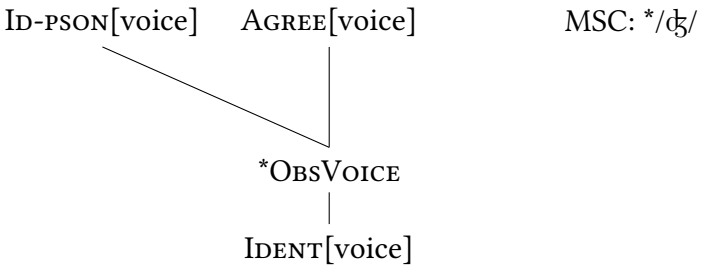
/kot bʲi/ 'cat IRR.'	IDENT-PRESON[voice]	AGREE[voice]	*OBSVOICE	IDENT[voice]
a.☞ kodbʲi			**	*
b. kotbʲi		*!W	*L	L
c. kotpʲi	*!W		L	*

Where I depart from Lombardi (1999), Padgett (2012), and everyone else is in accounting for forms such as [noʤ bʲi]. I argue that inputs with /ʤ/ are disallowed by a Morpheme Structure Constraint, */ʤ/, which prohibits voiced affricates in the lexicon (see (16)). As explained in §2.3, the MSC */ʤ/ does not interact with the faithfulness or markedness constraints. It might seem intuitive that */ʤ/ is in conflict with AGREE[voice], but AGREE does not dominate */ʤ/. The affricate [ʧ] is created by assimilation on the surface, where the MSC does not hold. The only way to satisfy */ʤ/ is to not add lexical entries with the proscribed segments (we will see this idea applied in §4). I show below why it cannot be the case that /ʤ/ maps to [ʧ] or to [dʐ] in hypothetical forms such as /ʤip/. The claim is that the grammar does not know how to map such forms to outputs; all it knows is that they are not legal inputs.

(16) */ʤ/: No lexical entry contains $\begin{bmatrix} \text{+strident} \\ \text{−cont} \\ \text{+voice} \end{bmatrix}$

In my analysis, there is just one constraint on voiced affricates in the grammar of Russian, and it holds of lexical entries only, where it is fully satisfied. The analysis would need to be augmented by some addtional constraints such as */ɣ/ and */ʒʒ/ to be complete; I consider those in §3.3.

(17) Grammar of Russian voicing without duplication



The factorial typology of this constraint set predicts the following seven systems (cf. Lombardi 1999, Petrova et al. 2006):[3]

(18) Factorial typology of the standard Positional Faithfulness account

	Ranking	/bat/	/pad/	/adpat/	/atbat/	Attested?
a.	{AGREE, ID-PSON}≫*VOICE≫IDENT	bat	pat	atpat	adbat	Polish, Russian
b.	{AGREE, ID-PSON}≫IDENT≫*VOICE	bat	pad	atpat	adbat	Hungarian
c.	ID-PSON≫*VOICE≫{AGREE, IDENT}	bat	pat	atpat	atbat	German
d.	{IDENT, ID-PSON}≫*VOICE, AGREE	bat	pad	adpat	atbat	Georgian
e.	{*VOICE, AGREE} ≫{IDENT, ID-PSON}	pat	pat	atpat	atpat	Finnish
f.	AGREE≫IDENT≫*VOICE≫ ID-PSON	bat	pad	atpat	atpat	Isthmus Zapotec

MSCs are by nature language-specific, since lexicons are language-specific. But MSCs are not completely typologically inert, despite not being part of any factorial typology. The presence of the MSC will have consequences, restricting the distribution of the segment in question. While Russian and Polish have the same input-output mappings, the presence of */ʤ/ in Russian means [ʤ] is not freely distributed. Polish lacks an analogous MSC, and so it has a full two-way voicing contrast in stridents (Gussmann 2007, i.a.). Limiting the input changes the surface contrast possibilities but does not affect the alternation patterns predicted for voicing.

My analysis includes just one constraint against /ʤ/, but suppose there is a redundant set of markedness constraints identical to MSCs. If so, the output constraint *[ʤ] must be dominated by AGREE and IDENT-PRESON[voice]—otherwise /notʃ bɨ/ couldn't map to [noʤ bɨ] (as shown in (19)). As the tableau shows, *[ʤ] favors no winners and does no work in the analysis. There is no reason to include it in the analysis if the MSC is assumed—the statement about gaps needs to only be made once.[4]

(19) Ranking the constraint against voiced affricates: {IDENT-PRESON[voice], AGREE[voice]} ≫*[ʤ] (constraint does no work)

/notʃ bɨ/ 'night IRR.'	ID-PSON[voice]	AGREE	*[ʤ]	*OBSVOICE	ID[voice]
a.☞ noʤbɨ			*	**	*
b. notʃbɨ		*!W	L	*L	L
c. notʃpɨ	*!W		L	L	*

Crucially, however, the ranking in (19) would yield the wrong result if a rich base were assumed. AGREE[voice] and IDENT-PRESON[voice] must dominate *[ʤ]: the voiced affricate is tolerated when the alternative is voicing disagreement or devoicing a presonorant obstruent. But this ranking creates a problem under standard OT assumptions: while the ranking works for the inputs considered so far, it rules in the wrong forms if the base is rich. Input /ʤ/ is predicted to map faithfully in presonorant position, which is incorrect.

[3]See the works cited in Petrova et al. for additional information on the first five languages. Isthmus Zapotec instantiates a language with a voicing contrast in pre-sonorant position ([ko?] 'no', [gi] 'fire', [ʃjaa] 'his wing', [ʒjaa] 'cotton') but neutralization to voicelessness in obstruent clusters (e.g., [bere] 'chicken', [ʃ-pere-be] 'his/her chicken') (Pickett 1967, p.306). The restriction is surface-true; all surface obstruent clusters are voiceless (p. 294).

[4]Thanks to Maggie Baird for discussion.

(20) The rich base alternative: voiced presonorant affricates incorrectly predicted to map faithfully

	/ʤop/	Ident-pson[voice]	Agree	*[ʤ]	*ObsVoice	Ident[voice]
a.☞	ʤop			*	*	
b.	ʧop	*				*

The problem is a general one for ROTB. When a structure does not occur on the surface in a language, the usual OT explanation is to say that markedness outranks faithfulness. But in the Russian case, the native faithfulness ranking derives the wrong outcome: the wrong thing is ruled in. If we rejigger the ranking to map /ʤ/ to something else—say, a sequence such as [dʐ], which is how it is pronounced in loanwords (see §4)—then it breaks the account of native assimilation, since the option to decompose the affricate into a CC sequence now needs to be ruled out for native voiced affricates in contexts where they are derived by regressive assimilation.

The usual avenues for saving a theory are to question the facts (e.g., by questioning the phonetic reality of assimilation) or to modify the theory by complicating it (e.g., by adding elaborate constraints, or entire derivational levels as in Stratal OT). The first strategy does not seem promising. All sources that discuss the assimilation pattern in sufficient detail agree on the facts (Halle 1959, Comrie et al. 1996, Garde 1998, i.a.): Russian has non-contrastively-voiced allophones in assimilation contexts (see also Figs. 1–4 below). This contrasts with other claims made about Russian voicing, such as sonorant transparency, which has engendered far more controversy (see Kulikov 2013 for a review). The second strategy of complicating the theory comes in many flavors, as I discuss in the section on alternatives in §5. The problems with these, I argue, is that they either introduce the duplication problem or do not succeed on OT terms. Before discussing alternatives, I consider the full complexity of the Russian facts: the other inventory gaps, and loanword adaptation.

3.3 Russian voicing assimilation in detail

The consonant inventory of Russian is in Table 1. There is a [±back] (palatalization) contrast for most consonants (Rubach 2000, Padgett 2003). There is also a voicing contrast for most obstruents.[5] The strident and velar series have gaps in voicing and backness (boxed). Both affricates are voiceless, and they lack same-place backness counterparts, [tsˠ, tʃʲ] but not *[tsʲ, ʦˠ]. The consonant [ʃʃʲ] lacks a robust voiced counterpart; [ʒʒʲ] is at best marginal (see §3.3.5). Finally, there are no retroflex/velarized affricates, [ʦ ʤ] (this is unlike Polish, whose strident affricate and fricative contrasts have no gaps in place or voicing; see Gussmann 2007, Padgett and Żygis 2007, Żygis and Padgett 2010).

[5] I do not deal with the behavior of [v, vʲ]. As in other languages (Hungarian, Icelandic), these consonants are reflexes of historical /w/, and they show dual patterning: neutralizing as if they are obstruents, but failing to trigger assimilation as if they are glides, [s͡voj] 'own' vs. [z͡von] 'ringing' (Padgett 2002). Locating [v, vʲ] in the fricative rather than the glide row does not reflect a commitment to any analysis of these facts. Section 4 discusses [w] in loanword adaptation.

	labial	dental	(alv-)palatal	retroflex	velar
stops	$p^{ɣ}$ $b^{ɣ}$ p^{j} b^{j}	$t^{ɣ}$ $d^{ɣ}$ t^{j} d^{j}			$k^{ɣ}$ $g^{ɣ}$ k^{j} g^{j}
affricates		$ʦ^{ɣ}$	$ʧ^{j}$ <ч>		
fricatives	$f^{ɣ}$ $v^{ɣ}$ f^{j} v^{j}	$s^{ɣ}$ $z^{ɣ}$ s^{j} z^{j}	$ʃʃ^{j}$ <щ> ($ʒʒ^{j}$)	$ʂ^{ɣ}$ $ʐ^{ɣ}$ <ш ж>	$x^{ɣ}$ x^{j} ($ɣ^{ɣ}$)
nasals	$m^{ɣ}$ m^{j}	$n^{ɣ}$ n^{j}			
liquids		$l^{ɣ}$ $r^{ɣ}$ l^{j} r^{j}			
glides			j		

Table 1: Russian contrastive consonants (Padgett 2003, Padgett and Żygis 2007; orthographic counterparts are given in angled brackets where Russian/Slavicist readers might need them)

Table 1 includes transcription details that are often omitted, and I suppress them in the remainder of the paper (thus, I follow the convention of marking palatalization but not velarization, and only where there are robust contrasts; see Padgett 2003, Iskarous and Kavitskaya 2018, Gouskova and Stanton 2021).[6] I transcribe vowels phonemically, except for [i] and its back allophone, [ɨ], after velarized consonants. (I ignore the analogous retraction of [e], [$k^{ɣ}$óf^{j}e] 'coffee' vs. [$k^{ɣ}$a$f^{ɣ}$é̠] 'cafe'.)

The paradigm in (21) shows assimilation patterns for a fuller range of consonants. The gapped consonants appear below the line, in (21e–h).

(21) Russian voicing alternations, including gapped part of consonant inventory

	UR	___R	___#	___D	___T	Gloss
a.	/kot/	kot-am	kot	kod-ʐe	kot-to	'tomcat'
b.	/kod/	kod-am	kot	kod-ʐe	kot-to	'code'
c.	/bok/	bok-am	bok	bog-ʐe	bok-to	'side'
d.	/bog/	bog-am	bok	bog-ʐe	bok-to	'god'
e.	/noʧ/	noʧ-am	noʧ	noʤ-ʐe	noʧ-to	'night'
f.	/tsex/	tsex-am	tsex	tseɣ-ʐe	tsex-to	'workshop'
g.	/veʃʃ/	veʃʃ-am	veʃʃ	veʒʒ-ʐe	veʃʃ-to	'thing'
h.	/lʐ-eʦ/	lʐeʦ-am	lʐeʦ	lʐeʣ-ʐe	lʐeʦ-to	'liar'
		/-am/ DAT.PL	/-Ø/ NOM.SG	/-ʐe/ 'C.FOCUS'	/-to/ 'TOPIC'	

3.3.1 An aside on morphology and prosodic phrasing

The examples above show voicing assimilation to clitics. The clitics have a syntactically determined distribution, occurring roughly in second position of the clause (attached to the topicalized or focused constituent). Clitics may occur later in the clause, too, and they can be multiply instantiated. They are not selective as to the category of their hosts, occurring on nouns, verbs, adjectives, and some prepositions (Gouskova 2019).

[6] The literature on Russian is inconsistent in transcribing the alveo-palatal stridents. In Table 1 I transcribe <ч> as [ʧ], as do Padgett and Żygis (2007), Padgett (2008). But orthographic <щ> is sometimes transcribed as [ɕː] (Padgett and Żygis 2007) and sometimes as [$ʃ^{j}$ː] (Padgett 2010, Gouskova 2010), even though it is clearly homorganic with [ʧ]. By contrast, transcription of <ш, ж> as [ʂ ʐ] is more consistent in 21st century sources, following Żygis (2003) and Hamann (2004).

Clitics such as [bɨ] and [ʐe] provide the most abundant examples of assimilation due to their wide distribution, but voicing assimilation applies in a variety of other contexts (see (22)). Assimilation can occur morpheme-internally (with vowel deletion), at prefix and suffix boundaries, and in truncated compounds.[7]

(22) Morphological environments for voicing assimilation

a.	stem-internal				
	/dʲog(o)tʲ-a/	dʲoktʲa	'pitch GEN.SG'	dʲogotʲ	'pitch NOM.SG'
b.	prefix boundary				
	/ot-boj/	odboj	'lights out'	ot-mena	'repeal'
c.	clitic boundary				
	/s dʲogotʲ-em/	z=dʲoktʲem	'with pitch INST.SG'	s=otbojem	'with lights out'
d.	suffix boundary				
	/alʧ-(e)b-a/	alʤba	'greed'	alʧ-en	'greedy PRED.'
e.	truncated compounds				
	/naʧ(alʲnik) div(izii)/	naʤdif	'division chief'	naʧalʲnik divizii	'chief' 'division GEN.SG'
	/veʃʃ(estvennoje) dok(azatelʲstvo)/	veʒʒdok	'material evidence'	veʃʃestvennoje	'material'

Assimilation can optionally apply at phonological word boundaries, as well, as in /vraʧ bɨl/ [vraʤ bɨl] 'doctor was', shown in the spectrogram in Fig. 1 in the next section.

The position for devoicing is word-final, not coda (as sometimes erroneously claimed). Obstruents contrast in medial codas if a sonorant follows: witness [bm] in (23a), which must be heterosyllabic as it cannot start a word. Pre-sonorant obstruents also contrast for voicing in C͟R codas, [gr#] (see (23b)). By contrast, obstruents in PWd-final position devoice even before a sonorant-initial enclitic (23c). Enclitics are external to the PWd, unless apocope applies to their vowels, in which case they undergo devoicing (see Gouskova 2019 for details and analysis).

(23) Domain of devoicing: not coda

a.	/ob-man/	ob.man	'deceit'	not *[op.man]	
b.	/tigr/	tigr	'tiger'	not *[tikr], cf. [mokr] 'wet'	
c.	/mozg li/	mosk # li	'brain Q.'	not *[mozg.li]	# = PWd boundary
d.	/noga ʐe/	nogaʂ #	'leg C.FOCUS'		

Steriade (1999) argues convincingly that these patterns motivate presonorant faithfulness rather than onset faithfulness/licensing (contra Lombardi 1995). Steriade suggests that presonorant faithfulness is grounded in perception, since following sonorants allow the maximum expression for voicing cues.

[7] Compounds are single PWds by the diagnostic of final devoicing: witness /meditsinskij institut/ →[med͟institut] 'med school', not [met͟institut]. For additional discussion of PWd boundaries in Russian, see Gouskova (2010), Padgett (2012), Gouskova (2019).

3.3.2 Phonetics

Before considering the individual consonants in more detail, it is important to establish that the assimilation is phonetically real—if assimilation is incomplete, the patterns in (21) could be dismissed as weak phonetic effects (see Padgett 2012). It is well-known that word-final devoicing can be incomplete (Warner et al. 2006, Dmitrieva et al. 2010, Roettger et al. 2014). Burton and Robblee (1997) report that assimilation, too, is sometimes incomplete in Russian, and it depends on manner. Burton and Robblee found that fricatives were less likely than stops to assimilate completely: "There was less voicing in /sd/ than in /zd/ and more voicing in /zt/ than in /st/" (Burton and Robblee 1997, 109). But their study did not include affricates. It is therefore important to verify that /x, ʃʃ, ʦ, ʧ/ undergo the rule: for this pattern to merit the status of a theoretical problem, Russian speakers must encounter [ɣ, ʒʒ, ʣ, ʤ] in natural speech.

Studying voicing neutralization in the lab is methodologically difficult: it is affected by proficiency in English, orthographic presentation of materials, and pragmatics. The best source of evidence, therefore, is fluent speech produced outside the lab.[8] If voiced segments such as [ɣ, ʤ] occur in assimilation contexts in such speech, then Russian speakers must encounter them, and they must be able to derive them in their grammars. I looked for examples of assimilation-derived voiced allophones in the multimedia section of the Russian National Corpus (`https://ruscorpora.ru/new/search-murco.html`). Fig. 1 shows [ʤb]. The same speaker's voiceless [s] follows; note the contrast between the amount of voicing in [ʤ] vs. its absence in [s].[9]

[8] See the works cited above, as well as Łukaszewicz 2021 for a discussion of voicing neutralization in Polish. Łukaszewicz also concludes that running speech is the best way to demonstrate that assimilation happens, and that it is available to the learner in the acoustic signal.

[9] The audio files are at `https://media.ruscorpora.ru/download/akusherka_bolshoi_kamen_009/?name=akusherka_bolshoi_kamen_009.mp4` and `https://media.ruscorpora.ru/download/akusherka_bolshoi_kamen_025/?name=akusherka_bolshoi_kamen_025.mp4`, last accessed 13 July, 2022. They were converted to .wav format. The multimedia subcorpus of the RNC contains audio and video clips of TV shows, films, radio programs, etc. These clips are from a philologist's interviews; the speaker is a retired obstretrician. The other clips are from films and a radio play.

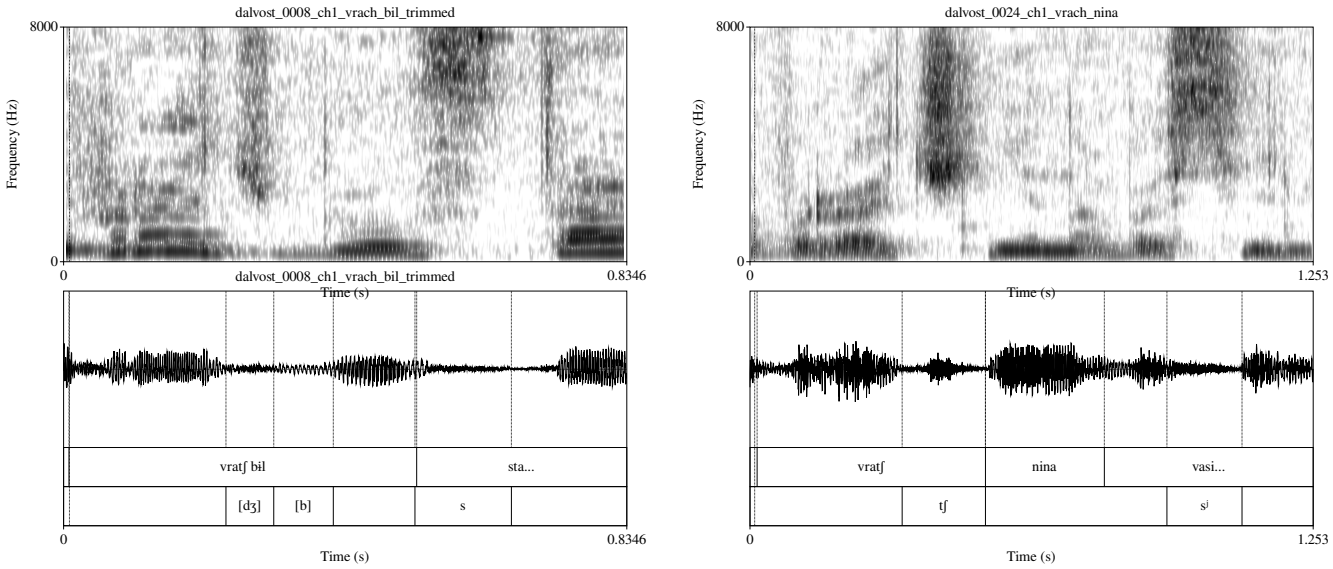


Figure 1: Left: voiced [ʤ] derived by voicing assimilation, /vratʃ bɨl starɨj/ ‘the doctor was old’. Right: the same speaker’s [tʃ] before a sonorant, /vratʃ nina/ ‘doctor Nina’.

Similar examples (from different speakers) in Figs. 2–4 show [ʣ], [ɣ], and [ʒʒ].[10] Note the presence of voicing pulses in the labeled consonant portions, and compare them to voiceless segments in nearby words. These allophones are voiced, though in the affricates, the voicing is slightly less pronounced (Żygis et al. 2012 discuss the reasons).

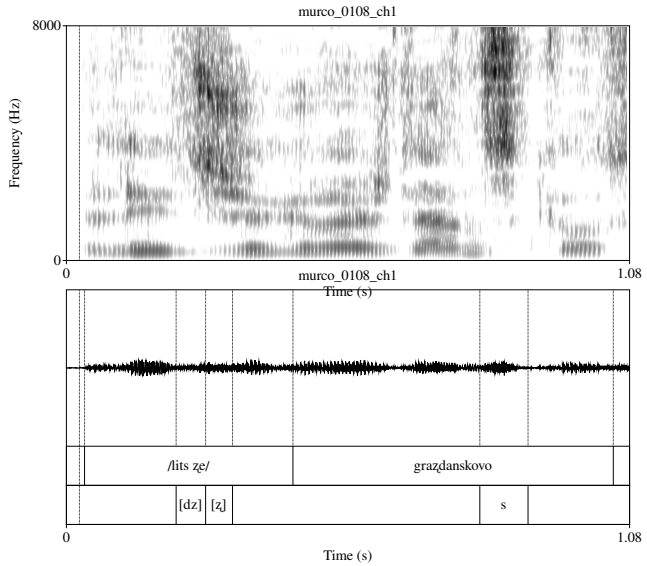


Figure 2: Voiced [ʣ] derived by regressive voicing assimilation, /lits zę/ ‘persons c.foc’

[10]Audio files at `https://media.ruscorpora.ru/download/a70puvp914.1913/?name=bednyj_pavel_109.mp4`, `https://media.ruscorpora.ru/download/nevskiy_prospekt_189/?name=nevskiy_prospekt_189.mp4`, and last accessed 13 July 2022.

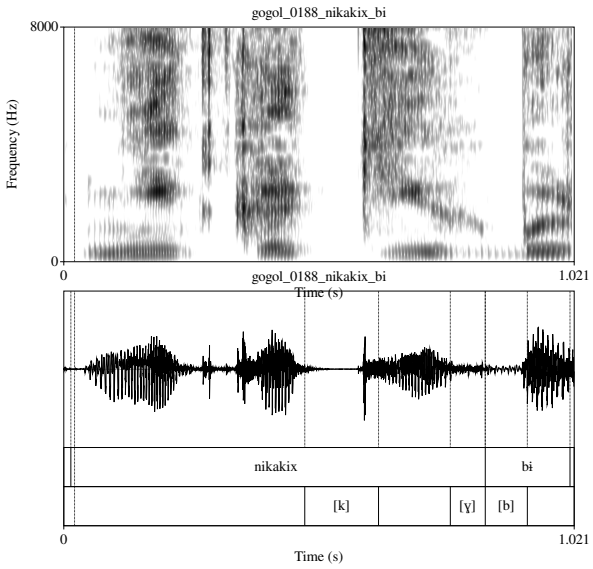


Figure 3: Voiced [ɣ] derived by regressive voicing assimilation, /nikakix bɨ/ 'none IRR.'

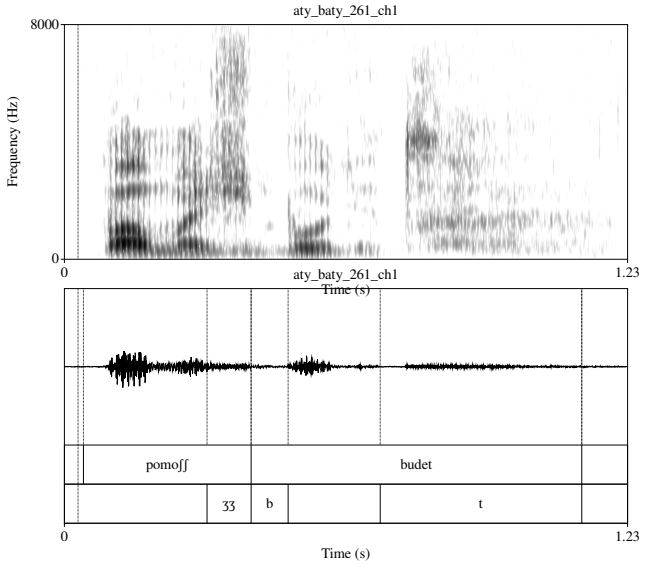


Figure 4: Voiced [ʒʒ] derived by regressive voicing assimilation, /pomoʃʃ budet/ 'help will be'

Recall that Halle's original argument concerned not just /ʧ/ but also other non-contrastively voiceless consonants, /ʦ/ and /x/ (and could have included /ʃʃ/). In the next sections, I consider the voiced allophones of these consonants [ʤ, ɣ, ʒʒ], and the additional complications they present. The purpose of considering [ʤ, ɣ, ʒʒ] is twofold. First, the facts are historically important in phonology, but often mischaracterized. Second, some details of the individual cases make a unified account difficult, which presents a challenge for alternatives (§5).

3.3.3 The [dz] sequence

I start with [dz]. One would expect it to parallel [ʤ], but the distributions differ: [dz] does occur outside the assimilation context at morpheme boundaries, in loanwords, and in onomatopoeia. Crucially, [dz] is often ambiguous between an affricate and a CC cluster (see (24)). One telling piece of evidence that [dz] is a CC cluster is that its parts can disagree in palatalization (see (24c)). By contrast, tautomorphemic [ʦ] is velarized throughout. Mismatched [tˠ-sʲ] sequences occur only at morpheme boundaries and are clearly CC clusters (e.g., [otˠ-sʲel] 'sat away from').

(24) Examples of [dz] in Russian (palatalization and velarization transcribed for clarity)

a.	onomatopoeia:	dˠzˠɨnʲ	'ding-dong'
b.	pfx/root boundary:	nadˠ-zˠor	'supervision'
c.	loanwords	fudˠzʲi	'Fuji'
		dˠzˠen	'Zen'
		ksendˠzˠ-ɨ	'Catholic priests' (Pol. <ksiądz>; see §4)

In my analysis, the affricate /ʣ/ violates the MSC in (16), just like /ʤ/ does. But there is little harm, or evidence either way, in assuming that /ʣ/ can just map faithfully—albeit in very few morphemes. Surface sequences much like [ʣ] occur in Russian, and the phonology provides few arguments for affricates: even the arguments for [ʧ, ʦ] are delicate, since Russian is phonotactically very permissive (Halle 1959, Gouskova and Stanton 2021).[11] Since /ʣ/ has an ambiguous status, it offers few insights into MSCs.

3.3.4 The voiced velar fricative in religious exceptions

The status of [ɣ] is complicated for a different reason. Just like [ʤ], [ɣ] occurs as an allophone derived by regressive assimilation: /mox bɨ/ → [moɣ bɨ] 'moss IRR.'. But in many dialects (e.g. southern ones), [ɣ] occurs where Moscow Russian has [g]. The fricative variant is stigmatized (Avanesov 1968, 111–112). But some prescriptive Moscow speakers have [ɣ] in religious contexts (see (25a–b)), with [x] as its devoiced allophone (25c):

(25) Voiced [ɣ], religious exemption

a.	ɣospodʲi	∼ gospodʲi	'O Lord'
b.	boɣa radʲi	∼ boga radʲi	'for god's sake'
c.	box	∼ bok	'god'

For many Moscow Russian speakers (including me), [ɣ] occurs only in voicing assimilation contexts. For such speakers, the distribution of [ɣ] presents the same challenge to the standard OT account of voicing neutralization as that of [ʤ]. Under my analysis, their grammars would include an MSC */ɣ/, following the same reasoning as for /ʤ/.

[11] One argument against [ʣ] comes from Gouskova and Stanton's (2021) learnability model, which uses distributions to diagnose sequences as complex segments or CC clusters. The model analyzes Russian [ʧ, ʦ] as affricates, but [d] and [z] occur so infrequently together that [dz] is considered a cluster.

Speakers with religious [ɣ] are more challenging: is theirs a limited contrast, or limited lenition? Under the first possibility, /ɣ/ and /g/ contrast, but only religious words have /ɣ/. This analysis could be criticized, because the contrast is confounded with a stylistic difference. As long as the analyst is not bothered by missing the stylistic generalization, there is a simple ROTB analysis: IDENT[continuant] dominates surface markedness constraints against [g] and [ɣ], and velars shed no light on the MSC */ɣ/.

A more interesting (and baroque) possibility is that (25) results from variable lenition of /g/, confined to a religious sublexicon. This would capture the religious generalization, but the analysis cannot be integrated with the ranking in (17). The problem is similar to the one presented by /ʤ/ in a rich base account (recall (20)). Analyzing regular neutralization of /g, ɣ/ to [g] requires the ranking *[ɣ]≫IDENT[cont]. But this ranking incorrectly allows [ɣ] to become [g] in voicing assimilation contexts, too. Let us unpack this.

One argument for the ROTB/lenition analysis is that it simplifies the treatment of (25). Such an analysis does not have to decide whether those forms have lexically-specific lenition[12] of /g/, or constitute a small club of morphemes that have underlying /ɣ/:

(26) Intuitive statement of a rich base analysis of voiced velars

a. In religious exceptions, /g/ and /ɣ/ neutralize to [ɣ].

b. Elsewhere, /g/ and /ɣ/ neutralize to [g].

This is formalized in (27), using lexically indexed constraints (Pater 2008, i.a.). Key here is *[g]$_{+}$, violated by instances of [g] in religious words. For these words, *[g]$_{+}$ triggers lenition to [ɣ]. Crucially, *[ɣ] must also outrank IDENT[cont] to force hypothetical inputs like /roɣa/ to harden to [g]:

(27) Analysis of exceptional [ɣ] in prevocalic positions, assuming a rich base

		*[g]$_{+}$	*[ɣ]	IDENT[cont]	*[g]
/bog$_{+}$-a/‘god’	a.☞ boɣ$_{+}$a		*	*	
	b. bog$_{+}$a	*W	L	L	*
/boɣ$_{+}$-a/	c.☞ boɣ$_{+}$a		*		
	d. bog$_{+}$a	*W	L	*W	*
/rog-a/ ‘horn’	e. ☞ roga				*
	f. roɣa		*W	*W	L
/roɣ-a/ (hypoth.)	g. ☞ roga			*	*
	h. roɣa		*W	L	L

Perhaps it is apparent why this is incompatible with the analysis in §3.2. If avoidance of [ɣ] in the general lexicon can compel violations of IDENT[cont], this should allow hardening in voicing assimilation contexts: /mox bɨ/ → *[mog bɨ]. The actual output [moɣ bɨ] ‘moss IRR.’ violates *[ɣ], and it cannot win if the ranking of IDENT[cont] and *[ɣ] is as shown in (27f). We have arrived at a ranking contradiction: *[ɣ] and IDENT[cont] cannot be ranked the same in (27) and (28).

[12]There is a [g]∼[x] alternation in dorsal-dorsal contexts in some morphemes: /lʲog(o)k-/ [lʲoxk-ij] ‘light ATTRIB.’ vs. [lʲogok] ‘light PRED.’, /mʲag(o)k-/ [mʲaxk-ij] vs. [mʲagok] ‘soft’ (Comrie et al. 1996, 38), but it is unrelated to voicing.

(28) Incorporating analysis of lexically specific lenition and voicing requires different ranking

inputs: (a) /rog-a/ 'horn', (b) /boɣ͡ɬ-a/, (c) /bog͡ɬ-a/ 'God (acc)', (e, f) /mox bʲ/ 'moss IRR.'

	winner∼loser	IDPSON[vce]	AGREE	*g͡ɬ	*OBSVCE	ID[vce]	ID[cont]	*ɣ	*g
a.	roga ∼roɣa						W	W	L
b.	boɣ͡ɬa ∼ box͡ɬa	W			L	W		L	
c.	boɣ͡ɬa ∼ bok͡ɬa	W			L	W	L	L	
e.	moɣ bʲ ∼ mox bʲ		W		L	L		L	
f.	moɣ bʲ ∼ mog bʲ						**W**	**L**	

Thus, whether the MSC *[ɣ] is needed depends on the dialect under discussion, and on the assumptions about how [ɣ] is derived in non-assimilating contexts: if analyzed as a contrast, there is no need for the MSC, but there is no explanation for why the contrast is so marginal. If we analyze it as lexically specific lenition, the rich base analysis does not work.

By contrast, my account can accommodate religious exceptions in two ways. First is admitting /ɣ/ URs on an exceptional basis. This entails enriching the theory of MSCs to allow lists of diacritic exceptions:

(29) Morpheme Structure Constraint: *[ɣ] 'No lexical entry contains a segment that is [+voice, +dorsal].'

͡ɬ *Exceptions*: { /boɣ͡ɬ/ 'god', /ɣospodʲ͡ɬ/ 'Lord', /blaɣ͡ɬ/ 'good'. . .}

This move might be independently necessary: languages sometimes violate existing MSCs by borrowing foreign segments (e.g., voiced stops in Quechua—see Gouskova To appear for a review). Another option is to treat *[ɣ] as inviolable, listing 'god' as /bog͡ɬ/, and implement lenition using the ranking in (28). The MSC analysis does not encounter a ranking paradox because inputs such as /roɣ-a/ are not entertained, and those inputs are the only reason to rank *[ɣ] above IDENT[cont].[13] Thus, the MSC theory offers multiple accounts for the full range of facts.

3.3.5 The voiced counterpart of [ʃʃ]

The last gap is [ʒʒ], the voiced counterpart of [ʃʃ] (which Halle does not mention). Both sounds historically occurred in derived environments; [ʒʒ] has become marginal, while [ʃʃ] is now standard. There is some confusion in the Western literature on the status of [ʃʃ], due to an obsolete dialect split between St. Petersburg and Moscow (Comrie et al., 33–35). St. Petersburg retained the [ʂtʃ] or [stʃ] pronunciation for some time, and it was apparently common among post-1917 émigrés. This might be why certain Western sources, such as Garde (1998), do not include [ʃʃ] in the consonant inventory. Garde characterizes [ʃʃ] as a variant of [stʃ] (1998, sec.85). But Comrie et al. note that by the 1970's, the [ʃʃ] pronunciation was the only option acceptable to Russian speakers, as documented in contemporary studies by Russian linguists.

[13] The one challenge for a lenition account is dealing with overkill: /bog/ shouldn't map to [box] if [bok] is an option (cf. Ito and Mester 2003 on a similar problem in German). A workaround can be implemented in Harmonic Serialism, which would not allow the mapping straight to [box] as it changes both [cont] and [voice]. Again, this might be independently necessary, to solve the Beckman-Noyer problem (see Jesney 2011).

The examples in (30a–b) show that [ʃʃ] occurs in a variety of environments. It still alternates with clusters, but it's also found in many etymologically opaque words (30c–f). Moreover, [ʃʃ] occurs obligatorily in many morphemes in contemporary Russian, whereas [ʒʒ] is both rare and variable–there is always an option to pronounce [ʒʒ] as something else, as shown in (31).

(30) Voiceless [ʃʃ] in alternating and non-alternating contexts (etymologies from Vasmer 1958)

a.	/s-ʧit-atʲ/	ʃʃitatʲ	'to count'	cf.	/so-ʧit-atʲ/	soʧitatʲ	'to combine'
b.	/rez(o)k-je/	reʃʃe	'more harshly'	cf.		rezok	'harsh'
c.	/ʃʃ-i/	ʃʃi	'cabbage soup'	<	* ʂti		
d.	/veʃʃ/	veʃʃ	'thing'	<	* veʂtʲ		
e.	/ʧud-iʃʃ-e/	ʧudiʃʃe	'monster'				
f.	/jeʃʃo/	jeʃʃo	'yet'				

By contrast, [ʒʒ] mainly occurs as an allophone in assimilation—but some Moscow speakers also have it in morpho-phonologically derived environments (see (31)). There are very few, if any morphemes whose [ʒʒ] that could be argued to be underlying. The best candidate is [droʒʒ-i]∼[drozʐ-i] 'yeast', historically derived from /ʐd/ but synchronically opaque. The [ʒʒ]∼[ʐʐ] alternation is not well-described. It seems to apply in intervocalic position and only stem-finally, conditioned by select suffixes (thus, plural /-i/ conditions it but nominalizer [vozʐd-izm] 'leaderism' does not. *[voʒʒizm], and root-internal [iz̲dіv-en-etsʲ] 'dependent' cannot become [ʒʒ]).

(31) Voiced [ʒʒ] allowed in derived environments

a.	/dozʐdʲ-i/	doʒʒi	∼ dozʐdi	'rains'	cf. dozʐd-liv-ij 'rainy'
b.	??	droʒʒi	∼ drozʐʐi	'yeast'	< * *drozʐdi*
c.	/po-do-ʐd-i/	podoʒʒi	∼ podozʐdi	'wait! (1)'	cf. ʐd-atʲ 'to wait', ʐd-i 'wait! (2)'
d.	/pri-jez(d)ʐ-ij/	prijeʒʒij	∼ prijezʐʐij	'out-of-towner'	cf. jezd-itʲ 'to ride, go'
e.	/so-ʐg-jom/	soʒʒom	∼ sozʐʐom	'we will burn'	cf. ʐg-i 'burn!'
f.	/voz(ʐ)-i/	voʒʒi	∼ vozʐʐi	'reins'	cf. voz-itʲ 'to drive, carry'

The eulogies for [ʒʒ] (Avanesov 1968, Padgett and Żygis 2007, Comrie et al. 1996, 35–36) appear to be premature, just like those for religious [ɣ]. I found several contemporary hits in the RNC.[14] And just as many speakers lack religious [ɣ], many speakers also lack morphologically derived [ʒʒ]. For grammars that only allow [ʒʒ] in assimilation contexts, the argument for the MSC */ʒʒ/ is parallel to that for */ʠ/. For grammars that allow [ʒʒ] in morphologically derived environments, the analysis is complicated by the well-known issues raised by such phenomena (Kiparsky 1985, Łubowicz 2002, Wolf 2008). But banning /ʒʒ/ from the lexicon via a MSC removes certain challenges in analyzing its surface distribution. It has long been known that ROTB complicates the analysis of segments that only occur in derived environments (see, e.g., Wolf 2007, sec. 6), so proscribing them in the input simplifies the account. For either group of speakers, the restricted distribution of [ʒʒ] follows from it being absent from lexical representations.

[14]Searching for <приезжи*> [prijezʐi*] 'out-of-towner' in the multimedia subcorpus turned up 3 [prijeʒʒi. . .] pronunciations in the first 10 hits. The remaining 7 speakers had [ʐ] there. Searching for <дрожжи> [droʒʒi]∼[drozʐi] 'yeast' found 6 hits, evenly split between the two pronunciations.

3.4 Local summary

Four Russian obstruents can be argued to lack a systematic voicing contrast: [ʧ, ʦ, x, ʃʃ]. All four have voiced allophones in regressive assimilation. But in other contexts, the consonants vary. On the surface, [dz] does occur outside the assimilation environment, although it might be analyzed as a CC sequence there. As for [ɣ] and [ʒʒ], they definitely occur in ambient speech, but their variable presence and restricted stylistic/morpho-phonological distribution complicate their analysis. By contrast, [ʤ] alone is found only in regressive assimilation contexts; it is this allophone, therefore, that presents the clearest argument for a MSC. Its special status is also supported by loanword phonology, as I show next.

4 MSCs in loanword phonology

4.1 Borrowing data

The preceding discussion argued for MSCs on analytic grounds: an insightful analysis of Russian voicing neutralization must rule out gaps at the UR level. MSCs allow for a simple, cross-linguistically valid analysis of voicing neutralization in the grammar of input-output mappings. Unlike some OT alternatives in §5, the MSC account uses formally simple constraints that can be motivated substantively.

In this section, I consider the role of MSCs in loanword adaptation, with a somewhat narrow focus on Russian. The broader question is what ROTB and MSCs predict for the handling of segments that a language lacks entirely. The usual OT explanation is that inventories are determined by markedness and faithfulness rankings; if a segment is missing, it violates an undominated markedness constraint. But what faithfulness constraint is violated in the mapping from a rich input to the output? This question rarely receives a clear answer.

In the case of Russian, we will see that foreign [ʤ] is adapted as though the phonology cannot even represent it as a single sound, and the handling of loan [ʤ] leaves few avenues for saving an analysis of voicing neutralization that does not rely on MSCs.

A striking feature of Russian loanword adaptation is that some segments are borrowed as consonant clusters. For example, Russian lacks a velar nasal [ŋ], even in place assimilation contexts, where many languages require it. Thus, in borrowings from English and German, [ŋ] maps to [ng] or [nk] (see (32a)). But Chinese and Korean loans follow a different convention: source [ŋ] maps to [n]:

(32) Russian borrows /ŋ/ as [ng], [nk] or as [n]

a. English, German:

rink, ring-a	'(boxing) ring (+GEN.SG)'	kansaltink, g-a	'consulting (+GEN.SG)'
dopink, doping-a	'doping (+GEN.SG)'	marketink, g-a	'marketing (+GEN.SG)'
ʦajtunk	'Zeitung, newspaper'	mango	'mango'

b. Chinese, Korean:

si dzinʲpin	'Xi Jinping'	kim ir sen	'Kim Il Sung'
den sʲaopin	'Deng Xiaoping'		

Borrowing [ŋ] as [nk] could be orthographic: German and English lack a single letter to write [ŋ], so Russian speakers render the orthographic cluster as a sequence of two sounds. If they

were basing their pronunciations on perceptual input, they might be expected to render [ŋ] as [nʲ]. I suggest an explanation for this differential adoption patterns in §4.3.

But orthographic borrowing cannot explain what happens to [ʤ].[15] Russian borrows [ʤ] from a variety of languages, including ones where it has no consistent spelling (English) or where orthography is unlikely to have been the main mode of contact (Turkic, Arabic via Persian). Almost without exception, [ʤ] is borrowed as [dzʲ]:

(33) Russian borrows source [ʤ] as a heterorganic cluster

a.	dzʲɨnsɨ	'jeans (Eng.)'	f.	menedzʲer	'manager' (Eng.)
b.	gudzʲarat	'Gujarat'	g.	mudzʲaxet	'mujahid' (Ar.)
c.	dzʲezva	'cezve (Turkish)'	h.	dzʲɨp	'Jeep' (Eng.)
d.	gadzʲet	'gadget (Eng.)'	i.	dzʲɨn	'genie' (Ar.) or 'gin' (Eng.)
e.	pidzʲak	'(pea) jacket' (Eng.)	j.	dzʲɨgit	'skilled horseman (Turkic)'

Word-finally, the sequence becomes [tʂ], not [ʧ]. This is systematic and does not depend on the source language:

(34) Word-final [ʤ] borrowed as [tʂ], not [ʧ]

	Nom sg	Gen sg	
a.	ímitʂ	ímidzʲa	'image (Eng.)'
b.	kotétʂ	kotédzʲa	'cottage (Eng.)'
c.	xátʂ	xádzʲa	'hajj (Ar.)'

By contrast, the voiceless sequences [ʧ] and [ʦ] are borrowed as affricates:

(35) Russian borrows voiceless affricates as affricates

ʧízburger	'cheeseburger (Eng.)'	ʦentr	'center (Germ. [ʦɛntʁum])'
ʧípsɨ	'chips (Eng.)'	ʦɨnk	'zinc (Germ. [ʦɪŋk]) '

There are comparatively few borrowings with [dz], and the Russian string's status is unclear (recall §3.3.3). One source is Polish, whose [ʤ, d͡ʑ] are borrowed as [dz] and [dzʲ] respectively. Another source is Japanese, whose affricated /d/ before [i] is borrowed as [dzʲ], with palatalization disagreement. It is unclear whether this pattern is guided by perceptual similarity or convention (see Kang 2011 for more).

[15] A reviewer suggests that the borrowing is orthographic in a different sense: "I think orthography can still explain what happens. Because [ʤ] is not a phoneme of Russian, the closest way to represent [ʤ] in writing is дж [dʐ]. Thus, it could be argued that restriction on underlying forms in Russian is not phonological but orthographic. In effect these are MSCs which are tied to the orthography rather than the phonology of the language." Under this interpretation, rather than use their phonological grammar or MSCs that delimit lexical storage possibilities, speakers instead wonder how they might spell a word before pronouncing it. This interpretation agrees with my claim that Russian speakers are not using a phonological grammar when borrowing.

(36) Russian borrowings of source [dz, dʑ] (Polish and Japanese)

	Polish			Japanese	
a.	dzʲerʑɨnskʲij	'Dzerzhinsky' [dʑ]	c.	fudzʲi	'Fuji'
b.	ksʲón(t)s, ksʲen(d)z-ɨ́	'priest(s)' /dz/	d.	nʲín(d)zʲa	'ninja'

While [ʤ] is usually borrowed as [dʐ], there are exceptions (see (37c)). Some of these are very recent ('gender', 'digitizer'). Some older borrowings from English have [ʐ]: [ʐokej] 'jockey', [ʐuri] 'jury', [piʐama] 'pajamas', [sufraʐɨzm] 'suffragism'.[16] This kind of inconsistency is not unusual; recall [ŋ] in (32). Consider [h], which is [g] in older borrowings but [x] in contemporary ones (see (37b)). The glide [w] is borrowed as [v] or [u] in contemporary Russian, sometimes in the same word (see 37a). In places where English orthography is under-informative, e.g., as to the voicing of [s, z], Russian sometimes borrows [s] as [z] (see (37d)). This would be surprising if borrowing happened via perception, since Russian has both [s] and [z], and speakers should be able to distinguish voicing contrasts. I think a better explanation is that borrowing is agrammatical, and I analyze it as such in the next section.

(37) Changing conventions in borrowing (all from English)

a.	source [w] → [v, u]		b.	source [h]	→ [g, x]
	vatson ∼ uotson	'Watson'		gudzon	'Hudson'
	vatsap	'WhatsApp'		gamburger	'hamburger'
	uimbldon	'Wimbledon'		mastxev	'must-have'
	vau	'wow'		xudi	'hoodie'
	svitʂot	'sweatshirt'		xit	'hit'
c.	source [ʤ]→[g, dʐ]		d.	source [s]	→ [s, z]
	genetika	'genetics'		zinger	'Singer (sewing machine)'
	digitajzer, didʐɨtajzer	'digitizer'		lizink	'leasing'
	gender	'gender'		kofe xauz	'Coffee House (cafe chain)'
	virginija	'Virginia'		unitaz	'toilet (Unitas, brand name)'

Another argument against a perceptual account is that English, the source of the vast majority of recent borrowings into Russian, does not have true voicing in [ʤ]. The English contrast is one of aspiration. If Russian speakers were using their perception, as opposed to orthographic and metalinguistic conventions, we would expect them to (occasionally) borrow [ʤ] as [ʧ], and they do not.

The main significance of the borrowing facts is that [ʤ] is not borrowed as an affricate, even in cases where it could be devoiced to a native sound (in words like "image"). Most of the time, it is decomposed into a stop and a fricative, and sometimes it is borrowed as other sounds. The most troubling aspect of this pattern for an OT account is that the ranking suggested by the native voicing alternations cannot be reconciled with loanword adaptation, as I explain in §4.3. I argue instead that [ʤ] is mapped to /dʐ/ at the point of lexicalization, by a conventional mapping rule. This rule exists to enforce the MSC, but it is not part of the grammar of voicing neutralization.

[16] There is even the occasional [g] borrowed as [ʤ], as in Italian 'Lamborghini' rendered as [lambordʐini]. The RNC has 13 documents with [g] and 10 with [dʐ]. This points to orthographic borrowing.

4.2 Evidence for analyzing [dʐ] as a CC sequence

The argument that loanwords are a problem for ROTB needs some evidence that [dʐ] is indeed a CC cluster. This is not a foregone conclusion: the only Western study that addresses [ʤ] loans into Russian, Benson (1959), characterizes [dʐ] as an affricate. This is, in my opinion, incorrect.

First, consider the place of articulation change in borrowing [ʤ]. If viewed as a phonological mapping, the treatment of place of articulation is inconsistent and puzzling. Russian systematically maps [ʃ] to a retroflex [ʂ] when borrowing from English, German, French, and other European languages. When borrowing from Japanese, the sound variably transcribed as [ʃ] and [ɕ] maps to Russian [sʲ]: [xirosʲima] 'Hiroshima', [xonsʲu] 'Honshu'. When Russian borrows English [ʤ], it renders the affricate as a sequence of dental and retroflex articulations. By contrast, Russian borrows [ʧ] without major alteration (it is phonologically palatalized, but the minor place distinction is probably too subtle to detect in the acoustics; see Jongman et al. 2000, Żygis 2003). It is certainly not [tʂ] or [tʂ] in loanwords. The simplest explanation for the fate of [ʤ] is that it is conventionally mapped to stand-alone sounds available in Russian, [d] and [ʐ]. The heterorganicity of this sequence is therefore one of the best arguments for its analysis as a CC cluster.

Next are some language-internal arguments for analyzing [dʐ] as two segments, following Trubetzkoy (1939). First is the diagnostic of phonotactics. Phonotactic arguments work well in languages like Fijian: words cannot start with CC sequences, but they may start with [mb] and [nr]; the analysis of the phonotactics is simpler if these sequences are prenasalized consonants rather than CC clusters. In Russian, by contrast, phonotactic patterns are rather permissive: words can start with many different sequences; even [ʧ] and [ʦ] cannot be distinguished from stop-fricative sequences on this basis (Gouskova and Stanton 2021). Thus, phonotactics is of little help.

But phonotactic permissiveness no doubt facilitates the borrowing of sequences that do not occur in native morphemes. This is relevant to another Trubetzkoy (1939) diagnostic: affricates are supposed to be freely distributed within morphemes, while CC clusters might be more likely to occur at morpheme boundaries only. In native Russian words, [dʐ] occurs across morpheme boundaries (e.g., [pod-ʐog] 'arson'), but not morpheme-internally. The native portion of the Russian lexicon suggests that [dʐ] must be two consonants. Benson (1959), by contrast, speculates that occurrence at morpheme boundaries facilitates borrowing of [dʐ] as an affricate. If this were a legitimate pathway towards borrowing non-native sounds, there would be no debate in English phonology about the status of [ts], given words like *out-side* and *cat-s*. As it is, most analyses of English treat [ts] as a CC sequence partly because it almost never occurs morpheme-internally (see Gouskova and Stanton 2021). Thus, morphological distribution diagnoses [dʐ] as a CC sequence.

The third Trubetzkoyan diagnostic is phonetic duration: CC sequences should be longer than single Cs (affricates). Brooks (1964) shows that duration correlates with the *trzy/czy* distinction in Polish; the CC parts of [tʂɨ] 'three' are longer than the parts of the affricate in [tʂɨ] 'Q. particle' (though in Polish, the difference mostly affects the fricated portion, not closure). This diagnostic is problematic when applied cross-linguistically (Arvaniti 2007, Stanton 2017, Gouskova and Stanton 2021), but for what it's worth, it goes in the same direction in Russian as in Polish: the affricates are shorter than stop-fricative clusters. Here are some recordings of loanword [dʐ] and

native heteromorphemic [d-zʲ], from the same speaker (the actor Oleg Tabakov).[17] The [d] in [dzʲ] is fairly long:

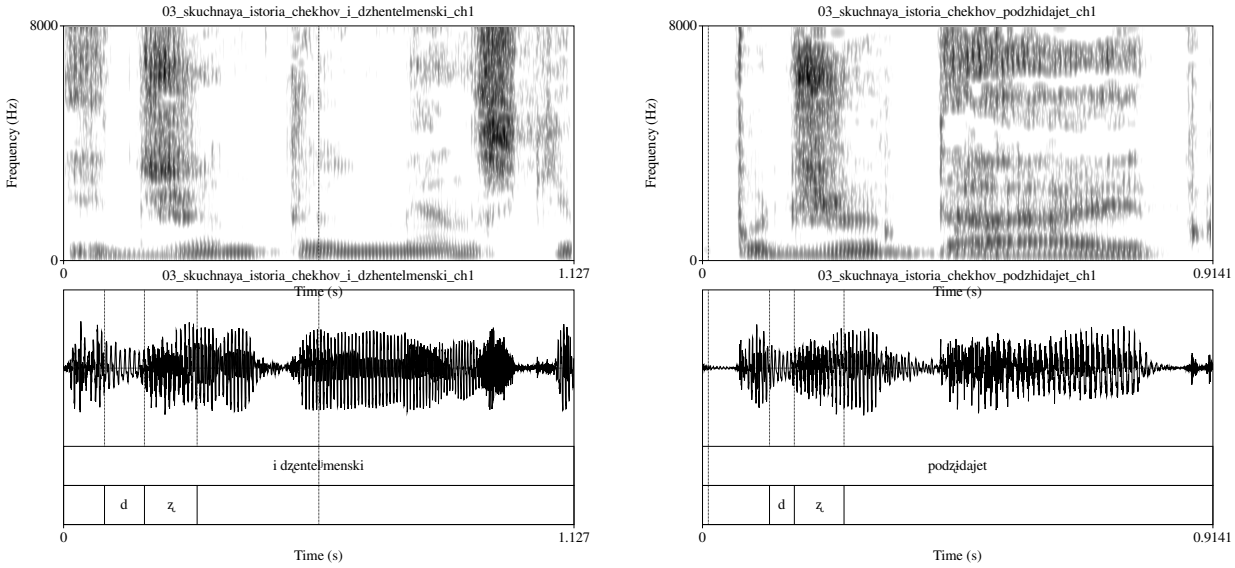


Figure 5: Left: borrowed morpheme-initial [dzʲ], right: native heteromorphemic [dzʲ].

Fig. 6 shows this speaker's intervocalic [ʧ], which has the very short closure that appears to be typical in Russian (recall also Fig. 1). One cannot draw conclusions about C vs. CC status from acoustics alone, especially when the sequences differ in voicing and constriction location, but this is still suggestive.[18]

[17]Source: `http://staroeradio.ru/audio/19176`.

[18]To my knowledge, nobody has followed up on Trubetzkoy's intuitions about the duration of affricates vs. singleton consonants in Russian. My preliminary investigations show that [ts] in Russian does not have a consistently short closure, unlike [ʧ]. The acoustics of Russian affricates need more study.

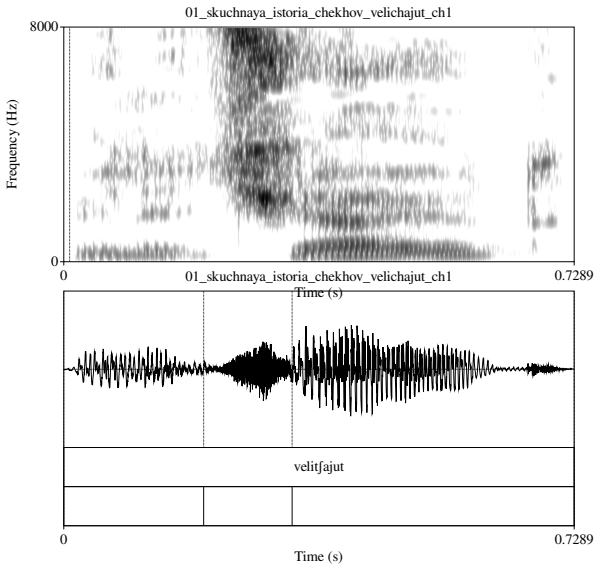


Figure 6: Native tautomorphemic [tʃ]

Fourth is a morpho-phonological diagnostic: in Russian, the allomorphy of the diminutive. The allomorph [-ok] tends to not attach to CC-final stems, while the allomorph [-ik] is found on disproportionately many CC-final stems (Gouskova et al. 2015). The [-ik] allomorph occurs on one [dz̪]-final noun, [kotédz̪] 'cottage': RNC has 14 hits of [kotédz̪-ɨk] 'cottage DIM', and zero [kotedz̪-ók]. This is consistent with [dz̪] being a CC sequence, although more systematic study is needed.

The last Trubetzkoyan diagnostic is inventory structure. In Russian, voice contrasts are mostly symmetrical: [b, p], [d, t], etc. Of course, many inventories have gaps—but the Russian system is less typologically odd if only [tʃ, ʦ] are affricates. Under the alternative analysis, the affricate [dz̪] has a relatively free distribution (albeit mostly in loanwords), while its voiceless counterpart, [ts̪], occurs only as a devoiced allophone (also in loanwords [imits̪], 'image'), and at morpheme boundaries (in native words such as [ot-s̪elʲnik] 'hermit'). That is an odd distribution. By contrast to this hypothetical, the analysis of [dz̪] as a cluster treats Russian as a typologically typical gapped system (per Żygis et al. 2012).

To conclude, the evidence points to analyzing [dz̪] as a CC cluster. When it devoices, it is also a cluster, [ts̪].

4.3 Is this fission?

Superficially, the loanword pattern seems like a conspiracy: Russian avoids voiced [ʤ], devoicing it in native contexts and fissioning it in non-native morphemes. But this intuitive characterization does not translate into a neat ROTB analysis. There are two problems:

(38) Problems for integrating the analysis of loanword [ʤ] with native phonology

a. If fission is a way to avoid loanword [ʤ], it should be a way to avoid native [ʤ] in assimilation: /notʃ bɨ/ should be *[nodz̪ bɨ], not [noʤ bɨ].

b. Conversely, if hypothetical native /ʤ/ devoices, then it should devoice in loanwords: [ʤɪn] 'gin' should be *[ʧin], not [dʐɨn].

Put in formal terms, INTEGRITY (McCarthy and Prince's 1995a anti-fission constraint) has no good ranking position in the standard analysis. If AGREE[voice] and *[ʤ] dominate INTEGRITY, we expect fission in assimilation contexts (problem (38a)).[19] If underlying /ʤ/ devoices except in assimilation contexts, then we expect devoicing in loanwords, as well, which is wrong (problem (38b)). Parallel OT encounters another problem, namely, fission in word-final position in loanwords such as [imitʂ] 'image' constitutes overkill. Regardless of the ranking of INTEGRITY, devoicing should be enough if /imiʤ/ is the UR: *[imiʧ] changes just one feature, while [imitʂ] changes voicing, number of segments, place, and [back]. Whatever is happening in loanwords is not a straightforward extension of the native pattern. This is not rare cross-linguistically, of course (Broselow 2004, Kang 2011, Simonovic 2015).

4.4 Conventional mappings

I argue that loanword [ʤ] must be decomposed before a morpheme enters the lexicon. I adopt Simonovic's (2015, ch. 6) *conventional mappings*, which are agrammatical rules, established in the community by convention to map foreign structures to native ones. Community conventions can differ between dialects of the same language even if there are no relevant grammatical differences between the dialects. Simonovic discusses Belgian and Netherlandic Dutch, which borrow English [æ] as [ɑ] and [ɛ] respectively (by using different conventional mappings). Russian motivates the following conventional mappings:

(39) Some conventional mappings for loanwords into Russian

a. [ʤ] → /dʐ/

b. [ŋ]$_{\text{English, German}}$ → /ng/

c. [ŋ]$_{\text{Chinese, Korean}}$ → /n/

d. [ʃ] → /ʂ/

There is no direct connection between these mappings and MSCs. It so happens that all MSCs are satisfied, but this is not a necessary feature: a language may borrow a foreign segment and restructure its inventory, in which case MSCs might eventually change. Simonovic has many arguments for this view of loanword adaptation, which I will not rehearse here. Conventional mappings do explain several intractable puzzles.

First, this view of loanword lexicalization straightforwardly explains why loan [imәʤ] does not devoice to *[imiʧ]. In my account, the UR is /imidʐ/. Its mapping to to *[imiʧ] is ruled out by UNIFORMITY (the anti-fusion constraint) and IDENT[back].

Second, conventional mappings can be mutually inconsistent, as in the differential adoption of [ŋ]. Since [ng] does not result from fission, we do not need to ponder why the segments appear in that order, or why [dorsal] is preserved in English/German borrowings but not Chinese ones. The agrammatical account allows for conventional mappings to arise because of different borrowing

[19] This same problem arises in analyses that replace *[ʤ] with a more context-sensitive constraint that overlaps with it in coverage, such as DISALIGN (see §5.2).

channels (with and without exposure to orthography, perhaps). It can also be influenced by extralinguistic factors suh as prestige. There is compelling evidence for such influences: in Lev-Ari and Peperkamp's (2014) experiment, French listeners adopt the fake loanword [ʤenna] more faithfully when presented as the name of a prestigious item (Italian ice cream) than when it is a non-prestigious Italian beer.

Conventional mappings illuminate another mystery: the inconsistent handling and lack of fission in English interdentals (see (40)). Mapping [θ] to /t/ and [ð] to /z/ is mutually inconsistent. Zooming out, if [ŋ] and [ʤ] undergo fission, then we expect fission for interdentals—perhaps to /tx/ or /dv/, which preserve [coronal] and [continuant]. Instead, [z] adds [strident], and [t] removes [continuant]. My explanation is that these are conventionalized mappings, which are under no requirement to be consistent with anything. Supporting this, Greek [θ] is borrowed as [f] in religious vocabulary (e.g., [anafema] 'anathema'). And some English loans are inexplicable exceptions: [ð] in [golsuor̲si] 'Galsworthy'.

(40) Conventional mappings of English [θ, ð] in Russian

a.	[ð]→/z/		b.	[θ] →/t/	
	smuzi	'smoothie'		tetʧer	'Thatcher'
	brazer	'Brother'		kit	'Keith'
	xizer	'Heather'		fejt	'Faith'

Conventional mappings exist because the language lexicalizes morpheme representations in forms that use native segments. Loanwords show that the grammar is not equipped to handle a rich base; there is just no evidence here for a grammar where the regularities are enforced by a consistent ranking of subordinated faithfulness constraints (Broselow 2004).

To be clear, I would not claim that all loanword adaptation works via conventional mappings, either in Russian or in other languages. Our current understanding of loanword adaptation suggests that the nature of contact influences the mechanisms of adaptation. Some loanword adaptation patterns have roots in perception, but it is controversial whether they interact with the grammar (Silverman 1992, Kang 2003, Peperkamp et al. 2008, and others). There are also numerous examples of adaptation that do not lend themselves to a grammatical explanation (see Kang 2011, Simonovic 2015). Loanword adaptation is likely not one thing but many things.

5 Alternatives

5.1 More on the duplication problem

The duplication problem, as framed both by Halle (1959) and by Prince and Smolensky (1993/2004), is a problem of theoretical economy. A theory misses a simple generalization about a pattern, requiring two separate devices. Halle's critique rests on the intuition that there should be one treatment for all segments, contrastive or not. He critiques structuralism for needing two voicing assimilation rules, but his own account also handles non-contrastively-voiceless consonants in several places. First, a morpheme structure rule requires /ʦ, ʧ, x/ to lack a voicing specification. Then, a phonological rule gives these consonants redundant features. His voicing assimilation rule is general, but the phonological system is not simple. Of course, as we have just seen, the

Russian system is more complex than Halle's presentation suggests, so a simple analysis is unlikely.

The problem for Optimality-Theoretic analyses is more dire, I think. All of the constraints in the positional faithfulness analysis have been recruited in the analyses of languages other than Russian. They are well-motivated substantively and typologically. Voiced obstruents are aerodynamically difficult, and many languages avoid voicing in stops (Westbury and Keating 1986, i.a.). The prohibition on voiced affricates is similarly well-grounded, and the Russian-style gapped inventory, where affricates are voiceless, is typologically common (Żygis et al. 2012). So this is an analysis worth saving. It is interesting, therefore, that most OT analyses either cannot handle these facts or encounter a duplication problem. Duplication is a problem for DISALIGN (§5.2), positional markedness (§5.4), and comparative markedness (§5.3). By contrast, Stratal OT (§5.5) fails to supply an internally consistent account of Russian and makes some odd typological predictions, depending on the specific internal assumptions.

5.2 An alternative: Hall's DISALIGN

The shape of the nasal assimilation problem in §2.2 suggests a general solution: ban the gapped segment in the environment where positional faithfulness protects contrasts. This solution is obviously duplicative: assimilation is handled once for all segments, and then again just for the gapped segments. A non-hypothetical example of such an analysis is Hall (2007), who identifies the problem presented by voiced affricates in Russian and Czech (the latter only involves /ʦ, ʧ/). Hall's solution is to augment the analysis with DISALIGN (41):

(41) DISALIGN[+voice, del rel]: "The output contains no instances of the features [+voice] and [±del rel] such that the leftmost segment associated with each feature is the letmost segment associated with the other and the rightmost segment associated with each feature is the rightmost segment associated with the other." (Hall 2007, p.9)

Unlike *[ʤ], which is simple paradigmatic feature co-occurence constraint, DISALIGN penalizes (i) affricates as sole sponsors of [+voice], or (ii) sequences assimilated for [+voice] and [del rel]: [ʤʤ, pʤ] are bad, [bʤ, ʤb, dʤ, ʤʧ] are good. Hall is himself skeptical, noting that DISALIGN cannot distinguish the legitimate Czech word [le:ʤba] 'cure' from banned *[le:bʤa]. His fix is a directional DISALIGN-R, which penalizes *[bʤ] but not [ʤb].

This style of approach can be criticized for any number of reasons. First, it does not escape the duplication problem for the reasons already explained. Second, the constraint is complex and stipulative; it is unclear why [ʤb] should be preferred to [bʤ] at all, or why either is better than, say, intervocalic [ʤ]. Third, an OT account should be judged on its predicted typology. The basic typology of the constraint set {AGREE[voice], IDENT, IDENT-PRESON, *OBSVOICE} generates 7 attested patterns (recall (18)). By contrast, adding {DISALIGN-R, DISALIGN} predicts 19 systems, including some rather intricate patterns that are, I think, unattested. Two such systems are illustrated in (42)–(43). The first language has regressive assimilation in obstruent clusters in general (e.g., [atpa], [adba]: AGREE dominates IDENT), and [ʤ] occurs as a singleton (IDENT dominates DISALIGN). But in clusters containing /ʤ/, there is wholesale devoicing. This is the opposite of Russian: [ʤ] is allowed except in assimilation contexts, and the presonorant contrast is conditional on a nearby stop. The second language has word-final devoicing and limited regressive

assimilation. It is not triggered by presonorant obstruents except for /ʤ/.[20]

(42) Prediction of DISALIGN: obstruent clusters agree regressively, but affricate-containing clusters always devoice (hypothetical language)

AGREE[voice]≫IDENT≫DISALIGN, DISALIGN-R≫IDPSON≫*OBSVOICE

/bat/	/pad/	/adpa/	/atba/	/ʤat/	/paʤpa/	/papʤa/
[bat]	[pad]	[atpa]	[adba]	[ʤat]	[paʧpa]	[papʧa]

(43) Another prediction of DISALIGN: regressive assimilation in ʤ-containing clusters, but not otherwise (hypothetical language)

DISALIGN≫IDPSON≫*OBSVOICE, DISALIGN-R≫AGREE[voice], IDENT

/bat/	/pad/	/adpa/	/atba/	/ʤat/	/paʤpa/	/papʤa/
[bat]	[pat]	[atpa]	[atba]	[ʧat]	[paʧpa]	[pabʤa]

Another odd prediction of DISALIGN is spread of [del rel] in voice-unassimilated clusters as a way to avoid voicing assimilation. The mapping /paʤta/→[paʤʧa] satisfies DISALIGN, since [+del rel] is linked to the entire cluster, while [+voice] is linked only to the first segment.

As was shown in §2.2, such solutions do not generalize. A specific DISALIGN constraint on affricate voicing in certain clusters might suffice for Czech, whose gaps *[ʧ, ʤ] form a natural class, but additional DISALIGN constraints would be needed for Russian, where the gaps are not a natural class. Russian [x, ʃʃ] lack robust voiced counterparts just like the affricates do—but the entire set of gaps cannot be isolated with one phonological feature, and it does not make much sense phonetically, as the gaps are non-contiguous in the articulatory tract (recall Table 1).

Thus, in addition to requiring a specific DISALIGN constraint for affricates (picked out by their [delayed release] feature), this analysis would have to recruit two additional, even more specific constraints: DISALIGN[+voice, DOR, +cont] to govern the distribution of [ɣ], and DISALIGN[+voice, −ant, +distributed, +cont] for [ʒʒ]. This is a general problem for a surface constraint account: no simple constraint will do.

5.3 Comparative markedness

Another alternative in the category of adding constraints was suggested to me by Andrew Lamont: McCarthy's (2002b) Comparative Markedness. In this theory, every markedness constraint is split into two versions: old and new. In Russian, *[ʤ]-OLD would penalize faithful voiced affricates (e.g., /noʤ-am/→[noʤam]). The new version, *[ʤ]-NEW, penalizes a voiced affricate not present in the fully faithful candidate—such as one derived by voicing assimilation, /noʧ-bɨ/→[noʤbɨ]. The Russian pattern could be analyzed in terms of the ranking *[ʤ]-OLD, AGREE[voice]≫*[ʤ]-NEW: old/underlying voiced affricates are not allowed, but new/derived ones are.

The question is what happens to these underlying affricates, and how the learner would ever figure this out. The ranking established so far suggests that IDENT-[voice] is the crucially dominated faithfulness constraint: underlying /ʤ/ devoices. But, as McCarthy himself points out, rankings of the shape MARK-OLD≫FAITH≫MARK-NEW are not learnable through basic recur-

[20] The factorial typology was calculated using OT-Help (Staubs et al. 2010).

sive constraint demotion in phonotactic learning (see McCarthy 2002b, §6.3). The only examples where old markedness transitively outranks new markedness in McCarthy's catalog involve counterfeeding opacity—evidence for which must come from morphophonemic alternations, not phonotactics. The nature of the Russian problem is simpler: there are several inventory gaps, but the pattern is transparent, treating all underlyingly voiceless consonants alike.

McCarthy himself anticipates the criticism that Comparative Markedness introduces duplication by splitting every markedness constraint in two. McCarthy counters that, unlike MSCs, old and new markedness constraints can compel and block alternations. But, as we saw in the discussion of loanword adaptation, in Russian, *ʤ-OLD—if it were to exist—does not compel the right kind of alternation, since borrowed affricates fission rather than devoice. Handling this would require multiple faithfulness constraints in addition to splitting markedness constraints into two, way beyond duplication.

5.4 Positional Markedness

Positional neutralization can often be analyzed either in positional faithfulness or markedness terms. I took it for granted that the positional faithfulness account is right, so here, I show that even the positional markedness alternative does not escape the duplication problem.[21] The obvious alternative to *ObsVoice≫Ident[voice] is to ban word-final voicing instead:

(44) NoVoicedPWdCoda: Assign a violation mark for a PWd-final consonant that is [−son,+voice].

Voiced affricates could then be banned by a general constraint *[ʤ], which is outranked by Agree (see (45)):

(45) Analysis of devoicing and agreement, basics

		NoVcdPWdCoda	Agree[voice]	*[ʤ]	Ident[voice]
/bog/	a.☞ bok				*
	b. bog	*!W			L
/notʃ bɨ/	c.☞ noʤbɨ			*	*
	d. notʃbɨ		*!W	L	L
/ʤop/	e.☞ ʧop				*
	f. ʤop			*!W	L

As with nasal place assimilation in (7), we face problems in analyzing the direction of assimilation. To get that right, Ident-Preson could be ranked anywhere, as it just breaks the tie between two assimilated cluster candidates (46c–d). But to get the correct results for clusters that include an affricate, Ident-Preson must dominate *[ʤ], and this leads to a ranking contradiction. If the presumed fate of /ʤop/ in (45) is to devoice, then the ranking cannot be as in (46). We would need a constraint against [ʤ] in presonorant position, and with it returns the duplication problem.

[21] Thanks to Jaye Padgett and Rachel Walker for discussion.

(46) Direction of assimilation requires positional faithfulness to be ranked above *[ʤ]

		NoVcdPWdCoda	Ident-Preson[voice]	*[ʤ]	Ident[voice]
/notʃ bɨ/	a.☞ noʤbɨ			*	*
	b. notʃpɨ		*!W	L	*
/bok bɨ/	c.☞ bogbɨ				*
	d. bokpɨ		*!W		*
/ʤop/	e. ʤop		L	*W	L
	f.✗ ʧop		*		*

A reviewer challenges the assumption that devoicing rather than fission is the right outcome in this analysis (recall that any conclusions about these hypothetical inputs with voiced affricates are guesses, since we never see evidence for them from alternations).[22] If we suppose that underlying /ʤ/ maps to [dz̬] in the grammar in (46), it would have to be because fission is less costly than devoicing—i.e., Integrity is the bottom-ranked constraint. But if that were true, then /ʧ/ would split into [dz̬] in assimilation contexts, too (recall (28) and (38)).

To summarize, the analytic role of positional faithfulness is not only to protect contrasts in certain positions but to determine the direction of assimilation. This aspect of the constraint family makes it necessary for complete analyses of assimilation patterns. Whenever these assimilation patterns involve gapped inventories—which is not rare—positional faithfulness needs to be augmented with a constraint, or several constraints, to block the gappy segments from occurring in positions protected by positional faithfulness. I argue that this situation is unsatisfactory. A simpler analysis is to ban the non-contrastive segments from URs across the board, and to understand their absence in various environments as a consequence of their derived status. If theoretical economy is the goal, then MSCs achieve it better than surface-oriented constraints.

5.5 Stratal OT

The last alternatives I consider are cast in Stratal OT (Kiparsky 2000, Rubach 2000, Bermúdez-Otero 2018), a constraint-based descendant of Lexical Phonology and Morphology (Mohanan 1982, Kiparsky 1982, Kaisse and Shaw 1985). A Stratal OT grammar usually assumes a serial interaction between morphology and phonology. A stem is phonologized in the stem level/stratum. It is then concatenated with affixes, and the result passes through another, possibly different phonological grammar. Clitics and phrasal phonology apply in the postlexical stratum. Stratal OT is argued to be a theory of inventory restrictions: the stem level enforces them.

I discuss three stratal analyses. In the first one, affricates fission into stop-fricative sequences, before either assimilation or devoicing apply. The next two options are suggested by Mackenzie (2022): in the first, affricates become voiced fricatives, and in the second, they devoice. I'll argue

[22]The reviewer also suggests replacing Ident-Preson[voice] with a positional faithfulness constraint that protects voicing in post-consonantal position, Ident-C2[voice]: *VoicedObsCoda≫Ident-C2[voice]≫Agree≫*ʤ≫Ident[voice]. This ranking predicts longer clusters to be more faithful. Russian requires all clusters to assimilate, regardless of length (/k v(e)sʲ-em/ → [k͡fsem] 'to all', not *[kvsem], cf. [v͡esʲ] 'all'). The vowel-zero alternation shows that the medial consonant is underlyingly voiced, but even if Russian lacked such cases, ROTB coupled with the constraint Ident-C2 predicts contrasts in the middle of such clusters.

that fission and frication fail to capture the facts I laid out earlier. The predictions of the third analysis are examined in the last subsection, where I evaluate Stratal OT as general theory of morpheme shape. Depending on the specific assumptions, Stratal OT either makes the wrong predictions for Russian, or has nothing to say about well-documented root-affix asymmetries, which positional faithfulness to roots explains well. Worse still, various published Stratal OT accounts either explicitly or covertly assume MSCs, suggesting the stem level does not suffice as a theory of morpheme shape.

5.5.1 Fission again

Three reviewers suggest that the loanword facts point to the content of the stem stratum. Thus, /ʤ/ fissions to [dz̡] at the stem level (*[ʤ]≫Integrity), and then at some later level, Integrity and Agree are promoted above *[ʤ]. The fission analysis of /ʤ/ cannot be maintained once we zoom out from the posterior affricate to the other gaps, and especially to other loanword facts.

An OT analysis of an unfaithful mapping requires two components. First, unfaithfulness must be driven by a markedness constraint. For /ʤ/→[dz̡], this is *[ʤ] (unproblematically). Second, fission must be the "cheapest" faithfulness violation: Integrity must be ranked below Ident[voice], Ident[cont], Max, etc. Given freedom of analysis, Gen will proffer fission candidates for every input, and it is in dealing with other gaps that this analysis is going to encounter difficulties. The intuition behind fission of /ʤ/ is simple enough: [dz̡] preserves the plosiveness of the first half of the affricate, and the stridency of the second half, at the cost of being unfaithful to each half's place of articulation (and backness, since [ʧ] and [ʤ] are palatalized, unlike [dz̡]). But what about the fission option for other segments that Russian lacks or restricts on the surface? Some of these are listed in (47):

(47) Some fission options to rule out (all phonotactically legal, modulo voicing assimilation)

	Rich base	Fission options	Actual loanword outputs
restricted:	ʤ	dz̡, dʃʃ	dz̡, g
	ɣ	vg, gv, xg, gx	g?
	ʒʒ	tʃ, ʃd, dz̡, z̡d	?
banned:	ŋ	nk, kn, ng, gn	nk, ng, n
	ð	dx, ɣd, dz, dz̡	z
	θ	tx, xt, st, ts	t
	w	kv, vk, ku, gu, xv, xu. . .	v, u

The challenge for a fission analysis is finding a consistent ranking of various Ident constraints that would allow fission for /ʤ/ but rule it out for segments that show no evidence of splitting. Thus, the analysis must countenance the option of /ɣ/ mapping to [xg], a sequence that should be phonotactically licit provided it eventually assimilates in voicing. The same goes for /θ, ð/ splitting into various sequences of stops and fricatives, strident or not—again, there is no evidence for this whatsoever. Some internal logical contradictions arise when we compare loan handling of /w/ and /ŋ/: the dorsal component is preserved in /ŋ/ → [nk] (which looks like fission) but not in /w/→[v]. Why not [xv], a perfectly good Russian onset cluster? It is indeed these internal logical inconsistencies that led me to reject a phonological account of loanword adaptation; no one ranking simultaneously favors /ð/→[z], /θ/→[t], /ŋ/→[nk], etc.

Thus, the fission analysis encounters a dilemma: the ROTB theorist must either make guesses in the absence of evidence as to what illicit inputs map to, or pick and choose which patterns of loanword adaptation constitute phonology, as opposed to being dismissed as analytic residue. The MSC analysis does not attempt to make sense of the chaos.

5.5.2 Mackenzie (2022): affricates become fricatives

According to Mackenzie's (2022) analysis, /ʤ/ is fricated to [ʒ] at the stem-level (see (48a)). Then, in a later stratum, assimilation creates [ʤ] (see (48b)). Just as in my analysis, all instances of [ʤ] are derived from /ʧ/. But ROTB requires the analyst to identify a way to remove the offending structure, with no evidence of its fate. As I show below, this approach encounters a problem anticipated in §2.3: it is impossible to identify one consistent way to remove all the gaps.

(48) The Stratal OT analysis of Mackenzie (2022, tableaux 13–15)

a. Stem-level ranking: *[ʤ], Ident[voice], Ident-Pson[voice] ≫Ident[cont], Agree[voice]

i. /biʧbol/ →biʧbol 'beach ball, loan'

ii. /ʤox/ → ʒox (hypothetical)

b. Phrase-level ranking: Agree[voice]≫Ident[voice], Ident-Pson[voice], Ident[cont]≫*[ʤ]

biʧbol →[biʤbol]

This analysis predicts that /ʣ/ and /ɣ/ should map to [z] and [g] respectively. But the handling of /ʤ/ and /ʒʒ/ is a problem. Mackenzie explains, "nothing crucial hinges on the relative ranking of Ident[voice] and Ident[continuant]. Filtering the rich base to the Russian inventory requires input /dʒ/ to map to some output segment present in the language, whether [ʒ]... or [ʧ], as would be expected if Ident[continuant] outranked Ident[voice]" (Mackenzie 2022:11). But, as I explained in §3.3, there is no freely distributed phone in Russian that matches /ʤ/ in everything but [continuant]. Russian has the [+back] [ʐ], and the [–back] [ʒʒ]—which is homorganic to [ʤ, ʧ], but which also must be banned at the stem level. Mackenzie does not discuss this, and neither do Stratal OT accounts of backness (Rubach 2000, Blumenfeld 2003). Rubach does not mention [ʃʃ, ʒʒ], while Blumenfeld sneaks in MSCs: his account incorrectly predicts that /ʂ/ should palatalize to [ʃʃ] at the word level (e.g., /[mɨʂɨ] 'mice' should be *[mɨʃʃi]), so he suggests that [ʃʃ] should be stored as /ʂtʃ/ (fn. 13). This requires the MSC */ʃʃ/, and presumably, similar logic extends to */ʒʒ/.

Fixing this account requires pinning down the stem level phonology more explicitly than existing Stratal OT attempts have done. No Stratal OT analysis of Russian tackles even a partial set of inputs required by ROTB, or attempts to correlate properties of supposed stem-level or word-level affixes with each other (e.g., backness alternations, First Velar Palatalization, conditioning and undergoing yer deletion, and stress assignment). Critics note that these properties do not cluster together in a way that facilitates a phonological account (Iosad and Morén-Duolljá 2010, Padgett 2010, Jurgec 2016, and beyond Russian, Benua 1997, i.a.). For all the phenomena that were once the purview of Lexical Phonology, there are developed alternatives that allow for better empirical coverage, such as floating features or indexed constraints. Even Stratal OT proponents admit that floating features are needed (Blumenfeld 2003, p.8, Bermúdez-Otero 2018, p.123), so it is not clear what is left for the stem level to do.

5.5.3 Stratal OT as a theory of morpheme structure

The function of the stem level can be challenged from a different angle. Suppose the gapped segments /ʒʒ, ɣ, ʤ, ʧ/ devoice to their voiceless counterparts [ʃʃ, x, ʦ, ʧ], as Mackenzie (2022) suggests in passing. Analytically, this is more viable than fission or [continuant] change. The way to distinguish this option from my account, I argue, is by considering the larger implications of using the stem level as a theory of morpheme shape.

Kiparsky has suggested both in writing on Lexical Phonology (1982, pp.53–54) and Stratal OT that generalizations previously attributed to lexical redundancy rules are enforced at the stem level:

> ". . .the view that stems are domains of constraint evaluation is supported by phonological evidence independent of issues of opaque and cyclic constraint interaction. Indeed, the well-documented existence of well-formedness constraints that hold specifically for stems [. . .] is a major problem for parallelism, and constitutes another telling body of evidence for the stratification of phonology that LPM-OT envisages." (Kiparsky 2000, p.362).

> "A fundamental assumption of LPM is that acquiring the stem-level phonology is tantamount to learning the constraints on lexical (underlying) representations (Kiparsky 1982). Though this is conceptually akin to OT's Lexicon Optimization and Richness of the Base, it differs in relating the lexicon specifically to the STEM LEVEL constraint system, which can crucially differ from the word-level and postlexical constraint systems." (Kiparsky 2000, p.361)

What Kiparsky alludes to in the first quote is presumably minimal size constraints and prosodic shape generalizations, which often hold of stems but rarely, if ever, of affixes (see Gouskova To appear for a recent review). To enact this, illicit stems are filtered out at the stem level, which affixes skip. Affixes are added after a stem-only pass of evaluation, and clitics are added later still, at the post-lexical level. This is known as *level ordering*. While abandoned in some versions of the theory, it still figures in recent Stratal OT analyses (Jaker and Kiparsky 2020). The problem is that level ordering cannot explain another well-documented class of asymmetries between stems and affixes: stems often license a a superset of the segments allowed in clitics and affixes, but the reverse does not happen.

I am not the first to point out that Stratal OT predicts affixes and clitics to license segments banned from stems (Benua 1997, 87ff, Fitzgerald 2002, 267–268, McCarthy 2007, §3.6.1). Filtering gaps at the stem level in a level-ordering theory predicts that Russian should allow [ɣ, ʤ, ʒʒ, ʤ] in affixes and clitics. This is clearly wrong: these morphemes allow [x, ʧ, ʃʃ, ʦ], but not voiced counterparts except those derived by assimilation. The recognition of this prediction has led some versions of Stratal OT to abandon level ordering (Bermúdez-Otero 2018, Staroverov 2020). The problem is that the alternative does not succeed in capturing the existing typology of stem-affix asymmetries.

The two best-established typological asymmetries are (i) roots (or stems) can be subject to a size minimum, while affixes are not size-restricted; (ii) roots license more segmental contrasts than affixes. The size minimum is analyzed successfully in Prosodic Morphology without assuming strata (Selkirk 1995, McCarthy and Prince 1995b, i.a.). The inventory asymmetries have been analyzed in positional faithfulness terms (Parker and Weber 1996, Beckman 1998, Bakovic 2000,

Urbanczyk 2006). Root-affix asymmetries can be be static or dynamic. Quechua is a famous example of a static distributional asymmetry: roots contrast ejective, aspirated, or plain stops, while affixes have only plain stops (Parker and Weber 1996, Gallagher 2016, i.a.). Harar Oromo is an example of a dynamic pattern (Owens 1985:22, Lloret 1997): progressive laryngeal assimilation from root-final consonants to suffix ones (see (49d–i)). Harar also has root-controlled manner assimilation of sonorants (see (49a–c)). Owens's grammar suggests a static asymmetry, too: roots contrast ejectives, plain and voiced stops, while affixes only have plain stops, unless derived by assimilation (exception: reduplicative prefixes).

(49) Harar Oromo root-controlled assimilation patterns (Owens 1985)

Root+Suffix: progressive				UR support:
a.	/$\sqrt{}$ʧ'ap'-t-i/	ʧ'ap't'i	'it F breaks'	[ɗolki-t-i] 'prevent-F-IMP'
b.	/$\sqrt{}$k'ab-t-a/	k'abda	'you have'	[deem-t-a] 'you go'
c.	/$\sqrt{}$meek'-t-e/	meett'e	'you turned'	
d.	/$\sqrt{}$laal-n-e/	laalle	'we watched'	/ark-n-e/ [arkine] 'we saw'
e.	/$\sqrt{}$barar-n-e/	bararre	'we flew'	
Prefix+root: regressive				
f.	/hin-$\sqrt{}$waad-u/	hiwwaadu	'he doesn't bake'	[hin-agar-re]'NEG see PAST'
g.	/hin-$\sqrt{}$laal-n-u/	hillaallu	'we don't observe'	
h.	/hin-$\sqrt{}$raf-t-u/	hirraftu	'you don't lie down'	
i.	/ol-$\sqrt{}$raf-e/	orrafe	'he slept up'	[ol-gatʧe] 'UP returned home'

A non-stratal classic OT account attributes both static and dynamic asymmetries to positional faithfulness to roots (McCarthy and Prince 1994, Beckman 1997, Urbanczyk 2006). The static asymmetry justifies the ranking IDENT-RT[lar]≫{*[voice],*[cg]}≫ IDENT[lar]: plain stops in affixes, a three-way contrast in roots. The dynamic asymmetry in direction of assimilation requires AGREE[laryngeal], IDENT-RT[lar]≫IDENT-PSON[lar]. This analysis must entertain hypothetical input affixes with ejective and voiced stops—a limited rich base. But, unlike a fully ROTB-compliant OT account of absolute neutralization between /n/ and /ŋ/ in Italian (§2.2), this analysis predicts rather than guesses the direction of neutralization: affixes have plain stops. This analysis extends without embellishments to cases of static distributional restrictions, such as Quechua and Navajo (Alderete 2003).

By contrast, Stratal OT offers no obvious account of static or dynamic root-affix asymmetries. If level ordering is assumed, then it is not clear why affixes ever show a less marked inventory than roots. Depending on the differences in ranking between the stem level and later strata, affixes are predicted to have more contrasts or the same contrasts, but not fewer contrasts. Bermúdez-Otero (2018) suggests this problem is alleviated by requiring affixes to pass through the stem level as separate entities, just as stems do—and as evidence, he observes that in some languages, *some* affixes "behave like miniature stems" (p. 111). But this cannot cause all affixes to neutralize contrasts that stems preserve. The theory also fails to explain why in languages like Quechua, affixes are demonstrably non-stem-like in their phonotactics (see (50)). The vast majority of roots are templatic (most are CV(C)CV) and respect the phonotactics of words (e.g., they cannot begin in CC). Quechua affixes, on the other hand, can be subminimal (-C) and begin in consonant clusters:

(50) Quechua roots vs. affixes (see Gouskova and Gallagher 2020, Gouskova To appear, and references therein)

	roots	affixes
Size	89% disyllabic, (C)V(C)CV	-C, -CCV, -CVCV
Begin with	(C)V	-C, -CCV, -CV, -V
End with	overwhelmingly V-final	either C- or -V
Segmental content	ejectives, aspirates allowed	no ejectives, aspirates

The explanation for the reduced inventory in affixes cannot be that they lose those segments while passing through the stem level—the segmental restrictions on stems are too liberal, and prosodic ones are too stringent. There are ways out, of course. Introducing positional faithfulness to roots would do it, and is presumably independently necessary to deal with Harar Oromo-style root-controlled assimilation. But then the stem level does no work in explaining segmental asymmetries.

Echoing Blumenfeld's (2003) use of (covert) MSCs, there is a long tradition of non-OT approaches resorting to representational explanations for dynamic asymmetries in terms of underspecification (see Bakovic 2000 for a critique). Underspecification allows directionality to follow from the need to build (but not change) structure. For example, one could claim that Harar Oromo stops are obligatorily unspecified for laryngeal features *in affixes*. This is not a straw man: in a Stratal OT account of Tetsǫ́t'iné, Jaker and Kiparsky (2020) and Jaker (2022) attribute various root-affix asymmetries to underspecification. Affixes are argued to lack moras, and Jaker formulates the underspecification requirement as a MSC. Thus, Stratal OT does not succeed in capturing generalizations about morpheme shapes by means of the stem level alone.

To summarize, I think there are several critical problems with the idea that the stem level can replace the function of MSCs in Stratal OT. MSCs are either overtly assumed in Stratal OT analyses or are hidden in the background, but Russian has a sufficiently rich phonology to falsify guesses about the fate of hypothetical rich inputs.

6 Conclusion

This paper revisited an old phonological debate: should the input to the grammar be restricted on a language-specific basis, or is it enough for the grammar to refer only to surface representations? My argument was based on Russian facts, whose significance was originally pointed out by Morris Halle in a critique of structuralist phonemics. Halle noted a duplication problem in structuralist approaches to gapped inventories: some rules must be stated twice. I argued that the same problem arises in constraint-based grammars. Most constraint-based theories require constraints to refer to surface representations—the input is unrestricted. I suggested that restricting the input offers the best analysis of positional neutralization with inventory gaps. This proposal requires abandoning the putatively simpler theory where markedness constraints refer only to outputs, and faithfulness constraints refer to input-output disparities. The addition of input-only constraints (MSCs), I suggested, offers a simpler analysis of segments that occur only in assimilation contexts. Moreover, I adduced evidence from loanword adaptation that gaps are enforced by constraints that do not interact with a faithfulness ranking; there is no consistency in how

the illicit segments are handled. I argued instead that the loanword patterns involve conventional mappings, as in Simonovic's (2015) theory of loanword integration. These mappings serve to enforce MSC restrictions but are agrammatical, which explains their internally inconsistent character. The argument is that MSCs are constraints without a specific recipe for ridding the language of the offending structures.

Duplication is a general problem in positional neutralization of gapped contrasts. If the argument for Richness of the Base is that it avoids the duplication problem, then this class of cases constitutes a counterargument. Assuming unconstrained inputs requires the analysis to handle certain segments twice, just as in pre-generative structuralist phonemics. The way forward is to accept that there are, indeed, interesting generalizations to be made about the shapes of morphemes in languages, and some of these generalizations might be stated at a fairly abstract level. We cannot do all of phonology by referencing only surface phonological words; we need to worry about the lexicon.

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