Do we need self-destructive feeding?

1 Introduction

Opacity, as defined by Kiparsky (1973), is the phenomenon where the applicability or application of a phonological rule $\mathbb{P}$ is somehow obscured on the surface (1):

(1) Opacity (Kiparsky 1973: 79)

A phonological rule $\mathbb{P}$ of the form $A \longrightarrow B$ / C_D is OPAQUE if there are surface structures with either of the following characteristics:

a. instances of A in the environment C_D,

b. instances of B derived by $\mathbb{P}$ that occur in environments other than C_D.

In terms of the pairwise rule orderings in the rule-based serialism framework (Chomsky & Halle 1968), UNDERAPPLICATION (1a) is usually derived from COUNTERFEEDING (2c), and OVERAPPLICATION (1b) from COUNTERBLEEDING (2d).

(2) Pairwise rule orderings (adapted from McCarthy 2007a,b, Baković 2011)

Given two rules $\mathbb{A}$ and $\mathbb{B}$ such that $\mathbb{A}$ precedes $\mathbb{B}$,

a. $\mathbb{A}$ FEEDS $\mathbb{B}$ iff $\mathbb{A}$ creates additional inputs to $\mathbb{B}$;

b. $\mathbb{A}$ BLEEDS $\mathbb{B}$ iff $\mathbb{A}$ eliminates potential inputs to $\mathbb{B}$;

c. $\mathbb{A}$ COUNTERFEEDS $\mathbb{B}$ iff $\mathbb{B}$ creates additional inputs to $\mathbb{A}$;

d. $\mathbb{A}$ COUNTERBLEEDS $\mathbb{B}$ iff $\mathbb{B}$ eliminates potential inputs to $\mathbb{A}$.

Counterfeeding results in underapplication opacity, because on the surface, it seems that $\mathbb{A}$ has failed to apply although its structural description is met. For example, in Lomongo, a non-low vowel changes into its corresponding glide before another vowel (3b), and a voiced obstruent gets removed prevocalically (3c). But in the SF of (3a), the vowel [o] should have glided before another vowel but does not, so Gliding seems to underapply.

(3) Counterfeeding example from Lomongo (Kenstowicz & Kisseberth 1979)

	UR	a. /o+bina/	b. /o+isa/	c. /ba+bina/
Gliding:	[−low] ⟶ [−syll] / _V		w	
Deletion:	[+voi,−son] ⟶ ∅ / _V	∅		∅
	SF	[oina]	[wisa]	[baina]

Glosses: (3a) ‘you (sg.) dance’, (3b) ‘you (sg.) hide’, (3c) ‘they dance’

Counterbleeding results in overapplication opacity, since $\mathbb{A}$ seems to have applied in an environment outside of its structural descriptions. For example, in Canadian English, /t/ and /d/ change into the alveolar tap [ɾ] intervocalically (4b), and low diphthongs raise to their mid counterparts before voiceless consonants (4c). In (4a), [aɪ] should not have changed to [ʌɪ] before voiced consonants but it does before [ɾ], so Raising seems to overapply.

(4) Counterbleeding example from Canadian English (adapted from Idsardi 2006)

	UR	a. /ɹaɪtɚ/	b. /saɪdɚ/	c. /ɹaɪt/
Raising:	V ⟶ [−low] / _[−voi]	ʌ		ʌ
Tapping:	t/d ⟶ ɾ / V_V	ɾ	ɾ	
	SF	[ɹʌɪɾɚ]	[saɪɾɚ]	[ɹʌɪt]

Glosses: (4a) 'write', (4b) 'cider', (4c) 'writer'

1.1 Roadmap

This paper centres around another kind of pairwise rule ordering (neither counterfeeding nor counterbleeding) that results in opacity, namely SELF-DESTRUCTIVE FEEDING (SDF). The current paper has two aims. The first is to reexamine all the SDF cases previously identified, demonstrate the peculiar similarities they share and provide a unified theory that accounts for not only the SDF pattern but also its related phenomena simultaneously. The second and more important goal is to show the underlying nature of the so-called SDF. Rather than the result of a genuine interaction between two rules, I will show that SDF is an epiphenomenon of phonologically-conditioned allomorphy. The boarder and more ambitious question to solve is whether SDF is still needed as a case of overapplication opacity.

The rest of the paper is arranged as follows. In the rest of §1, I define SDF, limit the scope of the paper to the 'true' SDF cases – two from Turkish, one from Javanese and one from Japanese – and discuss why other seeming SDF cases are excluded. A short version of the final proposal will also be shown before I justify it with further details. §2 reviews the similarities shared among all SDF cases by analysing the rules involved in each interaction. Two characteristics of these rules that previous literature has not mentioned but are vital for understanding why SDF occurs will be noted. §3 presents a new analysis which is able to account for all the generalisations made in earlier sections, with the help of underspecification and contextual faithfulness under Standard Optimality Theory (OT; Prince & Smolensky 1993). How this analysis provides more insight about SDF and the contributions it might make are also discussed. §4 provides concluding remarks.

1.2 Self-destructive feeding

Baković (2007, 2011: 59) defined another type of opacity where 'an earlier rule feeds a later rule that in turn crucially changes the string such that the earlier rule's application is no longer justified' and named it SELF-DESTRUCTIVE FEEDING. Two examples from Turkish (Turkic) were provided:

(5) SDF with vowels in Turkish (Sprouse 1997)

	UR	a. /bebek+n/	b. /ip+n/	c. /bebek+i/
Epenthesis[1]:	∅ ⟶ i / C_C#	i	i	
Velar Deletion:	k/g ⟶ ∅ / V_+V	∅		∅
	SF	[bebein]	[ipin]	[bebei]

[1] There has been debate about whether the V ~ ∅ alternation is a result of Epenthesis or Deletion. Both Lees (1961) and Yavaş (1980) prefer Epenthesis in Turkish loanwords. Hankamer (2011) argues that analysing the vowel in *-In* as epenthetic can reduce the range of productive vowel-initial suffixes in Turkish to only *-Iyor*. But none of these proposals precludes a Deletion analysis, and an underlying vowel will make the interaction no longer a case of SDF. I will follow Baković (2007, 2011) and keep analysing this interaction as SDF. However, discussions in §2 and 3 will show how it differs from all other cases of SDF.

Glosses: (5a) 'your baby', (5b) 'your rope', (5c) 'baby (ACC)'

(6) SDF with consonants in Turkish (Kenstowicz & Kisseberth 1979)

	UR	a. /ajag+sɯ/[2]	b. /ʧan+sɯ/	c. /bebek+i/
Elision:	s/j ⟶ ∅ / C_	∅	∅	
Velar Deletion[3]:	k/g ⟶ ∅ / V_V	∅		∅
	SF	[ajaɯ]	[ʧanɯ]	[bebei]

Glosses: (6a) 'his foot', (6b) 'his bell', (6c) 'baby (ACC)'

In Turkish, Epenthesis of a high vowel happens between two consonants before the end of the word. Velar Deletion removes (word-final) velar stops in intervocalic environments created by suffixation. Elision deletes /s/ or /j/ preceded by another consonant. In (5a), Epenthesis self-destructively feeds Velar Deletion because Epenthesis creates the intervocalic environment in which Velar Deletion could happen, but the deletion of the velar stop makes the application of Epenthesis unjustified since the velar stop is a crucial part of the structural description of Epenthesis. Similarly, in (6a), Elision self-destructively feeds Velar Deletion because the removal of the velar stop – a crucial part of the structural description of Elision which fed Velar Deletion – makes the application of Elision in the first place unjustified.

Another example of SDF is found in Javanese (Austronesian), which was first reported and analysed by Lee (1999, 2007):

(7) SDF in Javanese

	UR	a. /omah+ne/	b. /kulit̪+ne/	c. /səkolah+an/
n-deletion:	n ⟶ ∅ / C_	∅	∅	
h-deletion:	h ⟶ ∅ / V_V	∅		∅
	SF	[omae]	[kulit̪e]	[səkolaan]

Glosses: (7a) 'the house', (7b) 'the skin', (7c) 'school building'

Again, n-deletion creates the intervocalic environment in which h-deletion could apply. But in turn, the deletion of /h/ obscures why /n/ is deleted in the first place, because /h/ is a crucial part of the structural description of the n-deletion rule. So n-deletion self-destructively feeds h-deletion.

The final example, sometimes referred to as 'opaque allomorph selection' (Hall *et al.* 2018), comes from Japanese. Continuant Deletion removes any continuant (in this case, /r/) after consonants (Poser 1986, 1988). w-deletion removes any /w/ before non-low vowels (Vance 1987, Gibson 2008, Nevins 2011). Deleting /r/ feeds w-deletion by creating the /w/ + non-low vowel environment. But since /w/ is what motivates the removal of /r/ in the first place, deleting /w/ makes the application of Consonant Deletion unjustified. Thus, Continuant Deletion self-destructively feeds w-deletion.

(8) SDF in Japanese (Poser 1988, Hall *et al.* 2018)

[2] Turkish is subjected to Vowel Harmony, meaning that the vowel in this suffix (orthographically *-(s)I* in Turkish literature) changes with the root vowel. Since vowel changes are not of primary concern of this paper, I will always transcribe the vowel in this suffix as the context demands without further explanations.

[3] Some systematic exceptions of this rule exist. The final velar stop of monosyllabic words and some specific lexical items do not undergo deletions; for more details, see Inkelas (2000). I will simplify the situation by leaving these cases aside in this paper given that they do not involve SDF.

	UR	a. /kaw+ru/	b. /tob+ru/	c. /iw+e+ru/
Continuant Deletion:	[+cont] $\longrightarrow \varnothing$ / C_		$\varnothing$	$\varnothing$
h-deletion:	w $\longrightarrow \varnothing$ / _[−low]	$\varnothing$		$\varnothing$
	SF	[kau]	[tobu]	[ieru]

Glosses: (8a) 'to buy', (8b) 'to fly', (8c) 'can say'

Based on the definition provided in (1), SDF should be a type of overapplication opacity. In these four examples, there are always instances of B derived by $\mathbb{P}$ – the first rule – occurring in environments other than C_D. In (5a), the epenthetic [i] is supposed to appear between two consonants, and yet it is surrounded by a vowel and a consonant on the surface. In (6-8), the disappearance of the suffix-initial consonant is expected to be found after another (root-final) consonant, but such a process cannot be recovered from the SFs because no consonant exists before the deletion site.

Previous literature identified other cases of SDF. However, they will not be discussed in this paper because they differ critically from (5-8) in several aspects. The first case is the CONCEALED FREE RIDE found in Cibaeño Spanish (9). As pointed out by Baković (2007: 247-251), it can be analysed as a case of SDF ON FOCUS, because Gliding feeds Glide Deletion by creating the focus of the latter. Concealed free rides differ from (5-8) in two ways. First, unlike SDF ON ENVIRONMENT in (5-8) where the 'environment' of the first rule is destroyed by the second, (9) does not involve any opacity when analysed as SDF on focus. On the surface, there are no cases of [j] derived from Gliding that appear in environments other than the structural description of Gliding, since this created focus [j] is removed altogether.

(9) Concealed Free Rides in Cibaeño Spanish (Golibart 1976, Guitart 1981, Baković 2007)

A. Phonotactically motivated

	UR	a. /sirβe/	b. /salβo/	c. /salir/	d. /salar/
Gliding: /X/ $\longrightarrow$ |Y|	r/l $\longrightarrow$ j / _{C, #}	j	j	j	j
Glide Deletion: |Y| $\longrightarrow$ [Z]	j $\longrightarrow \varnothing$ / i_	$\varnothing$		$\varnothing$	
	SF	[ˈsiβe]	[ˈsajβo]	[saˈli]	[saˈlaj]

Glosses: (9a) 'it serves', (9b) 'I save', (9c) 'to go out', (9d) 'to salt'

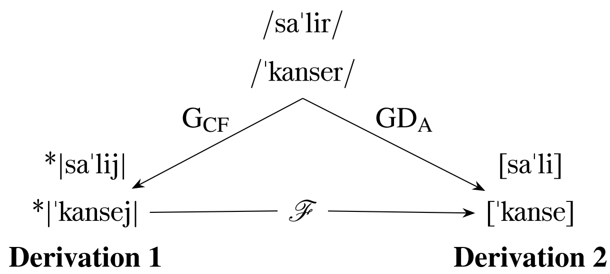
B. Prosodically motivated

	UR	e. /kanser/	f. /kansar/
Gliding:	r/l $\longrightarrow$ j / _{C, #}	j	j
Glide Deletion:	j $\longrightarrow \varnothing$ / $\sigma C_0 \check{V}$_#	$\varnothing$	
	SF	[ˈkanse]	[kanˈsaj]

Glosses: (9e) 'cancer', (9f) 'to tire'

Second, (9) can be analysed as CROSS-DERIVATIONAL FEEDING (Baković 2005) as in (10). Gliding cross-derivationally feeds Glide Deletion, because the counterfactual application of Gliding in Derivation 1 creates the focus for the actual application of Glide Deletion in Derivation 2 (for more details, see Baković 2007: 251). However, the SDF on environment cases in (5-8) cannot be analysed in this way at all, indicating a non-trivial difference between them. Therefore, SDF on focus will not be included in this paper.

(10) Cross-derivational feeding in Cibaeño Spanish (adapted from Baković 2007: 251)



G_{CF} = counterfactual application of Gliding

GD_A = actual application of Glide Deletion

$\mathscr{F}$ = cross-derivational feeding relationship

The second set of cases to be excluded are examples in the Ramsau dialect of German which Noelliste (2017) chose to analyse as SDF on environment. In (11), Vowel Nasalisation applies to vowels that appear in front of an underlying nasal sound. Nasal Deletion removes the word-final coronal nasal after a nasalised vowel (11a). Word-final non-coronal nasals (11b) and word-internal coronal nasals (11c) are not deleted. Vowel Nasalisation creates the environment in which Nasal Deletion could take place, but the deletion of the nasal leaves the application of Vowel Nasalisation unjustified. In (12), Nasal Place Assimilation dictates that /n/ assimilates in place with its preceding non-nasal consonant. Voiced Stop Deletion removes the voiced stop before a homorganic nasal. So, in cases like (12a), the assimilation of /n/ to its preceding consonant creates the environment for Voiced Stop Deletion to happen, and the removal of /b/ makes the application of Nasal Place Assimilation unjustified. Hence, Noelliste (2017) analysed (11a) and (12a) as SDF on environment.

These examples in (11-12) contrast with (5-8) too. More specifically, the two sounds involved in Turkish (epenthetic vowels, /s/ or /j/ and velar stops), Javanese (/n/ and /h/) and Japanese (/r/ and /w/) interactions do not undergo any feature-sharing process, but those in Ramsau German do, in the form of the first rule in each interaction. In (11a), the coronal nasal changes its place feature to resemble /b/. In (12a), the vowel changes to share the nasality feature of /n/. On the contrary, in (5-8), segments are simply inserted or removed without any assimilation. Because of such feature-sharing of neighbouring sounds in Ramsau German, these examples are better analysed in a way other than SDF, namely COALESCENCE (Zaleska 2020, a.o.), the phenomenon or process where two phonological elements are merged into one by assimilation and deletion. The first rule always assimilates one segment to the other, and the second rule removes the segment that did not make any changes. But the cases in (5-8) cannot be analysed in terms of coalescence at all. Given this critical difference, the alleged SDF cases in Ramsau German are in fact coalescence and will also be excluded in the following discussion.

(11) Vowel Nasalisation self-destructively feeds Nasal Deletion

		a.	b.	c.
	UR	/ʃen/	/kam/	/ke.nə/
Vowel Nasalisation:	V ⟶ Ṽ / _N	ẽ	ã	ẽ
Nasal Deletion:	n ⟶ ∅ / Ṽ_#	∅		
	SF	[ʃẽ]	[kãm]	[kẽ.nə]

Glosses: (11a) ‘pretty’, (11b) ‘hardly’, (11c) ‘can (INF)’

(12) Nasal Place Assimilation self-destructively feeds Voiced Stop Deletion

	UR	a. /geb+n/	b. /ʃlʊk+n/	c. /ʃlof+n/
Nasal Place Assimilation:	$/\text{n}/ \longrightarrow \left[\beta\text{place}\right] / \begin{bmatrix}+\text{cons}\\ -\text{nasal}\\ \beta\text{place}\end{bmatrix} \_$	m	ŋ	m
Voiced Stop Deletion:	$\begin{bmatrix}-\text{del rel}\\ -\text{nasal}\\ \beta\text{place}\\ +\text{voice}\end{bmatrix} \longrightarrow \varnothing / \_ \begin{bmatrix}+\text{cons}\\ +\text{nasal}\\ \beta\text{place}\end{bmatrix}$	∅		
	SF	[gem]	[ʃlʊ.kŋ̍]	[ʃlo.fm̩]

Glosses: (12a) 'to give', (12b) 'to swallow', (12c) 'to sleep'

1.3 Proposal at a glance

Unlike cross-derivational feeding or coalescence, it has been argued that SDF cannot be dealt with Standard OT (see more details in §3.1). This paper would like to show that, with appropriate theories – namely UNDERSPECIFICATION (Kiparsky 1993) and CONTEXTUAL FAITHFULNESS (Steriade 2009, a.o.) – SDF can be accounted for in Standard OT. Before the analysis is fully sketched out in §3, I briefly demonstrate how the proposal works with Turkish consonant-SDF as an example.

The main motivations for using underspecification and contextual faithfulness in my theory are the two interesting characteristics of SDF (more details in §2). First, SDF is always observed on morpheme boundaries and always involves non-derived environment blocking. Underspecification is hence used to limit certain processes to morpheme edges (more on its justifications in §3.2). Second, the first rule in each interaction always tries to resolve consonant clusters by manipulating the presence of suffix-initial segments. Contextual faithfulness is thus used to capture the /s/ ~ ∅ alternation conditioned by the root-final segment (more on the motivations in §3.4).

Underspecification assumes that some segments can be underspecified in the UR. With the under- vs. full-specification contrast, some processes can be limited to affect underspecified segments only. The morpheme-edge-only feature of certain rules falls out if underspecified segments appear on morpheme edges. For Turkish consonant-SDF, the suffix-initial segment /s/ or /j/ and the root-final velar stop can be underspecified for its linkage with a C slot on the skeletal tier in autosegmental terms. §3.2 will explain why these segments and such a feature should be underspecified. Contextual faithfulness preserves segments in certain contexts of the UR. For SDF, segments that already form CV syllable structures with their neighbours are preserved. §3.4 will provide justifications for the choice of contexts.

Consequently, SDF can be captured in Standard OT with the constraints listed in (13) as shown in (14). The rest of the paper will gradually present the full analysis and why it is appropriate.

(13) Constraints needed for Turkish consonant-SDF

a. SPECIFY: AOV for each segment that is not linked to a C/V slot (cf. SPECIFY[T] in Myers 1997: 861 and Zoll 2003: 241).

b. MAX$_{full}$: AOV for each underlying fully-specified segment removed.

c. *VkV (for Turkish): AOV for each [k] or [g] between two vowels.

d. MAX-C/V_V: AOV for each consonant between two vowels in the input deleted in the output.

e. DEPLINK: AOV for each association line added between a segment and a C/V slot (cf. NO-LINK[place] in McCarthy 2008: 278).

f. MAX: AOV for each segment removed.

(14) How the proposal works for Turkish consonant-SDF

A. SDF example

/ajaG+Sɯ/	SPECIFY	MAX_{full}	*VkV	MAX-C/V_V	DEPLINK	MAX
a. ☞ ajaɯ						**
b. ajasɯ					*!	*
c. ajagsɯ					*!*	
d. ajagɯ			*!		*	*
e. ajaGSɯ	*!*					

B. Elision

/ʧan+Sɯ/	SPECIFY	MAX_{full}	*VkV	MAX-C/V_V	DEPLINK	MAX
a. ☞ ʧanɯ						*
b. ʧansɯ					*!	
c. ʧasɯ		*!			*	*
d. ʧaɯ		*!				**
e. ʧanSɯ	*!					

/ʃiʃe+Si/	SPECIFY	MAX_{full}	*VkV	MAX-C/V_V	DEPLINK	MAX
a. ☞ ʃiʃesi					*	
b. ʃiʃei				*!		*
c. ʃiʃeSi	*!					

C. Velar Deletion

/sokaK+a/	SPECIFY	MAX_{full}	*VkV	MAX-C/V_V	DEPLINK	MAX
a. ☞ sokaa			*	*		*
b. sokaka			**!		*	
c. sokaKa	*!		*			

D. Non-derived environment blocking effects

/avukat/	SPECIFY	MAX_{full}	*VkV	MAX-C/V_V	DEPLINK	MAX
a. ☞ avukat			*			
b. avuat		*!		*		*

/sene+ki/	SPECIFY	MAX_{full}	*VkV	MAX-C/V_V	DEPLINK	MAX
a. ☞ seneki			*			
b. senei		*!		*		*

2 A closer look at the rules

The past section has limited the scope of the current research to SDF cases that are truly opaque and cannot be analysed with alternative methods. The goal of the present section is to provide more insight to the rules involved in the Turkish, Javanese and Japanese cases. At a glance, the rules in SDF fall into two categories. The 'earlier' rule in each interaction (15) always intends to resolve a consonant cluster, by either inserting or deleting a segment. That is, they work in conspiracy to resolve a *Complex violation.

(15) The earlier rule in each interaction (repeated)

a.	Epenthesis:	$\varnothing \longrightarrow$ i	/ C_C#
b.	Elision:	s/j $\longrightarrow \varnothing$	/ C_
c.	n-deletion:	n $\longrightarrow \varnothing$	/ C_
d.	Continuant Deletion:	[+cont] $\longrightarrow \varnothing$	/ C_

The 'later rule' in each interaction (16) always removes a root-final segment (velar stops, /h/ or /w/) in an environment created by suffixation:

(16) The later rule in each interaction (repeated)

a.	Velar Deletion:	k/g $\longrightarrow \varnothing$	/ V_V
b.	h-deletion:	h $\longrightarrow \varnothing$	/ V_V
c.	w-deletion:	w $\longrightarrow \varnothing$	/ _[−low]

A closer look reveals two common characteristics of these rules and interactions, which have not been explicitly noted in previous literature discussing SDF. In a word, the changes made by these rules are heavily dependent on the morpheme concatenation process. For one thing, every interaction involves at least one rule which is NON-DERIVED ENVIRONMENT BLOCKING. That is, these rules are not observed at every position of a word in each language, but only at morphologically derived environments, namely morpheme boundaries. For another, although the earlier rule in each interaction always attempts to avoid consonant clusters, the method adopted is different from the common solution crosslinguistically and better explained by root-affix asymmetry.

§2.1 introduces the notion of NDEB and explains why the rules involved in SDF examples are cases of NDEB. That is to say, the SDF observed in each language is not an interaction between two rules generally applicable regardless of position in that language, but rather an edge-specific alternation. §2.2 demonstrates how these cases attempt to avoid consonant clusters but take a rather different approach from the more common solution to consonant cluster reduction.

2.1 Non-derived Environment Blocking

Non-derived environment blocking (NDEB) refers to cases where a phonological process is blocked unless the structural description is morphologically or phonologically derived (Kiparsky 1982, 1993). A classic example is Assibilation in Finnish:

(17) Finnish Assibilation

	UR	a. /halut+i/	b. /vete/	c. /sata/	d. /tila/
Vowel Raising:	e $\longrightarrow$ i / _#		i		
Assibilation:	t $\longrightarrow$ s / _i	s	s		
	SF	[halusi]	[vesi]	[sata]	[tila]

Glosses: (17a) 'wanted', (17b) 'water', (17c) 'hundred', (17d) 'order'

Assibilation only applies when the environment /ti/ is formed across morpheme concatenation boundaries (17a), or when its structural description is met by the application of a prior rule – in this case, Vowel Raising, which raises mid vowels before a word boundary to high vowels (17b). /sata/ does not undergo either rule simply because the environment of neither rule is satisfied (17c). The word-initial /t/ in (17d) does not assibilate, although it also appears before /i/ like (17a-b), because the /ti/ sequence is formed neither by morpheme concatenation nor by other phonological rules. In fact, Elision and Velar Deletion in Turkish, n-deletion and h-deletion in Javanese, and Continuant Deletion in Japanese are all cases of NDEB, because their effects are only observed when a morpheme (in these cases, a suffix) is attached.

Elision of /s/ or /j/ is a morpheme edge-only process for two reasons. First, like Epenthesis, these two consonants are traditionally analysed as the morpheme-initial C that alternates with ∅ in Turkish suffixes (e.g., Lees 1961, Underhill 1976). Second, morpheme-internal post-consonantal /s/ and /j/ are not deleted and fairly common in Turkish:

(18) Turkish morpheme-internal post-consonantal /s/ and /j/[4]

	SF	Gloss		SF	Gloss
a. iksir	[iksiɾ]	'potion'	e. sübyan	[sybjan]	'minor'
b. borsa	[boɾsa]	'exchange'	f. madalya	[madaɫja]	'medal'
c. afsun	[afsun]	'spell'	g. isyan	[isjan]	'rebel'
d. konsa	[konsa]	'council'	h. dünya	[dynja]	'world'

The deletion of velar stops in Turkish is well-documented too (e.g., Lees 1961, Lewis 1967, Underhill 1976, Zimmer & Abbott 1978, Sezer 1981), and was confirmed to be a case of NDEB by Inkelas & Orgun (1995) and Inkelas (2011). It was found that root-final velar stops are deleted in intervocalic environments after suffixation (5, 6, 19), but not within a root morpheme (20a-d). Velar Deletion does not even apply in all morphologically derived environments: velar stops are not removed between two vowels when a /k/-initial suffix is attached to a vowel-ending root (20e-h).

(19) Turkish root-final Velar Deletion (Inkelas 2011)

	Gloss	Root UR	Dative (/-A/)	Genitive (/-In/)
a. bebek	'baby'	/bebek/	[bebee]	[bebein]
b. katalog	'catalog'	/katalog/	[kataloa]	[kataloun]
c. matematik	'mathematics'	/matematik/	[matematie]	[matematiin]

(20) Turkish morpheme/root-internal intervocalic velar stops preserved (Inkelas 2011)

	SF	Gloss		SF	Gloss
a. avukat	[avukat]	'lawyer'	e. seneki	[sene+ki]	'this year's'
b. hareket	[haɾeket]	'exchange'	f. adadaki	[adada+ki]	'the one on the island'
c. vagon	[vagon]	'railway car'	g. altıgen	[altɯ+gen]	'hexagon'
d. sigorta	[sigoɾta]	'insurance'	h. yedigen	[jedi+gen]	'heptagon'

Such NDEB effects are also observed for Javanese n-deletion and h-deletion. If n-deletion is not subjected to the restrictions of NDEB, one should expect /n/ to be deleted whenever it follows a consonant[5],

[4] Unless otherwise stated, the Turkish data used in this paper are cited from the Turkish Electronic Living Lexicon (TELL; http://linguistics.berkeley.edu/TELL/)

[5] Lee (1999, 2007) was not entirely consistent with the place specification of the nasals. Although the rule was named 'n-deletion' (Lee 1999: 32), the author used the constraint *CN in later analyses, which seemed to cover all nasals rather than just coronal ones. I will keep calling the rule 'n-deletion' because only coronal nasals are concerned in SDF.

regardless of its position in a word. However, morpheme-internal CN sequences are not banned (21), and the consonant preceding the nasal could be a stop, nasal, liquid, or even [h][6]:

(21) Javanese morpheme-internal CN sequences

	SF	Gloss
a. sakwèhning	[sak˺wɛhniŋ]	‘all’
b. prayitna	[prajɪt̪˺nɒ]	‘cautious, carefully’
c. ningnang	[niŋnaŋ]	‘no different, exactly the same’
d. pêrnah	[pərnae]	‘the family relationship’
e. rèhné	[rɛhne]	‘seeing that, in view of the fact that’
f. wahné	[wahne]	‘besides’
g. mungguhné	[muŋgʊhne]	‘supposing’

Similarly, if h-deletion is a case of NDEB, /h/ should be deleted whenever it is intervocalic, no matter whether it appears at a morpheme boundary or not. Again, this is not the case: /h/ is retained between two vowels when it appears in morpheme-medial positions (22):

(22) Javanese morpheme-internal intervocalic [h]

	SF	Gloss
a. dhihin (sic)	[dihin]	‘the first’
b. prihatin	[prɪhatɪn]	‘anxious’
c. bihal	[bihal]	‘mule (smuggler)’ (borrowed from Arabic)
d. trahing	[tra(h)iŋ]	‘being a family member of’
e. mihun	[mihun]	‘rice flour noodle’ (borrowed from Chinese)

Finally, in Japanese, Continuant Deletion only takes place at morpheme boundaries. Morpheme-internal consonant+continuant (mostly [nr]) sequences are commonly found (23).

(23) Japanese morpheme-internal consonant+continuant sequences

	SF	Gloss
a. kenri	[kenri]	‘right (n.)’
c. nenrei	[nenrei]	‘age’
d. kanren	[kanren]	‘connection’
e. shinrai	[ʃinrai]	‘trust’

The only two rules involved in these SDF interactions that are language-general are Epenthesis in Turkish and w-deletion in Japanese. Turkish Epenthesis takes place whenever the coda of a word has a flat or rising sonority (Sprouse 1997), which is banned in Turkish (Clements & Sezer 1982, Hulst & Weijer 1991). Japanese w-deletion is language-general because /w/ + non-low vowel sequences are absent in Japanese except for some loan words (Hall *et al.* 2018: 604).

In short, the data in (18-23) show that Turkish Elision and Velar Deletion, Javanese n-deletion and h-deletion, as well as Japanese Continuant Deletion, are all cases of NDEB because they only apply at (certain) morpheme concatenation boundaries, which are morphologically derived environments. Consequently, since all SDF interactions involve at least one NDEB rule, and all the rules are locally adding/removing segments, the result of SDF is always observed at morpheme edges.

[6] Unless otherwise stated, the Javanese data used in this paper come from personal elicitations and the SEAlang Library Javanese Resources (http://sealang.net/java/corpus.htm)

2.2 Consonant cluster reduction

Phonological processes usually take place to avoid certain prohibited patterns in a language, and the changes usually make the resulting pattern more phonotactically or prosodically harmonic. This section reviews the rules in Turkish, Javanese and Japanese SDF and discusses how all three cases also aim to avoid an suboptimal pattern – consonant clusters – with their first rules.

In Turkish, Epenthesis takes place whenever there is a 'certain disallowed coda consonant cluster' (Sprouse 1997) at a morpheme boundary. In all three languages, the first rule (Elision, n-deletion and Continuant Deletion) takes place whenever a suffix beginning with the target consonant (/s/, /j/, /n/ or /r/) is attached to a consonant-ending word. The motivation for these processes is easily understood, because consonant cluster avoidance is prevalent crosslinguistically, e.g., Korean (Choe 1986, Park 2009), Latin (Cser 2020, a.o.), Diola Fogny (Kiparsky 1973, Lombardi 2001, a.o.). Inserting a vowel and the deleting one of the consonants in the cluster are two common methods of simplification. However, apart from being NDEB, there is another peculiarity associated with the Turkish Elision, Javanese n-deletion and Japanese Continuant Deletion rules here. That is, if one of the consonants in an intervocalic cluster C_1C_2 should be removed, it is usually C_1 rather than C_2 crosslinguistically because of C_1's reduced perceptibility (Wilson 2001). In contrast, it is always C_2 that gets removed in these three rules.

There are indeed cases where C_1 is not the target for removal. Some languages simplify consonant clusters by always removing the more sonorous segment regardless of its relative position e.g., Pali (Hankamer & Aissen 1974). This is because the remaining consonant will become the onset of the following syllable (when there is one) and less sonorous onsets are preferred over more sonorous ones (Zec 1995, Prince & Smolensky 1993, Clements 1990). But this generalisation does not apply to Turkish, Javanese or Japanese here, who get rid of C_2 regardless of its relative sonority compared to C_1 (24-26).

(24) Turkish removes C_2 after suffixation of /-sI/

	Gloss	Root UR	Suffixation	SF
a. alay	'regiment'	/alaj/	alaj+sɯ	[alajɯ]
b. karar	'decision'	/kaɾaɾ/	kaɾaɾ+sɯ	[kaɾaɾɯ]
c. çan	'bell'	/ʧan/	ʧan+sɯ	[ʧanɯ]
d. gülüş	'smile'	/gylyʃ/	gylyʃ+sɯ	[gylyʃɯ]
e. top	'ball'	/top/	top+sɯ	[topu]

(25) Javanese removes C_2 after suffixation of /-ne/

	Gloss	Root UR	Suffixation	SF
a. bénér	'right'	/bener/	bener+ne	[benere]
b. béring	'unbalanced'	/beriŋ/	beriŋ+ne	[beriŋe]
c. tégés	'significance'	/teges/	teges+ne	[tegese]
d. kulit̪	'skin'	/kulit̪/	kulit̪+ne	[kulit̪e]

(26) Japanese removes C_2 after suffixation of /-ru/

	Gloss	Root UR	Suffixation	SF
a. shir	'to know'	/ʃir/	ʃir+ru	[ʃiru]
b. shin	'to die'	/ʃin/	ʃin+ru	[ʃinu]
c. hanas	'to speak'	/hanas/	hanas+ru	[hanasu]
d. tob	'to fly'	/tob/	tob+ru	[tobu]

The best explanation probably lies in the suffix nature of the deleted segment, which coincides with the 'restricted exceptions' of C_2 deletions at root+suffix boundaries described by Wilson (2001). More specifically, when a consonant cluster is formed at the suffixation site, the consonant in the suffix is removed because the root has a special faithfulness requirement (Beckman 1998, Casali 1997, Zoll 1998, McCarthy & Prince 1995). To satisfy this requirement, C_1 in the root must be protected and C_2 in the suffix is removed consequently. Furthermore, this theory of root faithfulness helps to explain the NDEB nature of Turkish Elision, Javanese n-deletion and Japanese Continuant Deletion. If such a C~∅ pattern is motivated by the relative dominance of the root over the adjacent suffix, it is surely expected at a root-suffix boundary only.

In conclusion, the consonant deletion pattern in Turkish, Javanese and Japanese is in contradiction with the crosslinguistic common tendency to delete the first or more sonorous consonant. The best explanation for such a choice is probably the faithfulness requirement that these languages posit on root segments.

3 Proposal

Summarising the conclusions made in §2, an interesting feature of SDF is revealed. This pairwise rule interaction differs drastically from other types of interactions insofar that SDF is heavily dependent on – or even confined to – morpheme concatenation sites. It is clearly shown that (1) all SDF cases involve NDEB that happen only at morpheme-concatenation boundaries, and (2) all these cases are trying to avoid consonant clusters by making changes to the suffix. A vital question thus naturally comes into play: Is the relationship between morpheme boundaries and SDF completely coincidental, or is there any factor that causes them to appear together?

To answer this question, I offer a unified account for all the documented SDF examples, which is not only able to capture the SDF pattern and its related phenomena, but also able to show that the so-called SDF is a necessary result when certain morphemes are attached to each other. The two important theories responsible for demonstrating how these morphemes are special and how they necessarily lead to a SDF pattern are underspecification (Kiparsky 1993) and contextual faithfulness (Beckman 1998, Lombardi 2001, 1999, Steriade 2009, Wilson 2001, a.o.). The framework in which I choose to operate is Standard OT, because I intend to show that, once the aforementioned theories are adopted and the URs of the relevant morphemes are clarified, Standard OT can handle certain cases of 'opacity', if they are still opaque.

§3.1 provides the background on how Standard OT is problematic when dealing with opacity. §3.2 to §3.5 introduce the two background theories – underspecification and contextual faithfulness – respectively, explain why they are needed for the two characteristics mentioned in §2, and illustrate how their application in the current proposal can account for SDF in all three languages using the same set of constraints with the same relative rankings in Standard OT. Finally, §3.6 evaluates the current proposal by discussing the predictions and contributions it might make.

3.1 A starting point

It has long been noted in the literature that Standard OT fails to account for opacity while rule-based serialism succeeds by ordering the rules. McCarthy (1999) showed how COUNTERFEEDING ON ENVIRONMENT poses problems for Standard OT but COUNTERFEEDING ON FOCUS does not, although they both lead to underapplication opacity. McCarthy (2007b) and Baković (2007) showed that all varieties of overapplication opacity are problematic for Standard OT. This is true for all SDF cases as well.

In OT terms, the effect of Turkish Epenthesis could be achieved by a markedness constraint penalising consonant clusters (*CC) dominating a faithfulness constraint penalising insertion of vowels (DEP). Velar Deletion could be analysed as a constraint penalising intervocalic [k] (*VkV) dominating MAX, which forbids the removal of segments. (27) lists the constraints needed for Turkish vowel-SDF and (28) shows how the interaction between them fails to derive the candidate that is supposed to win, because (28b) harmonically bounds (28a):

(27) a. *CC: Assign one violation (AOV) for each (illegal) consonant cluster.
b. *VkV[7]: AOV for each velar stop appearing between two vowels.
c. Dep: AOV for each segment inserted.
d. Max: AOV for each segment removed.

(28) Standard OT predicts the incorrect candidate for Turkish vowel-SDF (cf. Baković 2007: 229).

/bebek+n/			*CC	*VkV	Dep	Max
a.	☹	bebein			*	*
b.	💣	beben				*
c.		bebekin		*!	*	
d.		bebekn	*!			

Similarly, Turkish Elision, Javanese n-deletion and Japanese Continuant Deletion are derived from the domination of *CC and over Max. Apart from the markedness constraints (*VhV for Javanese and *w[−low] for Japanese), the only extra constraint needed for these two rules is Max$_{root}$ (29c), which captures the fact that, in a consonant cluster, the consonant in the suffix instead of the first consonant in the cluster is deleted because of the root faithfulness requirement. (30) shows how Standard OT fails to capture the SDF patterns involving consonants with Javanese as an example.

(29) a. *VhV: AOV for each [h] between two vowels.
b. *w[−low]: AOV for each [w] followed by a non-low vowel.
c. Max$_{root}$: AOV for each segment in the root in the input deleted in the output (adapted from Wilson 2001: 174).

(30) Example: Standard OT fails on Javanese SDF (cf. Lee 1999: 34)

/omah+ne/			*CN	*VhV	Max$_{root}$	Max
a.	☹	omae			*	**
b.	💣	omane			*	*
c.		omahe		*!		*
d.		omahne	*!			

In additional to its failure of accounting for SDF, the current Standard OT analysis cannot capture the NDEB nature of any of the processes at hand either. Take Javanese for example: [səkolaan] requires *VhV to dominate Max$_{root}$, whereas [dihin] requires the completely opposite ranking (31). But one should not expect contradictory rankings of constraints in a language.

(31) Constraint ranking conflict in Javanese

/səkolah+an/			*CN	*VhV	Max$_{root}$	Max
a.	☞	səkolaan			*	*
b.		səkolahan		*		

[7] In order not to confuse the readers with capital letters G or K representing the class of velar stops with underspecified segments, which are also traditionally represented by capital letters, I will always abbreviate the constraint as *VkV. But note that it essentially aims at both [k] and [g].

/dihin/			*CN	*VhV	MAX_{root}	MAX
a.	☹	dihin		*		
b.	💣	diin			*	*

In the next four subsections, I will demonstrate how the use of underspecification can solve the problem of NDEB in Standard OT, and with the help of certain contextual faithfulness constraints, the SDF patterns in all three languages can be successfully captured at the same time, all achieved with the same set of constraints and relative ranking.

3.2 Underspecification

Many theories have been proposed to deal with NDEB, including the Strict Cycle Condition (Mascaró 1976), Sequential Faithfulness (Burzio 2000), Coloured Containment (Oostendorp 2007), and Optimal Interleaving with Candidate Chains (Wolf 2008). However, as argued in Rasin (2023), none of these theories can capture the three extended puzzles of NDEB, namely persistent blocking, blocking within suffixes, and non-contrastive trigger (see Rasin 2023: §3-4 for more detailed discussion). In addition, Inkelas (2000) showed that another theory – Neighbourhood Protection (Itô & Mester 1996: 8) – fails as well. NEIGHBOURHOOD is a kind of LINEARITY constraint which, for each pair of adjacent input segments α and β, assigns one violation if it does not correspond to a pair of adjacent segments α_1, β_1 in the output where α_1 precedes β_1. NEIGHBOURHOOD^2, the self-conjunction of NEIGHBOURHOOD, penalises each pair of input segments with two NEIGHBOURHOOD violations. With these two constraints, this theory aims to capture NDEB by assuming that two segments separated by a morpheme boundary are not adjacent. However, it cannot capture the asymmetry in alternations between morpheme-initial and morpheme-final segments (32), wrongly predicts the behaviours of stem-internal undergoers of derived-environment rules, and does not account for certain phonotactically-driven cases that do not induce alternations (see Inkelas 2000: §2.1 for more details).

(32) Neighbourhood Protection

A. How it is supposed to capture NDEB

/sokak+a/			NEIGHBOURHOOD^2	*VkV	NEIGHBOURHOOD
a.		sokaka		**!	
b.	☞	sokaa		*	*
c.		soaka	*!	*	
d.		soaa	*!		* * *

B. How it incorrectly changes morpheme-initial segments

/sene+ki/			NEIGHBOURHOOD^2	*VkV	NEIGHBOURHOOD
a.	☹	seneki		*!	
b.	💣	senei			*

The only theory that is able to capture NDEB effects while avoiding all the aforementioned problems seems to be Kiparsky's (1993) UNDERSPECIFICATION account, which I will adopt for my analysis. The essence of this theory is that, in the UR, some segments are underspecified (Kiparsky 1982, Archangeli & Pulleyblank 1989) while others are fully-specified. Take Finnish Assibilation again for example:

(33) Underspecification derivation for Finnish

		UR	a. /haluT+i/	b. /veTe/	c. /saTa/	d. /tila/
Vowel Raising:	e ⟶ i /_#			i		
Assibilation:	T ⟶ s /_i		s	s		
Default:	T ⟶ t				t	
		SF	[halusi]	[vesi]	[sata]	[tila]

The alveolar stop in /halut+i/ and /vete/ are in fact underspecified /T/ with the feature [cont] not specified underlyingly. The /t/ in /tila/ is fully-specified for continuancy with [−cont]. Assibilation is essentially a feature-filling (or structure-filling) rule (Kiparsky 1982, Archangeli 1984, Pulleyblank 1986), which fills /T/ with [+cont] and changes the SF to [s] (33a-b). Another default rule taking place after Assibilation fills /T/ with [−cont] and turns all the underspecified /T/ at that point into [t] (33c). The fully-specified /t/ in /tila/ (33d) undergoes neither Assibilation nor the default rule, because both processes apply only to underspecified segments and fully-specified segments are protected from such feature-filling rules.

Given its ability to capture NDEB effects, underspecification serves as an important basis of my proposal. Two questions await answering before an analysis is sketched out. First, which *segment(s)* should be underspecified to capture the desired effects of NDEB and SDF simultaneously? Second, which *feature* should be underspecified for the segment ~ ∅ alternations in SDF?

3.2.1 Which segment(s)?

The main drawback of Kiparsky's (1993) theory, as pointed out by Burzio (2000) and Inkelas (2000), is that it leaves the distribution of underlying under- and fully-specified segments as an accident of the lexicon. That is, there is no theory regulating when and where an underspecified segment is generated, and the grammar is not prevented from generating URs like /halut+i/ which fails to undergo the obligatory process of Assibilation in Finnish.

Two theories have been proposed to regulate the distribution of underspecified segments and they make slightly different predictions as to where underspecification appears. Rasin (2023) used Morpheme Structure Constraints (MSC; Halle 1959, 1962, Chomsky & Halle 1968, a.o.), a theory whose central tenet is to prohibit certain structures from occurring in *individual* morphemes in the lexicon. The logic of formulating a MSC is to place fully-specified segments only in the environment meeting the structural description of the rule that later makes undesirable changes to this segment, and the environment must be found within a single morpheme. For example, the MSC responsible for deriving the NDEB feature of Finnish Assibilation is shown in (34). Here, /t/ is restricted to appear only before /i/, which is the environment of Assibilation, so that /t/ will not be accidentally changed by Assibilation which applies only to /T/:

(34) MSC for Finnish Assibilation (adapted from Rasin 2023: ex.5)
/t/ occurs before /i/; /T/ elsewhere.

Inkelas's (1995, 2000) Alternation-sensitive Lexical Optimisation (A-LO) theory, on the other hand, selects the segment and feature to be underspecified in a similar way to Lexicon Optimisation (Prince & Smolensky 1993: 192). The main take-away of A-LO is that alternation is the only way to determine underspecification and features are only underspecified when it aids input-output mapping. For an alternating segment, if a feature is completely predictable from the context, it can be underspecified. 'Nonalternating features, no matter how predictable, are lexically prespecified' (Inkelas 1995: 290). In other words, whether a segment alternates on the surface is an *indicator* of whether it has underspecified features – nonalternating segments must be completely fully-specified, and alternating ones are underspecified for certain features. This applies to NDEB in the sense that, if a segment fails to alternate even when the structural description for alternation is met, the reason must be that this segment is structurally immune because of lexical pre-specification of features (Inkelas 2000). For example, in Finnish, the alveolar stops [t] that alternate with [s] are underlyingly underspecified as /T/, while those [t]'s that never alternate are underlyingly fully-specified as /t/. The table below shows the prediction these two theories make for the URs of the Finnish words (35):

(35) URs predicted by the MSC and A-LO theory for Finnish

	SF	MSC	A-LO
a.	[halusi]	/haluT+i/	/haluT+i/
b.	[vesi]	/veTe/	/veTe/
c.	[sata]	/saTa/	/sata/
d.	[tila]	/tila/	/tila/

Under the MSC theory, only the word-initial /t/ in /tila/ is fully-specified, because it is the only /t/ appearing before /i/ in a single morpheme. In contrast, A-LO predicts that if a segment never alternates on the surface, it must be lexically fully-specified to resist the phonological feature-filling rules. So the /t/ in both /sata/ and /tila/ are underlyingly fully-specified.

Despite the different predictions for the UR, the two theories arrive at identical SFs for Finnish. However, this is not the case for Turkish Velar Deletion and A-LO is shown to be more empirically correct. Recall that Turkish removes morpheme-final velar stops when they become intervocalic as a result of suffixation, but retains morpheme-initial and morpheme-internal intervocalic /k/ or /g/, even when the morpheme in which it appears is a suffix (36):

(36) Turkish Velar Deletion alternations (repeated, URs to be modified)

	UR	SF	Gloss
a.	/sokak+a/	[sokaa]	'street'
b.	/avukat/	[avukat]	'lawyer'
c.	/katalog/	[katalog]	'catalog'
d.	/sene+ki/	[seneki]	'next year'

Since the structural description of the Velar Deletion rule in Turkish is V_V, any velar stop that occurs between two vowels in a single morpheme should be fully-specified in order not to be changed, according to the MSC theory. In contrast, the A-LO theory predicts that all the nonalternating segments should be fully-specified. Leaving aside the question of what features are underspecified for later, the table in (37) summarises the URs predicted by each theory. Although most of the SFs end up the same even if the URs diverge (like x[katalog]), a difference does occur for [seneki], which becomes a problem (38).

(37) URs predicted by the MSC and A-LO theory for Turkish Velar Deletion

	SF	MSC	A-LO
a.	[sokaa]	/sokaK+a/	/sokaK+a/
b.	[avukat]	/avukat/	/avukat/
c.	[katalog]	/KataloG/	/katalog/
d.	[seneki]	/sene+Ki/	/sene+ki/

(38) SFs derived from the URs under the MSC and A-LO theory

A. MSC:

	UR	a. /sokaK+a/	b. /avukat/	c. /KataloG/	d. /sene+Ki/
Velar Deletion:	K ⟶ ∅ / V_V	∅			∅
Default:	K ⟶ k			k g	
	SF	[sokaa]	[avukat]	[katalog]	*[senei]

B. A-LO:

	UR	a. /sokaK+a/	b. /avukat/	c. /katalog/	d. /sene+ki/
Velar Deletion:	K ⟶ ∅ / V_V	∅			
Default:[8]	K ⟶ k				
	SF	[sokaa]	[avukat]	[katalog]	[seneki]

MSC and A-LO assign different URs to [seneki], but only the latter is able to derive the correct SF for [seneki]. The main reason for the failure of MSC is that it is only able to regulate the distribution of segments in *single* morphemes. When the environment in which a segment should not alternate spans across two morphemes like /sene+Ki/, the theory is unable to stop underspecified segments from being changed. In other words, it is too late to realise that /k/ should be fully-specified in the intervocalic environment created after suffixation in /sene+ki/. Therefore, I will adopt the A-LO approach in identifying which segment to underspecify, and assume that segments that alternate on the surface are underspecified for certain features while those that do not are fully-specified (39).

(39) Underspecification representations for all SDF examples

Turkish:	a. /bebeK+In/	Javanese:	c. /omaH+Ne/
	b. /ajaG+Sɯ/	Japanese:	d. /kaW+Ru/

3.2.2 Which feature?

A final question that needs addressing is which feature should be underspecified. Unlike the Finnish case where the surface alternation happens between two segments [t] ~ [s], the alternations in SDF examples are always between a segment and ∅. The segment ~ ∅ alternation makes it difficult to choose the underspecified feature, if any unspecified feature on the surface can equally lead to the disappearance of a segment. That is, when [t] alternates with [s], where the two segments only differ by one feature [cont], it is easily decided that [cont] should be the feature to be underspecified to accommodate later alternations. But when the alternation is between the presence and absence of a segment, and one assumes that the absence of a segment is attributed to whichever feature being unspecified on the surface, the choice of the feature to be underspecified among all features becomes rather unclear[9].

One possible choice is to underspecify the Place feature of a segment, or a certain aspect of it. There are two motivations for such a choice. First, the nasals in Javanese (affixes) are subjected to Place Assimilation triggered by obstruents and /w/(e.g., Mester 1986) as shown in (40). One could assume that all nasals in Javanese are underspecified for Place underlyingly, and they get Place specifications from an adjacent

[8] A processes analogous to this default rule was not deemed necessary by Inkelas (2000). One should note that omitting this rule will not lead to any difference in the SFs.

[9] Inkelas & Orgun (1995) and Inkelas (2000) pointed out the difficulty for the A-LO theory to account for segment ~ ∅ alternations and used a different approach which depended on syllable structures. I will not go along this line but seek the feature to be underspecifed instead.

obstruent or /w/. When appearing intervocalically, the default Place [Coronal] (Yip 1989) is filled[10]. Second, Turkish is famous for Vowel Harmony where vowels are only prespecified for height and assimilate their frontness and roundness according to the surrounding environment (e.g., vowels in the stem or certain consonants, see Clements & Sezer 1982, Hulst & Weijer 1991). A vowel underspecified for frontness and rounding in /-In/ would work for the Turkish vowel-SDF case if it already has part of its Place feature left to be filled.

(40) Place Assimilation in Javanese (adapted from Yip 1989: 355)

	Root	Affixed	Gloss
a.	[bakar]	[mbakar]	'roast (ACT)'
b.	[dudur]	[ndudu]	'place'
c.	[wudjut]	[mudjutake]	'shape (CAUS)'
d.	[gad̪ag]	[ŋgad̪ag]	'pervasive'

But this proposal also has some drawbacks. First, the Place Assimilation in Javanese is only observed in prefixes. Suffix-initial nasals simply get removed as far as my elicitation and the database show. So it is hard to decide whether nasals in Javanese assimilate to preceding consonants as well as those that follow. Even if one chooses to go down this line, the default Place must be determined on a language-to-language basis. For example, the default Place feature might be [Coronal] for Javanese nasals, but it is arguably [Dorsal] in Japanese (Rice 1996). Although language variations can be explained by different constraint rankings, preference would be given to a uniform account that does not need to vary from language to language. The most critical reason to not underspecify Place lies in Turkish. Velar Deletion targets at stops at the *velar* Place only: if Place is underspecified for these stops, how could the Velar Deletion rule target them to delete?

Therefore, I choose to adopt the autosegmental underspecification account proposed by Kiparsky (1993) for Finnish Consonant Gradation (for Autosegmental Phonology, see Goldsmith 1976). In Finnish, a geminate at the beginning of a closed syllable degeminates in derived environments only (41a). Consonant Gradation is blocked when the syllable containing the geminate is contained in a single morpheme, so the first /tt/ in (41b) does not degeminate, nor does the /tt/ in (41c).

(41) Finnish Consonant Gradation alternations (adapted from Kiparsky 1993 and Rasin 2023)

	UR	SF	Gloss
a.	/hattu+n/	[hatun]	'hat (GEN)'
b.	/attentaatti+n/	[attentaatin]	'assassination (GEN)'
c.	/maa+i+tten/	[maaitten]	'country (PL.GEN)'

Kiparsky's (1993) theory assumes that the skeletal tier containing C (consonant) and V (vowel) slots are separated from the melodic tier hosting the segments. Fully-specified short and long consonants are associated with one and two C slots respectively. Underspecified geminates are associated with one C slot and preceded by another unassociated C slot (42), and the first unassociated C slot is assumed to close the preceding syllable[11].

[10] Note that Yip (1989) transcribed the coronal nasal as a dental [n̪]. Since I did not find this phonetic detail in my own elicitations and the dental vs. alveolar contrast does not lead to any difference in the main analysis, I will just transcribe the coronal nasal as [n] for simplicity.

[11] The necessity of syllabification in the UR after affixation is shown in words like /hottento**tti**-**tt**oma-ta/ → [hottento**ti**-**t**on-ta] 'Hottentotless-PART.SG.' (Kiparsky 1993: 283). The two 'tt' in boldface are degeminated because 'they are onsets of closed syllables at some level of representation'. Without the assumption that underspecified geminates have a preceding C slot that closes the preceding syllable, the syllable containing the first 'tt' in boldface is never closed. The second 'tt' in bold face is in a closed syllable after the V slot of /a/ in the suffix /-ttoma/ is removed (Kiparsky 1993: 296). Since syllabification does not influence idea of 'linking as a control of presence' that I wish to borrow from the autosegmental underspecification account, I will not go further and just completely follow Kiparsky (1993) and Rasin (2023) when citing examples.

(42) Autosegmental underspecification representation for Finnish Consonant Gradation

```
a. short   b. long   c. underspecified
   C         C C          C C
   |          \|            |
   t           t            t
```

As argued in Rasin (2023), a MSC in Finnish dictates that underlyingly long consonants are found only at the onset of a closed syllable, and all the remaining consonants are either short or underspecified. In this way, the Consonant Gradation rule that applies later will not undesirably change any long consonants at the onset of a closed syllable contained in a single morpheme (43).

(43) Derivations for Finnish Consonant Gradation (Rasin 2023: ex.50-51)

UR	a. /haT.Tu+n/	b. /maa+i+tten/
Consonant Gradation	hatu-n	
TT ⟶ tt		
SF	[hatun]	[maaitten]

The central tenet of this account is that, the linking and delinking between a consonant and a C slot can determine the consonant's presence or absence, which is suitable for the segment ~ ∅ alternations in SDF. Therefore, all the segments identified to be underspecified in the previous section are underspecified in the sense that they are not linked to the C or V slot on the skeletal tier (44). For simplicity of representation, I will keep using capital letters for underspecified segments. Fully-specified segments are underlying linked to a C or V slot.

(44) Autosegmental underspecification representation for all SDF examples

```
             C V C V C     V C                  V C V C     C V
             | | | |         |                  | | |         |
Turkish:  a. b e b e K + I n      Javanese:  c. o m a H + N e

             V C V C     C V                    C V C     C V
             | | |         |                    | |         |
          b. a j a G + S ɯ        Japanese:  d. k a W + R u
```

3.3 Interim analysis

With the relevant theories in place and constraints in (45), all SDF cases involving two interacting consonants can be successfully accounted for, along with the majority of NDEB effects and root faithfulness phenomena. Since the Turkish consonant-SDF, Javanese and Japanese cases have identical effects, (46) uses only Turkish consonant-SDF to demonstrate how the proposal works at this point. The other two cases can be derived by substituting the language-specific markedness constraint (45c) at the corresponding position.

(45) Constraints responsible for SDF (to be completed)

a. SPECIFY: AOV for each segment that is not linked to a C/V slot (cf. SPECIFY[T] in Myers 1997: 861 and Zoll 2003: 241).

b. MAX_{full}: AOV for each underlying fully-specified segment removed[12].

c. *VkV (for Turkish): AOV for each [k] or [g] between two vowels.

[12] Note that MAX_{full} and MAX penalise the complete removal of a segment rather than the delinking between a segment and a C/V slot.

*VhV (for Javanese): AOV for each [h] between two vowels.
*w[−low] (for Japanese): AOV for each [w] followed by a non-low vowel.

d. DEPLINK: AOV for each association line added between a segment and a C/V slot (cf. NO-LINK[place] in McCarthy 2008: 278).

e. MAX: AOV for each segment removed.

(46) Example: Consonant-SDF cases accounted for in Turkish (to be updated)

A. SDF example

/ajaG+Sɯ/	SPECIFY	MAX_{full}	*VkV	DEPLINK	MAX
a. ☞ ajaɯ					**
b. ajasɯ				*!	*
c. ajagsɯ				*!*	
d. ajagɯ			*!	*	*
e. ajaGSɯ	*!*				

B. Elision (to be refined)

/ʧan+Sɯ/	SPECIFY	MAX_{full}	*VkV	DEPLINK	MAX
a. ☞ ʧanɯ					*
b. ʧansɯ				*!	
c. ʧasɯ		*!		*	*
d. ʧaɯ		*!			**
e. ʧanSɯ	*!				

C. Velar Deletion

/sokaK+a/	SPECIFY	MAX_{full}	*VkV	DEPLINK	MAX
a. ☞ sokaa			*		*
b. sokaka			**!	*	
c. sokaKa	*!		*		

D. NDEB

/avukat/	SPECIFY	MAX_{full}	*VkV	DEPLINK	MAX
a. ☞ avukat			*		
b. avuat		*!			*

/sene+ki/	SPECIFY	MAX_{full}	*VkV	DEPLINK	MAX
a. ☞ seneki			*		
b. senei		*!			*

The interim proposal above has reduced SDF to the relative ranking between three constraints: SPECIFY ≫ DEPLINK ≫ MAX. When an underspecified segment appears in the UR, the best solution is to remove it completely (violating MAX), in order to avoid violations of more highly ranked SPECIFY, which requires full specifications of segments on the surface, and DEPLINK, which bans adding association lines to solve the underspecification problem. The fact that MAX_{full} outranks the markedness constraints (*VkV, *VhV and *w[−low]) serves the function of protecting fully-specified segments from deletion, achieving the effect of the MSCs. The NDEB and root faithfulness phenomena are captured by the contrast between underlyingly under- and fully-specified segments. Since the underspecified segments that can undergo alternations are always on the edge of a morpheme, these processes are inevitably NDEB. The highly ranked MAX_{full} over MAX implies that the deletion of a fully-specified segment leads to a more severe consequence than that of an underspecified segment. Therefore, in a consonant cluster where C_1 in the root is fully-specified but C_2 in the suffix is underspecified, the second consonant in the suffix gets deleted.

However, a serious problem arises with these constraints and their relative ranking: it predicts that an underspecified segment will always be removed because MAX is most lowly ranked. Three incorrect predictions are made consequently: (1) roots ending in underspecified segments have their final segments removed by mistake (47), (2) Turkish vowel-SDF (48) cannot be accounted for, and (3) when a suffix with an underspecified initial consonant is attached to a vowel-ending root, the underspecified consonant is incorrectly removed (49).

(47) Root-final underspecified segments are wrongly removed

/bebeK/			SPECIFY	MAX_{full}	*VkV	DEPLINK	MAX
a.	☹	bebek				*!	
b.	💣	bebe					*
c.		bebeK	*!				

(48) The up-to-date proposal fails on /bebeKIn/

/bebeKIn/			SPECIFY	MAX_{full}	*VkV	DEPLINK	MAX
a.	☹	bebein				*!	*
b.	💣	beben					**
c.		bebekn				*!	*
d.		bebekin			*!	**	
e.		bebeKIn	*!*				

(49) Example: Suffix-initial underspecified consonants are not preserved in Javanese

/kopi+Ne/			SPECIFY	MAX_{full}	*VhV	DEPLINK	MAX
a.	☹	kopine				*!	
b.	💣	kopie					*
c.		kopiNe	*!				

Although the problem of removing root-final segments can be solved by using constraints that require edge-alignments of words (McCarthy & Prince 1993, 1995) as shown in (50-51), the remaining problems suggest that there are still some important characteristics of each language that my proposal has overlooked. More specifically, word-internal underspecified segments have not been allowed to alternate on the surface at the moment: their only destiny is to be removed. The next section introduces the final theory that needs to be incorporated to correctly predict when these underspecified segments should surface.

(50) a. ANCHOR-W-IO: AOV for each misaligned input-output *word* edge.
b. Crucial ranking: ANCHOR-W-IO ≫ DEPLINK ≫ MAX[13]

(51) Example: Correct SFs derived for the roots in Turkish

/bebeK/	SPECIFY	ANCHOR-W-IO	DEPLINK	MAX
a. ☞ bebek			*	
b. bebe		*!		*
c. bebeK	*!			

3.4 Contextual faithfulness

By comparing the candidate that is supposed to win and the actual winning candidate in (48-49), it can be concluded that the proposal fails because the underspecified suffix-initial segments (that occur word-internally) always get incorrectly deleted. Again, if one accepts that phonological processes and phonotactic constraints exist to make the surface string more harmonic, the preservation of segments should be positively supported by some phonological normality as well. What is it then?

The answer seems to be the strong preference for the CV syllable structure in Turkish, Javanese and Japanese. At a large scale, it is widely acknowledged that CV is the most canonical syllable structure because it is the only structure that is found in all languages (Dryer & Haspelmath 2013, a.o.). For these three languages specifically, a preference for consonants and vowels to alternate is also confirmed. Hulst & Weijer (1991) reports the canonical syllable structure in Turkish to be (C)V(C). Yip (1989: 353) directly states that the most common word shape in Javanese is CVCVC. Japanese is famous for only allowing /N/ and the moraic obstruent /Q/ in coda positions (Vance 2008). In addition, the traditional description of allomorphy in these languages (e.g., for Turkish: Hulst & Weijer 1991, Hankamer 2011; for Javanese: Dudas 1976, Lee 1999; for Japanese: Kurisu 2012) and observations of the data confirm this hypothesis: whether the suffix surfaces as consonant- or vowel-initial depends on the final segment of the root: [-n], [-sɯ], [-ne] and [-ru] surface when the root ends in a vowel, and [-in], [-ɯ], [-e] and [-u] surface when the root ends in a consonant.

Therefore, the cases above could be the result of avoiding the deletion of the segment that is already part of the CV-alternating pattern. /I/ is underlyingly between two consonants in /bebeKIn/, and /S/, /N/ and /R/ are underlyingly between two vowels when they are attached to vowel-ending roots, regardless of whether their neighbours are fully-specified. Removing these segments in turn destroys the preferred syllable structure, which is already in place. So, all that is needed is a theoretically-supported constraint designed to protect a certain pattern in the UR.

The most straight-forward answer is the CONTEXTUAL FAITHFULNESS (also known as POSITIONAL FAITHFULNESS) constraints, whose general idea is that extra faithfulness is required in some specific contexts (Beckman 1998, Lombardi 1999, 2001, Wilson 2001, Steriade 2009). There are mainly two kinds of them. The first kind asks for faithfulness of certain features on segments in a specific position or environment. For example, IDENT-σ_1 in Beckman (1998: 56) requires extra faithfulness of features for segments in

[13] The relative ranking between ANCHOR-W-IO and the rest of the constraints in (45) is undetermined. I leave out the irrelevant constraints in the tableau below.

root-initial syllables. Wilson (2001: 179) proposed the constraint IDENT(voice)/_[son] for the Lithuanian data in Steriade (1997) to ensure that the [voice] feature of any pre-sononant segment does not change.

The second kind, which is the one adopted in this paper, asks for the preservation of a (class of) segment(s) in a specific context. In the P-Map[14] (P for 'perceptibility') theory proposed by Steriade (2009), a range of MAX/_K constraints (where K stands for the context) were employed to solve the *Too-Many-Solutions* problem in the OT framework. In short, the P-map theory states that, when there are many possible ways to satisfy the same phonotactic requirement, a language usually selects the solution involving the least perceptible contrast. For instance, in a $VC_1C_2C_3V$ sequence, the middle consonant C_2 is usually removed instead of C_1 or C_3, because C_2 is the most confusable and less perceptible segment. The constraint responsible for this generalisation is thus MAX-C/V_C, since C_2 is the only consonant not surrounded by a vowel plus a consonant.

Given that OT is a SF-driven framework and the protection of a certain structure is best achieved by ranking a faithfulness constraint over a markedness constraint instead of forcing a structure to remain unchanged, the choice of the context or structure in a constraint receiving extra faithfulness is best independently motivated. As for the aforementioned constraints, the context either appears in a special position (e.g., the initial syllable of a word), or is independently justified for other phonetic reasons as in P-map. There is indeed an independent motivation for the SDF cases too: Intervocalic consonants and interconsonantal vowels should not be removed because their deletions will lead to a less preferred syllable structure. So, the general idea of the second type of contextual faithfulness constraints used in P-map can be adopted here. A pair of constraints capturing this pattern would be MAX-V/C_C and MAX-C/V_V respectively (52). The critical ranking is MAX-V/C_C or MAX-C/V_V ≫ DEPLINK, which is able to ensure that suffix-intial vowels show up interconsonantally, and consonants show up intervocalically. These contextual faithfulness constraints also need to be outranked by markedness constraints *VkV/*VhV/*w[−low], to derive the NDEB effects when an underspecified segment appears on a morpheme edge.

(52) a. MAX-V/C_C: AOV for each vowel between two consonants in the input deleted in the output.
b. MAX-C/V_V: AOV for each consonant between two vowels in the input deleted in the output.

3.5 Full analysis

With the two additional constraints in (52), the full range of SDF cases and its related phenomena are successfully derived (53-56).

(53) Turkish vowel-SDF captured by the full analysis

A. SDF example

/bebeK+In/	SPECIFY	MAX$_{full}$	*VkV	MAX-V/C_C	DEPLINK	MAX
a. ☞ bebein					*	*
b. beben				*!		**
c. bebekn				*!	*	*
d. bebekin			*!		**	
e. bebeKIn	*!*					

[14] See McCarthy (2009) for P-Map's Input Problems (PMIP), one of which argues that the URs do not always contain enough information about what segments sound like (e.g., whether a sound is released), making P-Map constraints referring to such information in the input problematic. Since the constraints I intend to adopt do not refer to such information, and the necessity of contextual faithfulness is motivated in other situations mentioned in this section, I will not take PMIP as an objection to the constraints I propose below.

B. Epenthesis: occurring after only C-ending roots

/ip+In/		SPECIFY	MAX$_{full}$	*VkV	MAX-V/C_C	DEPLINK	MAX
a. ☞	ipin					*	
b.	ipn				*!		*
c.	ipIn	*!					

/anne+In/		SPECIFY	MAX$_{full}$	*VkV	MAX-V/C_C	DEPLINK	MAX
a. ☞	annen						*
b.	annein					*!	
c.	annin		*!				*
d.	anneIn	*!					

(54) Turkish consonant-SDF captured by the full analysis

A. SDF example

/ajaG+Sɯ/		SPECIFY	MAX$_{full}$	*VkV	MAX-C/V_V	DEPLINK	MAX
a. ☞	ajaɯ						**
b.	ajasɯ					*!	*
c.	ajagsɯ					*!*	
d.	ajagɯ			*!		*	*
e.	ajaGSɯ	*!*					

B. Elision: occurring after only C-ending roots

/ʧan+Sɯ/		SPECIFY	MAX$_{full}$	*VkV	MAX-C/V_V	DEPLINK	MAX
a. ☞	ʧanɯ						*
b.	ʧansɯ					*!	
c.	ʧasɯ		*!			*	*
d.	ʧaɯ		*!				**
e.	ʧanSɯ	*!					

/ʃiʃe+Si/		SPECIFY	MAX$_{full}$	*VkV	MAX-C/V_V	DEPLINK	MAX
a. ☞	ʃiʃesi					*	
b.	ʃiʃei				*!		*
c.	ʃiʃeSi	*!					

C. Velar Deletion

/sokaK+a/	Specify	Max$_{full}$	*VkV	Max-C/V_V	DepLink	Max
a. ☞ sokaa			*	*		*
b. sokaka			**!		*	
c. sokaKa	*!		*			

D. NDEB: fully-specified /k/ and /s/ retained

/avukat/	Specify	Max$_{full}$	*VkV	Max-C/V_V	DepLink	Max
a. ☞ avukat			*			
b. avuat		*!		*		*

/sene+ki/	Specify	Max$_{full}$	*VkV	Max-C/V_V	DepLink	Max
a. ☞ seneki			*			
b. senei		*!		*		*

(55) Javanese SDF captured by the full analysis

A. SDF example

/omaH+Ne/	Specify	Max$_{full}$	*VhV	Max-C/V_V	DepLink	Max
a. ☞ omae						**
b. omane					*!	*
c. omahne					*!*	
d. omahe			*!		*	*
e. omaHNe	*!*					

B. n-deletion: occurring after only C-ending roots

/kulit̪+Ne/	Specify	Max$_{full}$	*VhV	Max-C/V_V	DepLink	Max
a. ☞ kulit̪e						*
b. kulit̪ne					*!	
c. kuline		*!			*	*
d. kulie		*!				**
e. kulit̪Ne	*!					

/kopi+Ne/	Specify	Max$_{full}$	*VhV	Max-C/V_V	DepLink	Max
a. ☞ kopine					*	
b. kopie				*!		*
c. kopiNe	*!					

C. h-deletion

/səkolaH+an/			SPECIFY	MAX_{full}	*VhV	MAX-C/V_V	DEPLINK	MAX
a.	☞	səkolaan				*		*
b.		səkolahan			*!		*	
c.		səkolaHan	*!					

D. NDEB: fully-specified /h/ and /n/ retained

/dihin/			SPECIFY	MAX_{full}	*VhV	MAX-C/V_V	DEPLINK	MAX
a.	☞	dihin			*			
b.		diin		*!		*		*

(56) Japanese captured by the full analysis

A. SDF example

/kaW+Ru/			SPECIFY	MAX_{full}	*w[−low]	MAX-V/C_C	DEPLINK	MAX
a.	☞	kau						**
b.		karu					*!	*
c.		kawru					*!*	
d.		kawu			*!		*	*
e.		kaWRu	*!*					

B. Continuant Deletion: occurring after only C-ending roots

/tob+Ru/			SPECIFY	MAX_{full}	*w[−low]	MAX-C/V_V	DEPLINK	MAX
a.	☞	tobu						*
b.		tobru					*!	
c.		toru		*!			*	*
d.		tou		*!				**
e.		tobRu	*!					

/tabe+Ru/			SPECIFY	MAX_{full}	*w[−low]	MAX-C/V_V	DEPLINK	MAX
a.	☞	taberu					*	
b.		tabeu				*!		*
c.		tabeRu	*!					

C. NDEB: fully-specified /r/ retained

/nenrei/			SPECIFY	MAX_{full}	*w[−low]	MAX-C/V_V	DEPLINK	MAX
a.	☞	nenrei			*			
b.		nenei		*!		*		*

3.6 Discussion

In this section, a new analysis using the underspecification theory and contextual faithfulness constraints in Standard OT has been proposed to account for the SDF cases in Turkish, Javanese and Japanese, as well as other effects that co-occur with them. I argue that this proposal makes three contributions to the study of SDF and opacity in general.

First and most obviously, the current analysis shows that, with appropriate assumptions and understanding of the UR, certain types of overapplication opacity may no longer pose problems for Standard OT. OT solutions to opacity, including SDF, have not been very neat since the its inception. For example, Lee (1999) used Sympathy (McCarthy 1999) to account for Javanese SDF and Lee (2007) modified Lee's (1999) solution using OT with Candidate Chains (OT-CC; McCarthy 2006, 2007b). However, both solutions were forced to recognise some intermediate stages or their corresponding candidates in a derivation like rule-based serialism, which is against the gist of OT and led to their obsolescence. Baković (2007: 225-230) used the TURBIDITY theory first developed in Goldrick (2000) to capture opacity, including SDF, in OT. The key of turbidity is that some segments or morae might be hidden in the sense that they are projected but not pronounced. However, as Baković (2007) criticised, the deletion of /k/ is independently motivated without any reference to hidden structures, and turbidity would be included merely for the sake of explaining opacity. In contrast, the analysis in this section uses widely-adopted frameworks and constraints, each of which serves the function of capturing a critical phenomenon related to SDF. The content of each constraint is also independently justified. More specifically, Hauser & Hughto (2020) already attempted to use contextual faithfulness constraints as a solution to opacity. However, some of their constraints were slightly stipulative. For example, MAX(i)/k_CV penalises the deletion of any high vowel in the context of k_CV in Arabic, which is neither empirically nor phonetically motivated and merely helps with their analysis sketched out later. In comparison, the contextual faithfulness constraints here do have phonological motivations – they serve to preserve the most canonical and preferred syllable structure in these languages.

Second, the central tenets of the current theory are compatible with multiple frameworks and can even lead to more compelling conclusions in rule-based serialism. That is, the three key points my proposal entails (57) can be implemented in not only OT but also rule-based serialism.

(57) Key points responsible for the accomplishment of the current analysis:

a. NDEB effects are the result of the contrast between fully- and underspecified segments;
b. The atypical resolution to consonant cluster is a result of the root-suffix asymmetry;
c. Underspecified segments only surface when they contribute to a more harmonic phonological pattern – in this case, syllable structure and word-edge alignment.

Under these principles, (57c) in particular, the patterns observed in (5-8) are no longer a result of SDF between certain segment-deletion/insertion rules, but rather the result of the following rules determining the appearance of underspecified segments (58):

(58) Rewriting the rules under the new analysis

	Old	**New**
Turkish vowel-SDF:	∅ ⟶ i / C_C#	I ⟶ i / C_C
	k/g ⟶ ∅ / V_V	K ⟶ k / _#
Turkish consonant-SDF:	s/j ⟶ ∅ / C_	S/J ⟶ s/j / V_V
	k/g ⟶ ∅ / V_V	K ⟶ k / _#

Javanese:	n ⟶ ∅ / C_	N ⟶ n / V_V
	h ⟶ ∅ / V_V	H ⟶ h / _#
Japanese:	r ⟶ ∅ / C_	R ⟶ r / V_V
	w ⟶ ∅ / _[−low]	W ⟶ w / _#

On one hand, these new rules can be organised into one family with the same function, namely to determine the presence of underspecified segments, whereas the old ones look more like separate rules removing or inserting segments in certain contexts. On the other hand, and more importantly, each pair of rules no longer need to be crucially ordered to yield the desired SF. That is, with the assumptions introduced by the current proposal, SDF might no longer be needed, as shown in (59) with Javanese as an example:

(59) Ordering is not needed for the new rules, exemplified in Javanese

a.

UR	/omaH+Ne/
N ⟶ n / V_V	
H ⟶ h / _#	
N ⟶ ∅	∅ (N)
H ⟶ ∅	∅ (H)
SF	[omae]

b.

UR	/omaH+Ne/
H ⟶ h / V_V	
N ⟶ n / _#	
H ⟶ ∅	∅ (H)
N ⟶ ∅	∅ (N)
SF	[omae]

These two derivations indicate that, although the default rules (N ⟶ ∅, H ⟶ ∅) need to be ordered later than those applying in more specific environments and deciding the appearance of underspecified segments, the relative order between the two more specific rules or that between the two default rules no longer matters for the successful derivation of the correct SF. The SDF relation also disappears because the earlier rule does not create environments for the later rule to apply and later gets deleted any more. In other words, the so-called SDF patterns could be reanalysed with new rules formulated under the assumptions of the current analysis, and they are not in SDF – or any interaction – relationship. This finding probably suggests that SDF is no longer needed as a separate type of rule interaction (recall that SDF on focus can already be analysed in other ways) or even a case of overapplication opacity since no rule is applying outside of its structural description.

Finally, and most importantly, the current proposal provides a fresh angle to view the nature of the patterns in (5-8). The central conclusions made by this analysis illustrate that what has been identified as SDF is in fact an epiphenomenon of phonologically-conditioned allomorph optimisation instead of a genuine kind of rule interaction. Under the old analysis with self-destructively feeding rules, SDF was peculiarly different from other rule interactions in the sense that all interactions happen at morpheme edges, and it always ahieves a single goal – consonant cluster avoidance – with an atypical solution. What is more, the co-occurrence of these phenomena are just coincidental. Under the new analysis, the SFs of these SDF cases are essentially the optimal choice for realisation when two morphemes – each with an underspecified segment on one edge – are adjacent. The two peculiarities are also easily explained. These patterns are NDEB because the segments with alternating potential only appear at morpheme-concatenation boundaries. The atypical choice of the deleted consonant in a cluster naturally falls out from the asymmetry between the fully-specified segment at the end of a root and the suffix-initial underspecified segment. In the end, the surface pattern involving SDF is simply the most optimal way of realising the UR with the most harmonic phonological structure, regardless whether one chooses to think in rule-based serialism or OT terms. In brief, the current proposal has not only the descriptive ability but also explanatory power for the so-called SDF pattern and all its relating characteristics.

If the current theory holds correct, it is predicted that SDF may not be learnable, or at least in experiment settings. Since SDF is not a result of two interacting rules, but determined by the distributions of underspecified segments and the preferred phonotactic structures – both of which are decided by the individual language – it might be very difficult for learners in an experiment to grasp these points. Turkish, Javanese and Japanese speakers are able to produce SDF patterns because they are equipped with the underspecification details in their implicit knowledge, but participants invited to artificial grammar learning experiments are not. In fact, some research along this line has been done and this prediction seems to be borne out. Yang (2023) designed an artificial grammar learning experiment based on the vowel-SDF pattern in Turkish to test if SDF is learnable, and the results indicated that 'participants are learning something, though not what was intended'. Further research on more patterns (e.g., those involving consonant deletions) could be pursued down this line to reinforce the conclusion.

4 Conclusion

This article provides a detailed review of all the known cases of SDF – a type of overapplication opacity – and reexamines its nature. There are four cases of SDF in Turkish, Javanese and Japanese that are indeed opaque and cannot be analysed with methods other than SDF. Two interesting characteristics are shared among them. First, each interaction involves at least an NDEB segment-insertion/deletion rule, making SDF a phenomenon always observed on morpheme edges. Second, they are all driven by the desire to avoid consonant clusters by making some changes to the suffix, although the choice of the consonant removed is different from the crosslinguistic common one. In order to not only describe but also explain the co-occurrence of SDF and these two features, a new analysis involving the underspecification theory and contextual faithfulness is provided in the framework of Standard OT.

The central point made in this paper is that the SDF pattern is the consequence of optimising the SF of two morphemes with underlyingly underspecified segments. Underspecified segments are best deleted unless they contribute to a phonologically more harmonic structure (i.e., the CV syllable structure) or the alignment of word edges in the input and the output. The NDEB characteristics naturally falls out because the underspecified segments with alternating potential are always on the edge of a morpheme. The atypical way of consonant cluster simplification is resulted from the asymmetry between the fully-specified C_1 in the root and underspecified C_2 in the suffix.

This new way of analysing the so-called SDF pattern as phonologically-conditioned allomorph optimisation rather than a genuine interaction between two rules has three benefits. First, if one still considers SDF as a type of opacity, this analysis shows that Standard OT is able to deal some varieties of opacity once the UR is more appropriately understood. Second, SDF may be no longer needed once the rules are redeveloped into those determining the presence or absence of an underspecified segment. These rules are no longer in a SDF relationship and a type of opacity could even be dispensed with. Third, and most importantly, the co-occurrence of the so-called SDF pattern and its related phenomena are no longer coincidental under the new analysis, and these connected observations can be explained with a uniform set of theories.

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