Positional Faithfulness, Sympathy, and Inferred Input

0. Introduction

It has been observed in the literature that certain positions and segment types—which may be considered perceptually prominent—are more resistant to phonological changes, compared to less prominent counterparts. For instance, prevocalic consonants are rarely targeted in place assimilation, compared to preconsonantal ones. For a formal analysis of such asymmetries within the framework of Optimality Theory (Prince and Smolensky 1993; McCarthy and Prince 1993, 1995), Positional Faithfulness (most notably, Beckman 1998) has been invoked as a main mechanism. Various processes including place assimilation, deletion, and voicing assimilation have been analyzed under Positional Faithfulness.[1] The present study shows that the standard Positional Faithfulness approach cannot account for any asymmetries observed in consonant deletion typology (cf. Wilson 2001). We propose an alternative approach by adopting the conception of inferred input (Steriade 1997) and the formal mechanism of Sympathy Theory (McCarthy 1998, 1999).

The organization of this paper is as follows. The first section provides a brief introduction of the standard Positional Faithfulness approach. In section two, after discussing asymmetries involving released stops in place assimilation and consonant deletion, we will consider how to analyze the asymmetries within the framework of Positional Faithfulness. It will be shown that the standard analysis can correctly account for the asymmetries of place assimilation, but it cannot be extended to the same asymmetries of consonant deletion. In section three, we propose an alternative mechanism that can deal with the asymmetries in both place assimilation and consonant deletion. In section four, apparent exceptions to the proposed mechanism will be discussed. In section five, we consider an alternative approach, where Sympathy Theory is adopted, with no revision, in implementing the idea of Positional Faithfulness. Finally, section six summarizes conclusions of the present study.

1. Positional Faithfulness

The present study is mainly concerned with the following three asymmetries. In intervocalic C_1C_2 clusters, C_2 is rarely targeted in place assimilation (Webb 1982; Ohala 1990; Mohanan 1993; Steriade 1995, 2001; Jun 1995, to appear; Beckman 1998), consonant deletion (Steriade 2000; Wilson 2001; Côté 2000), and voicing assimilation (Steriade 1997, 2000; Beckman 1998; Lombardi 1996), compared to C_1. This positional asymmetry will be referred

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[1] Relevant references include Steriade (1995, 2000), Jun (1995, to appear), Casali (1996), Lombardi (1996, 1999), Kirchner (1998), Boersma (1998), Fleischhacker (2001, 2002) and Côté (2000).

to as C_2 dominance effect throughout the paper. The remaining two asymmetries involve specific segment types, fricatives and released stops. Fricatives, especially sibilants and stridents, are rarely targeted in place assimilation (Kohler 1990, 1991; Mohanan 1993; Jun 1995, to appear) and consonant deletion (Steriade 2000; Côté 2000), compared to stops (as well as nasals and non-strident fricatives). Released stops likewise are rare targets of place assimilation, compared to unreleased stops (Kohler 1990, 1991; Lamontagne 1993; Steriade 1997). These three position/segment-specific asymmetries are chosen because they are useful in identifying the characteristic properties, as well as unavoidable problems, of the standard Positional Faithfulness approach.

In most recent discussions of the positional/segmental asymmetries, it has been claimed or assumed that they are related to relative perceptibility of phonological elements involved: less likely target positions/segments in phonological changes are perceptually more prominent than more likely ones.[2] Within the framework of Optimality Theory, it has been proposed that such relative perceptibility differences motivate the projection of higher-ranked Faithfulness constraints for prominent positions/segments, relative to corresponding context-free Faithfulness constraints or those for non-prominent ones.[3] Some Position/segment-specific Faithfulness (henceforth, PF) constraints proposed in the literature are shown below:

(1) PF constraints for the analysis of place assimilation

a. C_2 dominance effect: IDENT-**onset**(place) >> IDENT(place) (Beckman 1998)

b. Rare target of fricatives, compared to stops:

$$\text{PRESERVE}(\text{pl}(\underset{[+\text{cont}]}{\underline{\quad\quad}}\ \text{C})) >> \text{PRESERVE}(\text{pl}(\underset{[\text{stop}]}{\underline{\quad\quad}}\ \text{C}))$$ (Jun 1995, to appear)

c. Rare target of released stops, compared to unreleased stops:

$\text{MAX}_{\textbf{REL}}(\text{PLACE}) >> \text{MAX}(\text{PLACE})$ (Padgett 1995)[4]

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[2] Steriade (1999, 2000, 2001) and Côté (2000) provide convincing arguments that prosody/syllable-based approaches fail to explain the positional/segmental asymmetric patterns for laryngeal neutralization, place assimilation, consonant deletion and vowel epenthesis; instead the Licensing-by-Cue approach—where the asymmetries are derived rather directly from the relative perceptibility of segments or contexts involved–can correctly capture the asymmetries.

[3] An alternative mechanism involves position/segment-specific Markedness constraints (Steriade 1995, 1999; Zoll 1996, 1998; Hume 1999; Zhang 2001). In the present study, no aspects of this alternative, which may be called Positional Markedness, will be discussed. See Wilson (2001) for the criticism on the Positional Markedness approach for consonant deletion and Zoll (1998) for a discussion of the comparison between Positional Faithfulness and Markedness theories.

[4] Padgett proposes $\text{MAX}_{\text{REL}}(\text{PLACE})$ for the purpose of explaining the C_2 dominance effect

(2) PF constraints for the analysis of consonant deletion

a. C_2 dominance effect: MAX-C/**__V** >> MAX-C/V__ (Côté 2000)

b. Rare target of fricatives, compared to stops:

MAX-C(**-stop**) >> MAX-C (Côté 2000)

MAX strident/C_C >> MAX[-cont]/C_C (Steriade 2000)

In the above pairs of universally ranked Faithfulness constraints, higher-ranked ones refer to perceptually more prominent positions/segments, such as onsets or prevocalic consonants (as opposed to codas or preconsonantal ones); continuants, non-stops or strident fricatives (as opposed to stops); and released consonants (as opposed to unreleased ones). These Faithfulness constraints interact with (Markedness) constraints triggering the changes to produce attested asymmetric patterns. The following tableau from Beckman (1998: 109) shows how the PF approach can analyze the C_2 dominance effect in Tamil nasal place assimilation:

(3) Analysis of Tamil nasal place assimilation (Beckman p. 109)

/pasan̪ + kaɭ/	ID-ONSET(place)	*LAB	*DORS	*COR	IDENT(place)
a. ☞ pa.sɛŋ.gɛ		p	ŋg	s	*
b. pa.sɛn̪.d̪ɛ	*!	p		s, n̪d̪	*
c. ta.sɛn̪.d̪ɛ	**!			t, s, n̪d̪	**

The crucial ranking here is ID-ONSET(place) >> Markedness constraints >> IDENT(place). Candidates (3b, c), with progressive assimilation, violate the high-ranking ID-ONSET(place) which requires the identity in place features between an onset segment and its input correspondent. In contrast, candidate (3a) with regressive assimilation obeys the higher-ranked PF constraint, violating only the lower-ranked IDENT(place) and Markedness constraints, and thus is optimal.

All PF constraints must refer to certain (prominent) positions or segment types which we will call the constraint focus in the remainder of this paper. One implicit assumption concerning the constraint focus in the PF literature is that the focus may be either input or output forms. Indeed, most PF approaches proposed thus far employ the output, not input, as the constraint focus. This reference to the output is clear from their definitions of PF constraints, as shown below, and conventional assumptions on phonological units involved.

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under the assumption that prevocalic C_2 is always released.

(4) MAX$_{REL}$(PLACE) (Padgett 1995: 19)

Let S be a [+release] **output** segment. Then every place feature in the input correspondent of S has an output correspondent in S.

(5) IDENT-ONSET(place) (Beckman 1998: 105)

A segment in the **onset** of a syllable and its input correspondent must have identical Place specifications.

Here, released and onset segments in the output are mentioned as the focus, directly, for MAX$_{REL}$(PLACE) and, less directly, for IDENT-ONSET(place), respectively. This adoption of the output focus is also clear from the conventional assumptions that distinctions between coda vs. onset and released vs. unreleased are specified only on the surface.[5]

To summarize, in the standard PF approach—which is proposed to analyze positional/segmental asymmetries—the output, not input, has been employed as the focus of PF constraints.

2. Released stops

As mentioned earlier, it has been noted in the literature (Kohler 1990, 1991; Ohala 1990; Jun 1995; Padgett 1995) that released stops are rarely targeted in place assimilation, compared to unreleased stops. This cross-linguistic generalization has been subsumed under the C_2 dominance effect since prevocalic C_2 stops are always released whereas preconsonantal C_1 may be unreleased. However, it seems that the generalization is not confined to released stops in C_2 position. Preconsonantal C_1 stops may be released, and they are also resistant to phonological changes such as place assimilation.

This asymmetry involving released C_1 stops follows from a claim in the articulatory phonology (e.g. Browman & Goldstein 1989, 1990, 1992; Byrd 1992) that much-overlapped consonants are more likely subject to casual speech weakening processes, such as place assimilation and deletion, than little-overlapped ones. Notice that in preconsonantal position, the distinction between released vs. unreleased stops may be equivalent with that between much- vs. little-overlapped ones, since the release status of C_1 stops mostly depends on the degrees of inter-consonantal overlap: specifically, C_1, which slightly overlaps with C_2, may be released, whereas much overlapped C_1 is necessarily unreleased (Ladefoged 1993; Lamontagne 1993; Wright 1996 among others).

[5] Below, we will discuss a possibility that such distinctions can be made underlyingly, and the input is adopted as the focus of PF constraints.

To verify the claim that released—as opposed to unreleased—stops in C_1 position are rare targets in place assimilation and consonant deletion, consider two cases in which degrees of inter-consonantal overlap typically differ. First, different languages may employ different canonical degrees of inter-consonantal overlap. It has been observed that many contrasts including place feature contrast in consonant clusters are neutralized in languages with significant interconsonantal overlap, whereas most contrasts can be maintained in languages with no such overlap (Browman & Goldstein 1992, Lamontagne 1993, Steriade 1999). Languages—in which pre-obstruent C_1 stops are canonically released, and thus must be little overlapped with C_2—include Twana; Arabic, Wikchamni, Tillamook (Lamontagne 1993); Chontal (Keller 1959: 45), Hindi (Rhee 1999), Motilone (Hanes 1952), Kutenai (Garvin 1948), Upper Chehalis (Kinkade 1963), Zoque (Wonderly 1951), Russian (Jones and Ward 1969, Zsiga 2000). In all these languages, various heterorganic obstruent clusters are observed, and thus stop place assimilation and deletion do not occur, confirming the dispreference for released C_1 targets. In contrast, in languages—where C_1 stops are targeted in place assimilation or deletion—, canonical forms of preconsonantal (or word-final) stops are unreleased. For instance, stop place assimilation occurs in German (Kohler 1992), Korean (Kim-Renaud 1974), English, Malay, Thai (Lodge 1986, 1992), Yakut (Krueger 1962), and Catalan (Pilar Prieto, p.c.), in which preconsonantal (or word-final) C_1 stops are typically unreleased. In addition, C_1 stops delete in Diola-Fogny (Sapir 1965), English (Guy 1980, Neu 1980), German (Kohler 1992), Thai, Malay (Lodge 1986, 1992), West Greenlandic (Rischel 1974), Basque (Côté 2000). Again, in these languages, canonical forms of preconsonantal (or word-final) C_1 stops are unreleased.[6] In the absence of counter-examples, we assume that the dispreference for released C_1 targets in place assimilation and consonant deletion is robust cross-linguistically.

In addition, degrees of inter-consonantal overlap may differ according to speech rate/style. Adjacent consonants overlap more significantly in casual/fast speech than in slow/formal speech. It is well known in the literature (Browman and Goldstein 1989, 1990, 1992; Kohler 1990, 1991, 1992; and many others) that reduction processes such as assimilation and deletion occur more often in casual/fast speech than in slow/formal speech. For instance, for an English phrase ‘late call’, there are several alternative pronunciation forms: [let˺ kɔl] and [lekkɔl] (casual/fast speech); and [let^{L} kɔl] (formal/slow speech) (cf.

[6] Unreleased C_1 stops can be observed in languages displaying optional deletion, such as English and German. By contrast, if deletion is obligatory, and thus preconsonantal stops are never attested, it would be impossible to see whether preconsonantal stops are released or not. Languages such as Diola-Fogny seems to belong to such cases. However, based on the fact that “in final position and before a pause [a stop] is optionally unreleased” (Sapir 1965: 5), we assume that preconsonantal stops would be unreleased in Diola-Fogny.

Barry 1985). The assimilated form [lekkɔl] occurs mainly in casual speech—where C_1 stops are typically unreleased as in [let˺ kɔl]—, but not in formal speech—where C_1 stops are released as in [let^L kɔl]. This confirms the claim that little-overlapped, thus released, C_1 stops are rare targets in assimilation compared to much-overlapped, thus possibly unreleased, C_1 stops.

In summary, little-overlapped, released, C_1 stops are rarely involved as a target in place assimilation and deletion, compared to much-overlapped, unreleased, C_1 stops.[7] Indeed, even a more strict generalization seems true: released C_1 stops are never targeted.[8] In discussing how to formally capture this asymmetry, we now consider the standard PF analyses of place assimilation and consonant deletion.

2.1 Place Assimilation

To explain the resistance of released C_1 stops to place assimilation, we may adopt the high-ranking PF constraint MAX$_{REL}$(place) (Padgett: 1995), as shown below.

(6) Fixed universal rankings

a. MAX$_{REL}$(place) >> MAX(place)

b. MAX$_{REL}$(place) >> *[αplace][βplace]

Here we take *[αplace][βplace] as a constraint prohibiting heterorganic consonant clusters.[9] The ranking in (6a) would capture the fact that released C_1 stops are less likely to be targeted in place assimilation than unreleased ones, and the one in (6b) the fact that released C_1 stops

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[7] This does not mean that mere overlap yields place assimilation or deletion. As shown in Jun's (1996) experimental study on Korean and English labial-initial stop clusters, place assimilation cannot be the result of mere gestural overlap; instead, gestural reduction is the necessary condition for the occurrence of place assimilation. We believe that the role of interconsonantal overlap in the occurrence of place assimilation is somewhat indirect. Significant interconsonantal overlap will reduce the perceptibility of the C_1 stop by making it unreleased, whereas little overlap will not significantly affect the C_1's perceptibility by making it released. This perceptibility difference leads to the difference in the relative ranking of Faithfulness constraints for released and unreleased C_1 stops. Then, Faithfulness constraint for unreleased C_1 is likely to be outranked by a Markedness constraint, which has the effect of reducing the target consonantal gesture. See Jun (to appear) for a more detailed discussion of this issue.

[8] The same generalization is not true for voicing assimilation. For instance, in Russian, a stop in C_1 position is normally released; nonetheless, it assimilates, in voicing, to the following obstruent.

[9] This constraint is chosen as one of many possible constraints triggering place assimilation including AGREE, ALIGN, and SPREAD; none of our claims should crucially rely on this choice.

are never targeted.

With these PF constraints and universal rankings at hand, consider how to block place assimilation in languages such as Zoque where preconsonantal C_1 stops are required to be released as stated below:

(7) RELEASE
Release stops in preconsonantal position (or ‘do not overlap adjacent consonants’)

The tableau below illustrates a standard PF analysis of the absence of place assimilation in Zoque:

(8) PF analysis (with output focus): Zoque, /petkuy/ → [pet^L kuy] ‘broom’

/petkuy/	RELEASE	MAX$_{REL}$(place)	*[αpl][βpl]	MAX(place)
a. pet˺ kuy	*!		*	
b. ☞ pet^L kuy			*	
c. pek^L kuy		*!		*
d. pekkuy	*!			*

The ranking employed above is consistent with universal rankings in (6). Candidates (8a, d), with unreleased C_1 stops, violate top-ranked RELEASE although they satisfy the other dominant MAX$_{REL}$(place) vacuously. Of candidates (8b, c) in which C_1 stops are released, and thus satisfies RELEASE, only candidate (8b) preserves underlying coronal place in C_1 position, satisfying MAX$_{REL}$(place), and thus is optimal. Here high-ranked MAX$_{REL}$(place) plays a crucial role in preventing place assimilation in (8c).

The same mechanism should be able to derive the occurrence of place assimilation in languages such as Yakut where stops in C_1 position are typically unreleased. In such languages with unreleased C_1 stops, we assume a constraint below is dominant:

(9) *RELEASE:
Do not release stops in preconsonantal position (or ‘overlap adjacent consonants’)

The tableau below illustrates a standard PF analysis of the occurrence of place assimilation in Yakut:

(10) PF analysis (with output focus): Yakut, /at+ka/ → [akka] ‘to a horse’

/ at+ka /	*RELEASE	MAX$_{REL}$(place)	*[αpl][βpl]	MAX(place)
a. at˺ ka			*!	
b. at^{L} ka	*!		*	
c. ☞ akka				*
d. ak^{L} ka	*!	*		*

Candidates (10b, d) include released C_1 stops, thus violating top-ranked *RELEASE. Candidates (10a, c), with unreleased C_1 stops, obey the two top-ranked constraints. Between the two candidates, only candidate (10c) obeys the next-ranked Markedness constraint prohibiting heterorganic clusters, and thus is optimal.

In summary, the standard PF approach to place assimilation can correctly account for the asymmetry involving released C_1 stops. Here the output is employed as the focus of PF constraints. Let us now consider a possibility that the input, not output, is employed as the focus of PF constraints, reformulating MAX$_{REL}$(place) as below:

(11) MAX$_{REL}$(PLACE)

Let S be a [+release] **input** segment. Then every place feature in S has an output correspondent.

The following tableaux are for the patterns of Zoque and Yakut.

(12) PF analysis (with input focus): Zoque, /pet^{L}kuy/ → [pet^{L} kuy] ‘broom’

/pet^{L}kuy/	RELEASE	MAX$_{REL}$(place)	*[αpl][βpl]	MAX(place)
a. pet˺ kuy	*!		*	
b. ☞ pet^{L} kuy			*	
c. pek^{L} kuy		*!		*
d. pekkuy	*!	*		*

(13) PF analysis (with input focus): Yakut, /at+ka/ → [akka] ‘to a horse’

/at˺ka/	*RELEASE	MAX$_{REL}$(place)	*[αpl][βpl]	MAX(place)
a. at˺ ka			*!	
b. at^{L} ka	*!		*	
c. ☞ akka				*
d. ak^{L} ka	*!	_		*

MAX$_{REL}$(place) here can be violated only when stops in C_1 position are released in the input, and thus all candidates in (13)—whose input includes unreleased C_1 stops—satisfy MAX$_{REL}$(place) vacuously. If we compare violation marks in the above tableaux with those in

(8, 10), there are minor differences: insertion of a mark in (12d) and deletion of a mark in (13d), both marked with an underline. The same output candidates are chosen as optimal forms. Thus, one might think that the PF approach employing the input focus accounts for the asymmetry involving released C_1 stops as well as that employing the output focus does.

However, there are problems with the input focus. For such analyses shown in (12, 13), the input specification of the feature [release] is necessary: e.g. /pet^{L}kuy/ and /at˺ka/. This is not compatible with the conventional assumption that no released/unreleased distinction is made in the underlying representation. Furthermore, it causes some serious problems for principles of Optimality Theory. The [release] specifications have to be consistent within the same language (and same speech rate/style). For instance, it must be assumed that C_1 stops are always [+release] in the input in languages, such as Zoque, with released C_1 stops on the surface. If some C_1 stops are allowed to be [-release] in the input, the high-ranking MAX$_{REL}$(place) will be satisfied vacuously, and thus place assimilation may occur. This will violate the cross-linguistic generalization that released stops are never targeted in place assimilation. To ensure the consistent feature specifications, language-specific constraints on the input are needed. This will violate the 'Richness of the Base' Principle (Prince and Smolensky 1993). In addition, such language-specific input constraints would require exactly the same pattern of feature specifications as the corresponding output constraints. For instance, in languages where C_1 stops are typically released, both input and output constraints for the [release] feature would require the specification of [+release] for preconsonantal stops. This causes a type of duplication problem (Kenstowicz and Kisseberth 1977).

In conclusion, the PF approach to place assimilation can correctly account for the asymmetry involving released C_1 stops, only when the output, but not input, is employed as the focus of PF constraints.

2.2 Deletion

This section discusses a PF analysis of the asymmetry involving released C_1 stops in consonant deletion. To begin, it will be useful to consider the motivation of the present discussion. As mentioned earlier, same positional/segmental asymmetries have been observed in both place assimilation and consonant deletion: for instance, C_2 dominance effect and the resistance of fricatives and released stops. If Positional Faithfulness is a right theory for the analysis of asymmetries in place assimilation, it should be able to account for the same asymmetries of consonant deletion in similar ways. In fact, PF constraints have been proposed for the analysis of the asymmetries in consonant deletion, as shown in (2). However, as discussed and concluded by Wilson (2001), asymmetries in consonant deletion are not analyzable within the standard PF approach. This paper, while discussing a different type of data and different PF constraints, provides additional arguments for Wilson's conclusion. Specifically, this section focuses on the data displaying the asymmetry involving released C_1 stops. We think this asymmetry is important since, as shown above, a correct PF analysis of the asymmetry in place assimilation requires the output focus, justifying the general adoption of the output focus in the standard PF approach. In addition, an Optimality-Theoretic analysis of consonant deletion normally involves segmental—as opposed to featural—Faithfulness constraints, and thus this section will be mainly concerned with MAX-C type constraints.

To explain the resistance of released C_1 stops to consonant deletion, we will extend the standard PF analysis, presented above, for place assimilation. Based on constraints and universal rankings employed in the analysis of place assimilation in (6), we may propose the following constraints and universal rankings:

(14) Fixed universal rankings

a. MAX_{REL}-C >> MAX-C

b. MAX_{REL}-C >> *CC

Here we take *CC as a constraint prohibiting the occurrence of two consecutive consonants, and thus triggering consonant deletion. The ranking in (14a) would capture the fact that released C_1 stops are less likely to be targeted in consonant deletion than unreleased ones, and the one in (14b) the fact that released C_1 stops are never targeted. What could be the proper definition of MAX_{REL}-C? A simple extension of the definition, given in (4) above, of MAX_{REL}(place) would provide a following definition:

(15) MAX_{REL}-C (with output focus)

Let S be a [+release] **output** consonant. Then the input correspondent of S must have an output correspondent.

Notice that the evaluation of this constraint will be meaningless since it can never be violated. There are only two logical possibilities: an output candidate may include a released stop or not. In the latter case, MAX_{REL}-C will be satisfied vacuously. In the former case, in which a released stop is included in the candidate, the stop is the output correspondent of its corresponding input segment, thus obeying MAX_{REL}-C.[10] Obviously, MAX_{REL}-C would play no role in the selection of an optimal candidate. Therefore, the loss of released and unreleased

[10] Even if there is no corresponding input segment for a released output segment, it would violate DEP-C, not MAX-C.

stops cannot be differentiated in the constraint evaluation. This point will be clear in the standard PF analysis of the Zoque pattern below:

(16) PF analysis (with output focus): Zoque, /petkuy/ → [pet^{L} kuy] 'broom'

/petkuy/	RELEASE	MAX$_{REL}$-C	*CC	MAX-C
a. pet˺ kuy	*!		*	
b. ☹ pet^{L} kuy			*!	
c. ☞ pe kuy				*

A ranking here is consistent with universal rankings in (14), but it derives a wrong optimal output in which C_1 deletes. MAX$_{REL}$-C is expected to prevent C_1 deletion in Zoque. However, it cannot since no released C_1 stop is present in candidate (16c), with deletion, and thus PF constraint, MAX$_{REL}$-C, is vacuously satisfied. This type of analysis can produce the correct output for languages such as Diola Fogny, with unreleased C_1 stops:

(17) PF analysis (with output focus): Diola Fogny, /let+ku+jaw/ → [lekujaw] 'they won't go'

/ let + ku + jaw /	*RELEASE	MAX$_{REL}$-C	*CC	MAX-C
a. let˺ kujaw			*!	
b. let^{L} kujaw	*!		*	
c. ☞ le kujaw				*

According to this analysis, stops in C_1 position may delete, regardless of whether it is canonically released or not in a language under consideration. Therefore, the asymmetry in the target of deletion between released and unreleased stops cannot be captured. The problem is not specific for the asymmetry involving released C_1 stops. None of asymmetries observed in consonant deletion can be analyzed in the standard PF approach. For instance, to account for the resistance of fricatives to consonant deletion, one might propose the high-ranking MAX-C type constraint for fricatives, e.g. MAX$_{FRICATIVE}$-C. Notice that once C_1 is deleted, there would be no way to distinguish between fricative deletion and stop deletion in the output. Likewise, to explain the C_2 dominance effect in consonant deletion, one might rely on the high-ranking MAX-C type constraint for prevocalic consonants, e.g. MAX-C/_V. Again, there would be no way to distinguish between C_1 deletion and C_2 deletion in the output: both [VC_1V] and [VC_2V] will satisfy the dominant MAX-C/_V. The source of the problem is lack of crucial perceptibility information in the output. In the standard PF theory, high-ranked PF constraints refer to perceptually more prominent positions and segments in the output, for a purpose of preventing changes in those prominent units. However, when perceptually prominent units delete, they are not present any more in the output, and thus the high-ranked

PF constraints would be satisfied vacuously. In other words, in the case of total deletion, there is no way to distinguish between perceptually more and less prominent units in the output. As a result, insofar as the output is the focus of PF constraints, no asymmetries in consonant deletion can be captured. One might attempt to analyze the asymmetries by employing the input focus. Such an attempt, however, would be subject to the problems discussed in the previous section, such as violation of the 'Richness of the Base' Principle and 'duplication' problem.

In conclusion, Positional Faithfulness cannot account for any of position- and segment-specific asymmetries observed in consonant deletion, regardless of whether it employs the output or input as the focus of PF constraints involved.

3. Inferred input

This section presents an alternative PF approach to deal with positional/segmental asymmetries observed in both place assimilation and consonant deletion. From discussions provided in the previous section, it follows that in order for PF constraints to function properly, it is necessary to have access to an input segment's perceptibility information such as stop releasing even when the segment fails to surface. To employ the constraint focus which can incorporate such perceptibility information, we adopt the conception of inferred input (Steriade 1997). Steriade defines the inferred input as a hypothesized phonetic interpretation of the input. The inferred input is then identical with the input except that it includes all phonetic details. Thus, we assume that perceptibility information including the stop releasing pattern is available in the inferred input.

We should now consider how to formalize the conception of the inferred input. For such a purpose, we rely on Sympathy Theory (McCarthy 1998, 1999). To begin, here is a brief introduction of Sympathy Theory. Its original purpose is to account for phonological opacities. For instance, in Tiberian Hebrew, vowel epenthesis and ʔ-deletion occur as shown in (18a,b).

(18) Interaction of epenthesis and [ʔ]-deletion in Tiberian Hebrew (from McCarthy 1999 #2)

a. Epenthesis into final clusters:

/melk/ → mele̱x 'king'

b. ʔ-Deletion outside onsets

/qaraʔ/ → qãrã 'he called'

c. Interaction: epenthesis → ʔ-deletion

/dešʔ/ → deše̱ʔ → deše 'tender grass'

An epenthetic vowel is inserted in a word-final cluster (18a). Independently, [ʔ] deletes in the coda (18b). As shown in (18c), the interaction of epenthesis and [ʔ]-deletion has been traditionally analyzed in terms of the counter-bleeding order: UR /dešʔ/ first undergoes the epenthesis, and then the epenthesized intermediate form [dešeʔ] undergoes [ʔ]-deletion, deriving the surface form [deše]. The actual output includes a gratuitous epenthetic vowel. This type of surface opacity has been a serious problem for parallel versions of Optimality Theory. In Sympathy Theory, one failed candidate is chosen as the model which all the other candidates are required to resemble. Its selection primarily relies on a designated input-to-output (IO) Faithfulness constraint. The model form, which is called the sympathetic candidate, must obey the designated IO faithfulness constraint, which is called the sympathy-selector. There are usually several candidates which obey the sympathy-selector. Among those obeying the selector, the candidate which is most harmonic with respect to the rest of the constraints is chosen as the sympathetic candidate. In Tiberian Hebrew, the sympathy selector is MAX-C. Once the sympathy candidate is chosen, all the other candidates are required to resemble this model candidate through candidate-to-candidate faithfulness, i.e. Sympathy. In the Tiberian Hebrew example, a crucial sympathetic faithfulness constraint is ❀MAX-V which requires preservation of vowels of the sympathetic candidate. Notice that an actual output [deše] resembles [dešeʔ] more than the transparent competitor [deš] does in that [deše] preserves all the vowels of [dešeʔ]. This Sympathy analysis of Tiberian Hebrew data is illustrated by the following tableau.

(19) Sympathy analysis of Tiberian Hebrew (slightly modified from McCarthy 1999 #5)

	/ dešʔ/	CODA-COND	*COMPLEX	❀MAX-V	☆MAX-C	DEP-V
opaque	a.☞ deše				*	*
transparent	b. ☜ deš			*!	*	
sympathetic	c.❀ dešeʔ	*!				*
faithful	d. dešʔ	*!	*!	*!		

Base on this formalism, we propose that the inferred input be the most harmonic one among candidates which obey ALL context-free IO Faithfulness constraints (cf. McCarthy

2002).[11] This proposal can be compared with the selection of a sympathetic candidate in standard Sympathy Theory in which only one particular Faithfulness constraint plays a role. Since the inferred input itself is a candidate, PF constraints would be a type of candidate-to-candidate faithfulness. PF constraints are different from sympathetic faithfulness constraints in that the former requires faithfulness to the inferred input whereas the latter faithfulness to the sympathetic candidate.

In summary, in proposing an alternative PF approach, we adopt Steriade's (1997) conception of inferred input, and formalize its selection and faithfulness by relying on Sympathy Theory (McCarthy 1998, 1999). We will first demonstrate how the proposed mechanism analyzes the asymmetries in consonant deletion and place assimilation. We will then consider a factorial typology of constraints involved.

3.1 Deletion

Consider the analysis of the asymmetry involving released C_1 stops in deletion. Under the mechanism proposed above, MAX$_{REL}$-C is defined as a constraint prohibiting the deletion of a released stop in the inferred input as shown below:

(20) MAX$_{REL}$-C

Every [+release] segment in the **inferred input** has a correspondent in the output.

Its constraint interaction is limited by the following universal rankings in (14), repeated below:

4

(21) Fixed universal rankings

a. MAX$_{REL}$-C >> MAX-C

b. MAX$_{REL}$-C >> *CC

The following tableau illustrates the analysis of the Zoque pattern:

[11] McCarthy (2002) also employs a very similar, if not exactly same, formal concept, 'the fully faithful candidate', in proposing Comparative Markedness theory. His use of such concept is mainly for the revision of the Markedness constraint mechanism, unlike in the present study focusing on the revision of the Faithfulness constraint mechanism. It should be interesting to note that the two approaches independently claim for the use of such similar concept in revising the two major types of constraints in Optimality Theory. Also, notice that the present approach is not subject to such circularity problem in selection of the inferred input as McCarthy (2002: 39) discusses concerning the selection of the fully faithful candidate in Comparative Markedness approach, in which the markedness constraints cannot be evaluated without knowing what the fully faithful candidate is.

(22) PF analysis (with inferred input focus): Zoque, /petkuy/ → [pet^L kuy]

input = /petkuy/	RELEASE	MAX$_{REL}$-C	*CC	MAX-C
a. pet˺ kuy	*!		*	
b. ☞ √ pet^L kuy			*	
c. pe kuy		*!		*

Candidate (22b) is an inferred input, marked with √, since it is the most harmonic one among candidates which obey all IO Faithfulness constraints. It crucially obyes dominant RELEASE. The coronal stop in the inferred input is released, and thus MAX$_{REL}$-C is active in the candidate evaluation. Candidate (22c), with C_1 deletion, violates this high-ranking PF constraint, and cannot be optimal. Candidate (22a), with an unreleased C_1 stop, violates dominant RELEASE. As a result, candidate (22b), i.e. the inferred input, is optimal, indicating released C_1 stops are never targeted in consonant deletion.

The same mechanism derives consonant deletion in languages, such as Diola Fogny, where C_1 stops are assumed to be unreleased. A ranking, which is consistent with the universal rankings in (21), is adopted, as shown below:

(23) PF analysis (with inferred input focus): Diola Fogny, /let+ku+jaw/ → [lekujaw]

input = /let+ku+jaw/	*RELEASE	MAX$_{REL}$-C	*CC	MAX-C
a. √ let˺ kujaw			*!	
b. let^L kujaw	*!		*	
c. ☞ le kujaw				*

Candidate (23a) is an inferred input since it is the most harmonic one among candidates which obey all IO Faithfulness constraints. Notice that it obeys dominant *RELEASE. The coronal stop in the inferred input is unreleased, and thus MAX$_{REL}$-C is vacuously satisfied in the candidate evaluation. Candidate (23b) violates dominant *RELEASE. The inferred input (23a) violates the next ranked Markedness constraint *CC. Candidate (23c), with C_1 deletion, obeys all the high-ranked constraints, and thus is optimal. This indicates that unreleased C_1 stops may delete.

In summary, we have accounted for the asymmetry involving released C_1 stops in consonant deletion by employing the inferred input as the focus of PF constraints. It is not difficult to see that the proposed mechanism can account for other asymmetries in consonant deletion in analogous ways. For instance, to account for the resistance of fricatives to consonant deletion, high-ranked PF constraint MAX$_{FRICATIVE}$-C will be employed. All underlying consonants are preserved in the inferred input. Presence of a fricative in the inferred input will activate MAX$_{FRICATIVE}$-C, and fricative deletion will incur a fatal violation, compared to stop deletion—which will incur a violation of only lower-ranked MAX$_{STOP}$-C. Thus, unlike in the standard PF analysis relying on the output focus, stop deletion is preferred over fricative deletion. For the analysis of C_2 dominance effect in consonant deletion, we may adopt high-ranked PF constraint MAX-C/_V. Both C_1 and C_2 are present in the inferred input. Loss of C_2 will violate higher-ranked MAX-C/_V, whereas that of C_1 only low-ranked context-free Faithfulness constraint. Thus, C_1 is preferred as a target of deletion over C_2.

In summary, PF constraints can correctly prevent consonant deletion in prominent positions and segments by employing the inferred input as the constraint focus.

3.2 Place assimilation

The proposed mechanism can deal with the asymmetries observed in place assimilation and deletion in almost identical ways. For instance, the analysis of the asymmetry involving released C_1 stops in place assimilation is very much like the one for consonant deletion given above. Under the proposed mechanism, MAX$_{REL}$(place) is defined as below:

(24) MAX$_{REL}$(place)

Let S be a [+release] segment in the **inferred input**. Then every place feature in S has an output correspondent.

Its constraint interaction is limited by the following universal rankings in (6), repeated below:

(25) Fixed universal rankings

a. MAX$_{REL}$(place) >> MAX(place)

b. MAX$_{REL}$(place) >> *[αplace][βplace]

The following tableau illustrates the analysis of the lack of place assimilation in languages, such as Zoque, where preconsonantal C_1 stops are released:

(26) PF analysis (with inferred input focus): Zoque, /petkuy/ → [pet^{L} kuy]

/petkuy/	RELEASE	MAX$_{REL}$(place)	*[αpl][βpl]	MAX(place)
a. pet˺ kuy	*!		*	
b. ☞ √ pet^{L} kuy			*	
c. pek^{L} kuy		*!		*
d. pekkuy	*!	*!		*

Candidate (26b) is an inferred input, marked with √, since it is the most harmonic one among those which obey all IO Faithfulness constraints. The coronal stop in the inferred input is released, and thus MAX$_{REL}$(place) is active in the candidate evaluation. Candidates (26c, d), with place assimilation, violate this high-ranking PF constraint, and cannot be optimal. Candidate (26a), with an unreleased C_1 stop, violates dominant RELEASE. Candidate (26b), i.e. the inferred input, obeys the both dominant constraints, and thus is optimal. This indicates that released C_1 stops are never subject to place assimilation.

The ranking adopted above, MAX$_{REL}$(place) >> *[αplace][βplace] >> MAX(place)—which is consistent with universal rankings in (25)—derives the occurrence of place assimilation in languages, such as Yakut, where C_1 stops are unreleased, as shown below:

(27) PF analysis (with inferred input focus): Yakut, /at+ka/ → [akka] 'to a horse'

/ at+ka /	*RELEASE	MAX$_{REL}$(place)	*[αpl][βpl]	MAX(place)
a. √ at˺ ka			*!	
b. at^{L} ka	*!		*	
c. ☞ akka				*
d. ak^{L} ka	*!			*

Candidate (27a) is an inferred input since it is the most harmonic one among candidates which obey all IO Faithfulness constraints. The coronal stop in the inferred input is unreleased, and thus MAX$_{REL}$(place) is vacuously satisfied in the candidate evaluation. Candidates (27b, d) violates dominant *RELEASE. The inferred input (27a) violates the next ranked Markedness constraint. Candidate (27c), with place assimilation, obeys all the high-ranked constraints, and thus is optimal, indicating that unreleased C_1 stops may be subject to place assimilation.

Like in the analyses of the asymmetries in consonant deletion, it is not difficult to see that the proposed mechanism can account for other asymmetries in place assimilation in analogous ways. In conclusion, the proposed mechanism—which employs the inferred input focus for PF constraints—can account for all the asymmetries in place assimilation and consonant deletion.

3.3 Factorial Typology

This section discusses a factorial typology of constraints involved, to ensure that the proposed mechanism may produce all and only attested patterns. For instance, if the proposed mechanism is a correct theory, it should be able to derive cases of vowel epenthesis as well as consonant deletion to avoid the occurrence of consonant clusters, and at the same time it should not derive unattested patterns such as C_2 deletion. The following set of constraints, where DEP-V is newly added for vowel epenthesis, is considered:

(28) Constraints

a. Markedness — *CC, RELEASE, *RELEASE

b. Faithfulness — MAX_{rel}-C, MAX-C, DEP-V

The interaction among these constraints is limited by fixed rankings below which have been assumed thus far:

(29) Fixed rankings

a. Either RELEASE or *RELEASE is dominant. (language-specific)

b. MAX_{REL}-C >> MAX-C (universal)

c. MAX_{REL}-C >> *CC (universal)

The following table summarizes the inferred inputs and optimal outputs that all possible rankings produce, taking a hypothetical form /at+ka/ as an illustrative example.

(30) Factorial Typology (e.g. /at+ka/)

language-specific release pattern		Possible rankings (only crucial rankings shown)	optimal output
Languages w/ released C_1 Inferred input: [at^{L}ka]	a.	RELEASE, DEP-V >> *CC	at^{L}ka
	b.	RELEASE, *CC >> DEP-V	atəka
Languages w/ unreleased C_1 Inferred input: [at˺ka]	c.	*RELEASE, MAX-C, DEP-V >> *CC	at˺ka
	d.	*RELEASE, *CC >> DEP-V >> MAX-C	aka
	e.	*RELEASE, *CC >> MAX-C >> DEP-V	atəka
	f.	*RELEASE, MAX-C >> *CC >> DEP-V	atəka
	g.	*RELEASE, DEP-V >> *CC >> MAX-C	aka

In the above table, all possible rankings fall into two major types according to the release pattern of C_1 stops. Under rankings in (30a, b) where RELEASE is dominant, the inferred input is always a candidate with released C_1 stops, [at^{L}ka]. In contrast, under rankings in (30c-g) where *RELEASE is dominant, the inferred input is always a candidate with unreleased C_1 stops, [at˺ka]. Notice that in the first group, consonant deletion is impossible since C_1 stop in the inferred input is released, and the fixed relative ranking of MAX_{REL}-C over *CC prevents its deletion. If DEP-V outranks *CC (30a), vowel epenthesis is prevented, and thus the faithful candidate, [at^{L}ka], would be optimal. Otherwise, vowel epenthesis would occur (30b).

In the second group, where *RELEASE is dominant, the inferred input is always a faithful candidate with unreleased C_1 stops, [at˺ka]. In this group, C_1 deletion is now possible since C_1 stops in the inferred input are unreleased, and thus they are not protected by high-ranked MAX_{REL}-C. If both MAX-C and DEP-V outrank *CC (30c), the faithful candidate [at˺ka] will be optimal. If both Faithfulness constraints are outranked by *CC (30d, e), the resulting patterns depend on the relative ranking of MAX-C and DEP-V. If DEP-V outranks MAX-C (30d), a candidate with C_1 deletion will be optimal. In the reversed ranking (30e), a candidate with an epenthetic vowel, [atəka], will be optimal. Also, if DEP-V, but not MAX-C, is outranked by *CC (30f), the optimal output will be a candidate with an epenthetic vowel, [atəka]. Finally, if MAX-C, but not DEP-V, is outranked by *CC (30g), the optimal output will be a candidate with C_1 deletion, [aka].

In summary, a factorial typology given above shows that in the proposed constraint system, consonant deletion (only in languages with unreleased C1 stops) and vowel epenthesis are possible, whereas unattested patterns such as consonant deletion in languages with released C_1 stops and C_2 deletion are not possible. Consequently, the proposed mechanism provides all and only attested patterns.[12]

4. Complex patterns

Above, we have considered only simple patterns in which place assimilation and consonant deletion do not interact with other phonological processes such as vowel deletion. Complex cases, in which different phonological processes interact, exist. The crucial cases in the present study are the ones in which place assimilation and consonant deletion interact with other processes—which may affect the relative perceptual prominence of elements involved. Specifically, phonological elements—which are considered prominent in the underlying representation—may become less- or non-prominent as a result of an independent process, being a potential target of a weakening process. In such cases, blocking of the weakening is predicted by the proposed mechanism, since all underlying properties are maintained in the inferred input, and thus any effects of the changes will not be considered in the evaluation of

[12] In the above discussion of a factorial typology, it is assumed that PF constraints are candidate-to-candidate faithfulness, whereas context-free constraints are all IO Faithfulness. A more plausible model would be the one in which two sets of context-free faithfulness constraints, Input-to-Output and candidate-to-candidate, exist, and fixed universal rankings are given between PF constraints and their context-free candidate-to-candidate, not IO, faithfulness counterparts. We are certain that in such an extended model, a factorial typology will produce a lot more possible rankings, but no new possible optimal outputs will result, thus maintaining the conclusion above that the proposed mechanism can produce all and only attested outputs. We have adopted a simpler model in the discussions above, simply to avoid complications unnecessary for illustrating the main points of the present proposal.

PF constraints. Such predicted opaque patterns are attested, for instance, in Hindi nasal place assimilation (See Moreton and Smolensky 2002 for more relevant cases). In Hindi, nasals assimilate in place to a following consonant: e.g. /sam+kiirt̪an/ → [saŋkiirt̪an] 'collective devotional singing' (Mohanan 1993: 75). However, if a nasal becomes adjacent to a consonant as a result of vowel deletion, assimilation is blocked: e.g. /sənək/ > [sənki], not *[səŋki], 'whim' (Ohala 1983: 110). The analysis of the Hindi pattern can be seen below:

(31) PF analysis of opaque case: Hindi, /sənək/ → [sənki]

/sənək/	V-SYNCOPE	MAX-place/__V	*[αpl][βpl]	MAX-place/__C
a. √ sənəki	*!			
b. ☞ sənki (opaque)			*	
c. səŋki (transparent)		*!		

A ranking MAX-place/__V >> *[αpl][βpl] explains the resistance of prevocalic consonants to Hindi nasal assimilation, and a ranking *[αpl][βpl] >> MAX-place/__C explains the target of preconsonantal nasals. An inferred input here is [sənəki] in (31a) since it obeys all context-free IO Faithfulness constraints. A coronal nasal occupies a prevocalic position in the inferred input, and thus high-ranked MAX-place/__V prevents it from being targeted in place assimilation as can be seen in (31c).

However, if there exist cases in which transparent outputs, e.g. candidate (31c), are optimal, they would be problems to the proposed mechanism. We are aware of two cases that might belong to such problematic cases: syllable reduction in Cariban languages and Korean fricative place assimilation.

Consider Cariban syllable reduction first. At least in some Cariban languages, final syllables of verb stems reduce. Specifically, vowel syncope occurs mainly before –CV, CVC, CVCV suffixes, but blocks before –CCV, VCV, C, V suffixes. This syncope may feed debuccalization, consonant deletion (mostly with compensatory lengthening), and nasal place assimilation. The following table summarizes some basic patterns of such stem-final syllable reductions:

(32) Reduction of the verb stem-final syllable in Cariban (based on Gildea 1995)

In syncope contexts (…V_1<u>**C_1V_2**</u>-C_2V), …

	Obstruent-vowel	*Nasal-vowel*
Panare	h	assimilation to C_2
Carib	zero ≈ χ	
Makushi	h or ʔ	
Hixkaryana	h	no assimilation
Apalaí	ʔ	zero (with nasalized long V_1)

The question for the proposed mechanism is why underlyingly prevocalic stem-final consonants, C_1 above, are targeted in consonant weakening processes such as nasal place assimilation and consonant deletion. According to the proposed mechanism, the stem-final consonants would occupy prevocalic position in the inferred input, and thus they should resist the weakening processes for same reasons that consonants—which remain prevocalic on the surface—do.

However, this would not be a problem to the proposed mechanism if we consider the fact that target consonants belong to a syllable which is ‘weak’ both prosodically and morphologically. According to Gildea, the role of stress is crucial in characterizing the environments for vowel syncope. The vowel syncope is blocked before –CCV, VCV, C, and V suffixes. All these suffixes make the preceding stem-final CV syllable heavy, and heavy syllables receive secondary stress, resisting the syncope. In contrast, syncope occurs before –CV, CVC, and CVCV suffixes since they cannot make the preceding stem-final syllable heavy, and thus no secondary stress is assigned. There are exceptions, and this stress-related factor is less clear in Carib in which stress rules are complex. This leads Gildea to state that a complete characterization of the environments for vowel syncope would additionally require morphological boundary information: occurrence of vowel syncope is mostly confined to the final syllable of verb roots. Based on Gildea’s discussion, we assume that vowel syncope normally occurs in a non-prominent syllable, prosodically (as it is unstressed) and morphologically (as it is root-final). Then, consonant weakening processes fed by the syncope are also confined to such non-prominent syllables. From this, it may follow that C_1 consonants in unstressed stem-final syllables are targeted in consonant weakening processes, not because they are preconsonantal in the output, but because they are part of non-prominent syllables. Since details of syllable reduction differ in different Cariban languages, and not all conditioning factors are identified yet, its complete formal analysis is clearly beyond the scope of this paper. Thus, we provide only a simplified analysis for nasal place assimilation in Carib, for a purpose of outlining how the proposed mechanism can treat Cariban transparent patterns by relying on syllable weakness.

(33) PF analysis (inferred input): syncope and nasal place assimilation in Carib

/kɨn-ekaanumɨ-taŋ̃/	SYNCOPE	*[αpl][βpl]	MAX$_{unstress}$-(place)	MAX$_{stem\text{-}final}$-(place)
a. √ kɨn-ekaanumɨ-taŋ̃	*!			
b. kɨn-ekaanum-taŋ̃		*!		
c. ☞ kɨn-ekaanun-taŋ̃			*	*

The fully-faithful candidate (33a) is an inferred input since it obeys all IO Faithfulness constraints. But it cannot be optimal since it violates top-ranked SYNCOPE. The next high-ranked *[αpl][βpl] forces the loss of place features in consonants in the stem-final syllable. Candidate (33c), with place assimilation, can be optimal, violating only lower-ranked Faithfulness constraints preserving place features of unstressed syllables and stem-final syllables.[13] In conclusion, the interaction of vowel syncope and consonant weakening processes in Cariban languages can be explained within the proposed mechanism.

Let us now consider Korean fricative place assimilation. As mentioned above, fricatives are rarely involved in place assimilation as a target, compared to stops and nasals (Mohanan 1993; Jun 1995). One apparent exception to this generalization can be found in Korean. Not only stops (34a) but also sibilant fricatives (34b) can be targeted in place assimilation:

(34) Korean place assimilation[14]

a. Stop target: coronals and labials (only before dorsals)

(i) /mit+ko/ → [mikko] ‘believe + and’

(ii) /mut+ko/ → [mukko] ‘ask + and’

(iii) /ip+ko/ → [ikko] ‘wear + and’

(iv) /pap+kwa/ → [pakkwa] ‘rice + and’

b. Fricative target

(i) /pis+ko/ → [pikko] ‘comb (verb) + and’ cf. /pis+ə/ [pisə] ‘comb! (imperative)’

(ii) /s’is+ko/ → [s’ikko] ‘wash + and’ cf. /s’is+ə/ [s’isə] ‘wash! (imperative)’

(iii) /mas+kwa/ → [makkwa] ‘taste + and’ cf. /mas+i/ [masi] (nominative)

(iv) /nas+kwa/ → [nakkwa] ‘sickle + and’ cf. /nas+i/ [nasi] (nominative)

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[13] PF constraints for syllables which are not subject to reduction are assumed to be dominant. In addition to PF constraints for prosodically strong syllables, i.e. stressed, we need PF constraints for morphologically strong syllables. However, it is not clear what natural classes can characterize “non-stem-final” syllables.

[14] Broad phonetic transcriptions are employed for these examples. For instance, actual phonetic forms must be subject to the regular process of post-obstruent fortition where lenis obstruents become fortis after an obstruent. See Kim-Renaud (1986) for more details of this process.

This seemingly exceptional pattern can be understood better if we consider coda neutralization in which all Korean obstruents become their homorganic unreleased lenis stops in coda position. Specifically, the underlying sibilant /s/ surfaces as a coronal stop [t˺] in the coda:

(35) Coda neutralization in Korean

	Citation form	Nominative
a. /mas/ 'taste'	[mat˺]	[masi]
b. /nas/ 'sickle'	[nat˺]	[nasi]
c. /pus/ 'brush'	[put˺]	[pusi]
d. /os/ 'clothes'	[ot˺]	[osi]
e. /pis/ 'comb (noun)'	[pit˺]	[pisi]

In derivational terms, after sibilant fricatives—which are resistant to place assimilation—undergo the coda neutralization, they become unreleased stops, and thus they are likely to be targeted in place assimilation just like underlying stops. If we assume that sibilant fricatives are never targeted in place assimilation, and thus a ranking MAX-sib(place) >> *[αplace][βplace] is fixed, this transparent case cannot be analyzed in the proposed mechanism, as can be seen below:

(36) PF analysis (with inferred input focus): Korean fricative place assimilation

/pis+ko/	*RELCODA	MAX-sib(place)	*[αpl][βpl]	MAX-stop(place)
a. √ pisko	*!		*	
b. ☞ pitko			*	
c. ☹ pikko		*!		

Candidate (36a) obeys all IO Faithfulness constraints, thus being selected as an inferred input. There is a sibilant fricative in the inferred input, and thus high-ranked PF constraint for sibilant fricatives becomes active. Candidate (36c) displaying place assimilation violates the PF constraint, and thus cannot be optimal, although it is the actual output, marked with ☹. Actually, if we employ the output as the focus of PF constraints, the Korean pattern can be explained without any difficulty: in candidate (36c) the underlying fricative is realized as a stop, and thus it will vacuously satisfy PF constraint for sibilant fricatives.

How can we solve this problem within the proposed mechanism? One possible solution is to reject the cross-linguistic generalization that sibilant fricatives are never targeted in place assimilation. There is no independent evidence from Korean that sibilant fricatives are resistant to place assimilation, since fricatives never appear as such in coda position. If both coronal fricatives and stops can be targeted in Korean place assimilation, the Korean pattern would be analyzed within the proposed mechanism. Lower-ranked PF constraints for stops and fricatives, relative to *[αplace][βplace], will be enough to account for the pattern.[15]

In this section, we have discussed potential problems of the present proposal. Suppose that in a language X, segments A and B are more and less prominent, respectively, and place assimilation (or consonant deletion) occurs, targeting B. If A can be additionally targeted only when A changes to B due to an independent process, its analysis would cause a problem to the proposed mechanism. We are not aware of any obvious cases displaying such a transparent pattern. We have shown above that Cariban and Korean patterns do not belong to such cases.

5. Sympathy

The present proposal has a lot of commonalities with the standard Sympathy Theory (McCarthy 1998, 1999): both the inferred input and sympathetic candidate are selected by IO Faithfulness constraints, and both PF and sympathetic faithfulness constraints are candidate-to-candidate faithfulness. We should then consider the possibility of accounting for all positional/segmental asymmetries within standard Sympathy Theory. Specifically, we should consider the possibility that the focus of PF constraints is a sympathetic candidate, and all PF constraints are in fact sympathetic faithfulness. It seems that such Sympathy-based PF approach—employing a sympathetic candidate as the constraint focus—can account for every pattern that has been analyzed above under the present mechanism. For instance, to explain the asymmetry involving released C_1 stops in consonant deletion, we propose PF constraint ❀MAX$_{REL}$-C, defined as below, and fixed universal rankings involving it:

(37) a. ❀MAX$_{REL}$-C

Every [+release] segment in the **sympathetic candidate** has a correspondent in the output.

b. Fixed universal rankings

❀MAX$_{REL}$(place) >> ❀MAX(place)

❀MAX$_{REL}$(place) >> *[αplace][βplace]

[15] The fact that noncoronal stops, especially velars, are not targeted can be captured by high-ranked PF constraints for noncoronals. See Jun (1995, to appear) for more details.

For the PF analyses of patterns attested in languages like Diola Fogny in which preconsonantal stops are assumed to be unreleased, the C_1 stops must be unreleased in the sympathetic candidate: e.g. [let˺ kujaw] for the underlying sequence /let+ku+jaw/. A ranking in (38), which is consistent with universal rankings in (37b), produces a correct analysis of Diola Fogny, as can be seen in (39):

(38) Ranking: *RELEASE, ❀MAX$_{REL}$-C >> *CC >> ❀MAX-C

(39) PF analysis (with sympathetic candidate focus): Diola Fogny, /let+ku+jaw/ → [lekujaw]

/ let+ku+jaw /	*RELEASE	❀MAX$_{REL}$-C	*CC	❀MAX-C	✰MAX-C
a. ❀ let˺ kujaw			*!		
b. let^{L} kujaw	*!		*		
c. ☞ le kujaw				*	*

Candidate (39a) is a sympathetic candidate since it is the most harmonic one among those which obey the sympathy selector, ✰MAX-C here. But, it cannot be optimal since it violates *CC. In candidate (39c), with C_1 deleted, high-ranking ❀MAX$_{REL}$-C is vacuously satisfied since the preconsonantal coronal consonant in the sympathetic candidate is not released. It also obeys the other top-ranked *RELEASE and *CC, being an optimal output.

The analysis process for patterns of languages with little interconsonantal overlap like Zoque, would be same except for dominant ranking of RELEASE, not *RELEASE. This can be illustrated by the following tableau:

(40) PF analysis (with sympathetic candidate focus): Zoque, /petkuy/ → [pet^{L} kuy]

/petkuy/	RELEASE	❀MAX$_{REL}$-C	*CC	❀MAX-C	✰MAX-C
a. pet˺ kuy	*!		*		
b. ☞❀ pet^{L} kuy			*		
c. pe kuy		*!			*

Candidate (40b) is a sympathetic candidate since it is the most harmonic one among those which obey the sympathy selector, ✰MAX-C. Notice that unlike in (39), RELEASE is dominant in the above. The preconsonantal coronal stop is released in the sympathetic candidate, and thus ❀MAX$_{REL}$-C is active. Candidate (40c) displaying C_1 deletion violates this high-ranking PF constraint and cannot be optimal. In conclusion, this Sympathy-based analysis can correctly explain the occurrence of consonant deletion in languages with significant interconsonantal overlap, and at the same time its absence in languages where C_1

stops are typically released. The same type of asymmetric occurrence of place assimilation, which can be seen in languages like Yakut with significant interconsonantal overlap, will be subject to a very similar treatment: the only difference will be in that the sympathy selector is MAX(place).

Actually, any complex patterns, including ones which may produce transparent outputs, can be explained by this Sympathy-based alternative PF theory. Consider Korean fricative place assimilation. The resistance of fricatives to place assimilation can be captured by the PF constraint ❀MAX-fric(place), defined as below, and fixed universal rankings involving it:

(41) a. ❀Max-fricative(place)
Let S be a fricative in the sympathetic candidate. Then every place feature in S has a correspondent in the output.
b. ❀MAX-stop(place)
Let S be a stop in the sympathetic candidate. Then every place feature in S has a correspondent in the output.
c. Fixed universal rankings
(i) ❀MAX-fricative(place) >> ❀MAX-stop(place)
(ii) ❀MAX-fricative(place) >> *[αplace][βplace]

For the PF analysis of fricative assimilation in Korean in which coronal fricatives become an unreleased coronal stop, the C_1 fricative must have a stop correspondent in the sympathetic candidate: e.g. [pit˺ko] for the underlying sequence /pisko/. The ranking in (42) produces a correct analysis of Korean fricative assimilation, as can be seen in (43):

(42) *RELCODA, ❀MAX_fricative(place) >> *[αpl][βpl] >> ❀MAX_stop(place)

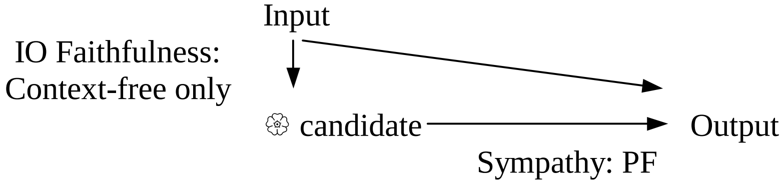
(43) PF analysis (with sympathetic candidate focus): Korean fricative place assimilation

input = /pis+ko/	*RELCODA	❀MAX-fric(place)	*[αpl][βpl]	❀MAX-stop(place)	✩MAX (place)
a. pisko	*!		*		
b. ❀ pit˺ko			*!		
c. ☞ pikko				*	*

Candidate (43b) is selected as a sympathetic candidate since it is the most harmonic one among those which obey the sympathy selector, ✩MAX(place) here. But, it cannot be optimal since it violates *[αplace][βplace]. In candidate (43c) displaying place assimilation, high-ranking ⊛MAX-fric(place) is vacuously satisfied since the preconsonantal consonant in the sympathetic candidate is not a fricative. It also obeys the other top-ranked *RELEASE and *CC, being an optimal output. Consequently, the Sympathy-based PF approach can provide an analysis of Korean fricative assimilation, while maintaining a generalization that sibilant fricatives are never targeted in place assimilation. The analysis of consonant weakening processes fed by vowel syncope in Cariban languages would be made in analogous ways.

In summary, the Sympathy-based PF theory can produce all the attested asymmetric patterns of consonant deletion and place assimilation. An important question here is whether it is sufficiently constrained to exclude unattested patterns? According to Sympathy Theory, any IO Faithfulness constraint like DEP-V can be a sympathy selector, and thus we should consider such cases to prove that Sympathy Theory provides a sufficiently constrained formalism for a PF theory. It seems that many unattested patterns can fall out if we employ, as a selector, IO Faithfulness constraints other than MAX-C or MAX(place). Let us take, for instance, DEP-V as a selector. One possible ranking will be *CC >> MAX-C. Then, the sympathetic candidate would be the one with one member of consonant cluster deleted. Notice that no PF constraints are available in the choice of a sympathetic candidate since in the Sympathy-based approach, all PF constraints must be assumed to be sympathetic faithfulness. The choice of the target consonant in deletion will then depend on the segmental markedness: e.g. *DORSAL >> *CORONAL. If the input cluster consists of C_1 dorsal and C_2 coronal, as in /at+ka/, a sympathetic candidate would be the one with C_2 deleted, [ata]. Notice that this candidate does not violate Markedness constraint *CC, and thus it will be optimal as well. In conclusion, the C_2 deletion, which is believed to be unattested, is possible. It seems that this type of problem is unavoidable as long as we adopt the standard Sympathy Theory, without revision, in formal implementation of the conception of Positional Faithfulness. The selection of the sympathetic candidate is processed with Sympathy constraints turned off (Invisibility Principle, McCarthy 1998, 1999). Therefore, PF constraints regulate only the correspondence between the sympathetic candidates and output forms; then, the correspondence between the input and sympathetic candidate is free to violate the generalizations motivating the PF constraints: for instance, C_2, but not C_1, stops can be deleted in consonant deletion. This can be seen in the following schematic representation for the correspondence relations among three different representations:

(44)



Such violations may be transferred onto the actual output form through sympathetic faithfulness. Therefore, unattested processes like C_2 deletion can freely occur.

In summary, if we adopt the standard Sympathy Theory in formulating the conception of Positional Faithfulness, the resulting PF theory would probably produce all attested patterns. However, such Sympathy-based PF theory cannot be constrained enough to produce only attested patterns.

6. Conclusions

In the present study, we have first shown that standard Positional Faithfulness approach—employing the output constraint focus—cannot be extended to account for any positional/segmental asymmetries observed in consonant deletion typology. The source of the problem is that perceptibility information—which is crucial in the evaluation of PF constraints—is absent when input segments fail to surface.

We have then provided alternative analyses for the asymmetries in place assimilation and consonant deletion by adopting the conception of inferred input (Steriade 1997) and the formalism of Sympathy Theory (McCarthy 1998, 1999).

Finally, we have considered the possibility that the standard Sympathy Theory is adopted, without revision, in implementing the idea of Positional Faithfulness, and it is concluded that the resulting theory is not sufficiently constrained.[16]

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[16] The present study is mainly concerned with how to maintain the main idea of Positional Faithfulness in explaining position/segment specific asymmetries. This is why we do not discuss Wilson (2001) who also provides an alternative approach to the same type of data, but employs a new optimization method.

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