Do strata allow bringing back intrinsic rule ordering? - A preliminary investigation

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The adoption of extrinsic process ordering within a theory of phonology, either with *SPE*-style ordered rules or PREC-constraints in Optimality Theory with Candidate Chains (McCarthy 2007) has been argued to fail the explanatory goal of phonological theory by dropping some stable generalizations about natural languages (e.g. Kiparsky 2000, 353; Kiparsky 2015, 9; Bermúdez-Otero 2018, 3). Kiparsky (2015, 35) advances the hypothesis that introducing stratal modularity into the phonological component, whereby morphologically conditioned strata interface via their input and output representations and may exhibit their own subphonology, is sufficient to eliminate the need for extrinsic ordering of two processes with respect to each other. Kiparsky combines stratal architecture with parallel constraint systems in which markedness and faithfulness constraints interact transparently. However, for rule-based systems Koutsoudas et al. (1974, hereinafter *KSN*) argued that the power of ordered rules can also be limited by imposing a universal *intrinsic* order, determined by some universal principle, on the application of phonological rules. While their approach adopting intrinsic rule ordering exclusively has been shown to undergenerate for counterfeeding (and tentatively bleeding) interactions, I'll show that combining it with a stratal organization of phonology in a system I dub *Stratal KSN* resolves that desideratum and makes it possible to account for the full range of attested opaque patterns. Interestingly, given that KSN maximizes process *action* (unlike OT maximizing process *interaction*), Stratal KSN even derives certain cases of intrastratal opacity (overapplication) that is excluded by Stratal OT. The question if such theoretical differences between the two approaches of comparably equal extrinsic power can be shown to have an empirical counterpart with respect to their performance on patterns found in natural language would be worth a proper investigation in future research.

The aim of this paper is to clarify theoretical implications of a stratal version of KSN as a first step of investigating a by now underexplored research program. Therefore section 1 addresses the question of process ordering in general. Within this perspective, section 1.1 summarizes the properties of the attempt to fully abandon extrinsic power in rule-based theory proposed by Koutsoudas et al. (1974). The crucial insights of KSN will be shown as well as the reason why KSN fails to derive some evident patterns in natural language. In section 1.2 then, the possibility for modular organization of phonology (strata) as a way to implement some restricted degree of extrinsic power will be discussed briefly. The broader examination of the properties of Stratal KSN will be laid out in section 2. Section 2.1. indicates how the system works and summarizes its core predictions while section 2.2 demonstrates that such a theory fully accounts for a complex system of interactions of phonological processes in Catalan (Mascaró, 1976). The section concludes with a refinement of Stratal KSN's predictions. Section 3 finally presents alleged counterevidence from Catalan (Bermúdez-Otero, 2019) and proposes a reanalysis of the respective data.

1 The question of process ordering

Any theory of phonology that allows for some degree of *sequential* process application needs to be explicit about how the order is determined, in which structural changes to representations (phonological processes) apply. Within rule-based phonology, Chomsky and Halle (1968, 340 f.) demonstrated that certain facts can be derived with greater generality by means of transparent interaction between two rules rather, than by specifying one single rule with a dubiously complex structural description for every such potential interaction. In OT, some degree of sequentiality was claimed to allow for generalizations about facts that were described as 'cyclic effects' and opaque process interactions, where strict parallelism needs to implement some other additional devices as e.g. a rich faithfullness theory with OO-correspondence that still doesn't predict the right results in a great range of cases (Kiparsky 2000, 2015; McCarthy 2007; Bermúdez-Otero 2011; Trommer 2013). Hence, the question to which extend phonological processes are ordered *extrinsically*, on a language specific basis or rather *intrinsically,* determined by some universal principles should be explored carefully. It addresses rule-based phonology as well as any version of OT that allows for more than two levels of representation.

To clarify the distinction, consider a rule-based analysis of the (hypothetical) data in (1) and (2). In Western Basque, the raising of low to mid vowels, cf. (1-b, d), counterfeeds another process of this language that raises mid vowels to high ones, cf. (1-a, c). If a theory of phonology allows for extrinsic ordering of the process (in this case formalized as a corresponding rule) RAISING-TO-HIGH to apply before RAISING-TO-LOW to account for the counterfeeding interaction, then the theory predicts another language to exist, showing exactly the same processes encoded by the very same grammatical devices but exhibiting the opposite feeding order, cf. (2).

(1) Western Basque (De Rijk 1970, Baković 2011)

a. [–low] → [+high]/_V Raising-to-High (RH)
b. [+low] → [–low]/_V Raising-to-Mid (RM)

c. /seme+e/ → [semie] 'daughter', DEF
d. /alaba+a/ → [alabea], *[alabia] 'son', DEF

e.

	/seme+e/	/alaba+a/
RH	semie	
RM		alabea ↰ *counterfeeds*
output	semie	alabea

(2) Hypothetical language

a. [–low] → [+high]/_V Raising-to-High (RH)
b. [+low] → [–low]/_V Raising-to-Mid (RM)

c. /seme+e/ → [semie]
d. /alaba+a/ → [alabia], *[alabea]

e.

	/seme+e/	/alaba+a/
RM	semie	alabea
RH		alabia ↲ *feeds*
output	semie	alabia

A theory of phonology where the applicational order of processes is determined intrinsically, i.e. by universal principles, predicts only one of the two languages above to exist.[1] Thus, a theory of phonology that avoids instances of extrinsic process ordering seems to be more restrictive in some principled way. With respect to which kinds of facts predicted to exist or to not exist in a single language a theory is more restrictive depends of course very much on the particular make-up of a framework and an individual theory within it. We are going to discuss that for a particular version of rule-based phonology in broader detail and very briefly for some version of OT below.

However, the reason to explore overall to which degree the extrinsic power of a theory of phonology can be reduced could also be stated as the following: If a theory with full extrinsic power can be replaced by another one with less extrinsic power but dealing equally well with the data, the first one obviously misses some generalizations that can be stated about natural language.

[1] But only if the universal principle that determines the order of application is not a chaotic one which leads to arbitrary order, cf. Chomsky and Halle (1968, 342f.).

1.1 KSN – The theory and its limits

The more interesting was the claim made by Koutsoudas et al. (1974) that the power of extrinsic rule ordering is, indeed, empirically unmotivated. They argued in favor of the following hypothesis:

(3) *UDRA* (Koutsoudas et al. 1974, 1)
All restrictions on the relative order of application of grammatical rules are determined by universal rather than language-specific principles.

As Koutsoudas et al. (1974) showed, it is redundant to state the relative feeding or counterbleeding order of two rules in addition to the rules themselves if a single principle holds:

(4) *Obligatory Precedence* (Koutsoudas 1980)
An obligatory rule must apply wherever its structural description is met.

(4) implies that rules can and will apply simultaneously if possible – as soon as their context is met. This is how counterbleeding interactions are derived. Consider e.g. the rule in (5-a) that nasalizes vowels before nasals in French and another rule, cf. (5-b), that deletes nasals followed by a word boundary or another consonant and by this destroys possible inputs to (5-a). In an analysis of the derivation of (5-c) with extrinsic order, nasal deletion would be ordered after nasalization, such that the vowel will be nasalized before the nasalization triggering /n/ is deleted by nasal deletion: nasal deletion applies too late to bleed nasalization as it generally applies after it. Koutsoudas et al. (1974) argue that, for (5) and counterbleeding interactions in general, such an ordering step is unnecessary, because nasal deletion would also apply too late to bleed nasalization if both rules would apply simultaneously. Since the context for both rules is met already in the underlying representation, both rules apply in the first applicational cycle executing their respective structural changes. The output is obscured because one of the rules happened to destroy the context for the other one. Crucially, in this approach, counterbleeding opacity is not claimed to be due to applicational precedence of one process over the other one. The counterbleeding and the counterbled process are coequal and applicationally unordered.

(5) French (KSN)

a. V → Ṽ/_N — Nasalization (N)

b. N → ø/_{C,#} — Nasal Deletion (CD)

c. /grand(e)/ → [grãd] — 'big'

d. Extrinsically ordered rules

	/grand(e)/
N	grãnd
CD	grãd ↰ *counterbleeds*
output	grãd

e. Intrinsically ordered rules (in KSN)

	/grand(e)/
N, CD	grãd
output	grãd

(4) also implies that rules can and will apply in a sequence if inevitable – if their context first gets created through a former derivational step. This is how feeding interactions are derived. Consider e.g. the rules in (6-a, b). Following Kiparsky (1968), in some Finnish dialects, there is a rule that deletes certain medial voiced continuants between two vowels, cf. (6-a), thereby potentially creating additional inputs to another rule that diphtongizes 'long mid vowels', c.f. (6-b). To account for the feeding interaction of consonant deletion and diphtongization in the derivation of /teye/, cf. (6-d), it is possible to extrinsically order diphtongization after consonant deletion, thereby dropping a generalized explanation why diphtongization applies to underlying and derived representations alike, cf. (6-e). Given the assumption that rules apply to any representation that

meets their structural description, the latter is presupposed. Consonant deletion correctly applies to /teye/ returning the intermediate representation /tee/ and diphtongization will apply to underlying /vee/ as well as to the intermediate representation /tee/ returning the correct output forms [vie] and [tie] which neither meet the structural description of one of these or further rules.

(6) Finnish dialect (Kiparsky 1968, KSN)

a. y → ø/V_V — Consonant Deletion (CD)
b. ee → ie — Diphtongization (D)

c. /vee/ → [vie] — ('will take')
d. /teye/ → [tie] — ('road')

e. Extrinsically ordered rules

	/vee/	/teye/
CD		tee
D	vie	tie ⤵ *feeds*
output	vie	tie

f. Intrinsically ordered rules (in KSN)

	/vee/	/teye/
CD, D	vie	tee
CD, D		tie ⤵ *feeds*
output	vie	tie

To sum up the properties of the KSN-theory so far: Feeding interactions of rules are a simple consequence of the requirement that a rule has to apply whenever its context is met and since this requirement explicitly involves the simultaneous rule application whenever it is possible, counterbleeding interactions fall out, as well. One insight of KSN was thus, that implementing the possibility for processes to sequentially apply does not necessarily premise all processes to apply in a sequence and furthermore that such a permission of variability regarding simultaneous and sequential application doesn't have to lead to a loss of generalization. In the particular theory of KSN the opposite is the case because of the strict ban on extrinsic instances of ordering. There is no possibility to state on a language specific basis which rules need to apply simultaneously, which in a sequence and if sequentially then in which order. This decision makes the theory of KSN quite restrictive, which becomes clear with respect to its implications for other well-established types of rule interaction.

Koutsoudas et al. (1974) claim that bleeding interactions between two rules don't exist, at least not without a second universal principle taking effect in special cases[2]. As rules apply simultaneously, there cannot be a situation where the context for a rule A and a rule B is met in one representation and A applies such that the context for B is eliminated before B applies. In that case B will apply before its context is eliminated. Furthermore counterfeeding interactions are predicted not to exist. As rules are allowed to, or rather forced to, apply over and over again as often as their context is met, there cannot be a situation where a rule A applies such that the context for a rule B is created, but B doesn't apply. In that case B will apply. There is only feeding, no counterfeeding. Consequently, the authors claim that all facts that had been analyzed as the bleeding or counterfeeding interaction between two rules need to be reanalyzed in the light of a generalization about the particular language that had been overlooked so far. This generalization beeing either another rule interacting (resulting in a 'Duke-of-York' effect, cf. Pullum 1976) or a more fine grained specification of the structural description of the putative counterfed or bled rule, respectively.[3]

[2] Such a special case, where bleeding is predicted to exist by KSN is the compound interaction of a rule A bleeding B and B counterbleeding A. In that case A takes precedence over B as the result of another universal principle, cf. (i) and Koutsoudas et al. (1974) and Koutsoudas (1980) for the argumentation.

(i) *Proper Inclusion Precedence, KSN, 8*
For any representation R, which meets the structural descriptions of each two rules A and B, A takes applicational precedence over B with respect to R if and only if the structural description of A properly includes the structural description of B.

[3] Cf. e.g. Koutsoudas et al. (1974, 13f.) and Koutsoudas (1980, 28f.) for a Duke-of-York type reanalysis of an alleged bleeding interaction in a Schaffhausen dialect of Swiss German and Koutsoudas et al. (1974, 25f.) for a reanalysis of the context specification

Indeed, even if Koutsoudas and colleagues didn't explicitly state this, for putative bleeding interactions the second option might technically be a principled way to face the 'explanatory residue problem' that was claimed to break down KSN in the work responding to the proposal of Koutsoudas et al. (e.g. Cathey and Demers 1976, Noske et al. 1982). Even if, for a certain language, it turns out that there is no independent 'missed generalization' to find, it is possible to integrate the 'negative' of the structural description of the former bleeding rule into the putative bled rule. Consider e.g. devoicing of consonants after voiceless consonants in English, cf. (7-a, c), which is claimed to be bled by epenthesis of schwa in between two adjacent stridents, cf. (7-b), in certain contexts, cf. (7-c, f).

(7) English

a. [C] → [– voice] / [C,– voice] __ Devoicing (DV)

b. ø → [ə] / [+ strid] __ [+ strid] Schwa-Epenthesis (E)

c. /glɛs+z/ → [glɛsəz] 'glass', PL

d. /rɛbɪt+z/ → [rɛbɪts] 'rabit', PL

Extrinsically ordered rules

	e.	f.
	rɛbɪt+z	/glɛs+z/
E		glɛsəz
DV	rɛbɪts	⤸ *bleeds*
output	rɛbɪts	glɛsəz

Intrinsically ordered rules (as in KSN)

	g.	h.
	rɛbɪt+z	/glɛs+z/
E, DV	rɛbɪts	glɛsəs
output	rɛbɪts	*glɛsəs

Assuming the rules in (7-a, b), KSN cannot account for (7-c) because here, the context for the bled rule – a voiced consonant after a voicless one – is met underlyingly as well as the context for schwa-epenthesis. Hence, devoicing is predicted to apply simultaneously with schwa-epenthesis, cf. (7-h), resulting an incorrect output. Anyway, the generalization that devoicing always applies to a voiced consonant after a voicless one *except* in environments where also the context for schwa-epenthesis is given can be captured by reformulating the devoicing rule as in (8-a). If the context for strident devoicing is restricted to preceding voiceless non-stridents, it won't apply to /glɛsz/ as its context is not met here, cf. (8-d).

(8) English (temporarily modified for illustratory reasons)

Devoicing' (DV')

a. $\begin{bmatrix} \text{C} \\ \text{+ voice} \\ \text{<+ strid>}_a \end{bmatrix} \rightarrow [\text{– voice}] \,/\, \begin{bmatrix} \text{C} \\ \text{– voice} \\ \text{<– strid>}_b \end{bmatrix} \text{—}$

condition: a then b; ¬ a then b optional

b. ø → [ə] / [+ strid] __ [+ strid] Schwa-Epenthesis (E)

Intrinsically ordered rules (as in KSN)

	c.	d.
	rɛbɪt+z	/glɛs+z/
E, DV'	rɛbɪts	glɛsəz
output	rɛbɪts	glɛsəz

Such a kind of reformulation might appear like to naively integrate the effectiveness of high ranked OT markedness constraints into a single rule within rule-based phonology. And it basically works for the same reasons why parallel OT can easily handle bleeding process interactions: 1) the blocking of a process does not depend on a derivational step – in parallel OT where all candidates are evaluated in parallel there are

of an alleged bled rule in Alsatian dialects.

no intermediate representational levels – and 2) the relation between the potentially 'bled' processes and the 'bleeding' process is an indirect or even epiphenomenal one: Neither a parallel OT analysis of 'bleeding' nor the analysis in (8) is concerned with an actual interaction between two *processes*. In OT, a process $\mathbb{A}$ applies iff a representation involves a structural description penalized by a high ranked markedness constraint. But $\mathbb{A}$ is 'bled' so to say in environments where its structural change to the representation fails to satisfy another high ranked markedness constraint *and* another process $\mathbb{B}$ is able to result an output that satisfies both markedness constraints. Transferred to unordered rule logic: The rule A applies obligatorily as soon as a certain context is met and another one is crucially *not* met at a given point of the derivation, be it the underlying representation or a later step.[4] If this other context is met, A is blocked but there might potentially be another rule B that applies to exactly that particular context (the 'bleeding' rule). Of course, reformulating rules in this fashion to 'rescue' the theory in dealing with certain kinds of facts might be conceptually undesirable. Unlike actual parallel OT or a version of rule-based phonology that just orders the two rules extrinsically, it namely drops the generalization about the apparent connection between in this case devoicing and schwa-epethesis: The complementary distribution of both processes is completely accidental in such an analysis, whereas parallel OT and extrinsic rule ordering have their own respective devices to derive an applicational precedence of schwa-epenthesis over devoicing.

Legitimate conceptual concerns aside, anyhow, the insight is that facts described as *transparent* inhibitory interactions (bleeding) are reanalyzable in KSN with some degree of generality which in some cases might be a reasonable analysis while facts described as *opaque* inhibitory interactions (counterfeeding) remain as so called 'hard facts' with the potential to falsify the theory. For putative counterfeeding interactions, in case no missed independent generalization can be found, there is no similar strategy to reformulate the rules at hand, since the putative counterfed rule treats underlying representations differently from derived ones (which makes these process interaction even problematic for strictly parallel OT). Consider the following example. For a variety of Scottish English, Noske et al. (1982) describe a process of raising monophtongization (AYE-distribution) applying to /ʌi/ before a voiced fricative, cf. (9-b, d, e), unless the voiced property of this fricative is a derived one. By adding the voiced plural suffix, underlying voiceless fricatives become voiced, cf. (9-a), but crucially,

[4] However, as KSN still is a derivational theory with intrinsically determined timing effects, the distinction between derived and underlying contexts does matter with respect to the applicational timing of the alleged *bleeding* rule. This is why rules with 'negative context' could not account for their non-application in hypothetical cases in other theories describable as *fed bleeding*, cf. (i-e), of such kind that the context of the alleged bleeding process first gets derived through the application of another process, while strictly parallel OT can. If the context C[*b*] that triggers the alleged bleeding rule B first gets derived through the application of another rule R while the structural description C[*a*, ¬*b*] of a rule A is met to begin with, the specification of a negative part of the context (¬*b*) in A could not account for the blocking of A in these environments. The surfacing structural description will be C[*a, b*] but the destruction of possible inputs to A through application of B happens too late to bleed A if R and A apply simultaneously, cf. (i-f). Hence, KSN allowing for rules with 'negative context' is still more restrictive with respect to transparent process blocking than parallel OT.

(i) Toy example

a. /glɛst+z/ → [glɛsəz]

b. $\begin{bmatrix} \text{C} \\ \text{+ voice} \\ \text{<+ strid>}_a \end{bmatrix} \rightarrow [\text{– voice}] \,/\, \begin{bmatrix} \text{C} \\ \text{– voice} \\ \text{<– strid>}_b \end{bmatrix} \text{—}$ Devoicing' (A)

condition: a then b; ¬ a then b optional

c. ø → ə / [+ strid] __ [+ strid] Schwa-Epenthesis (B)

d. t → ø / s __ Deletion (R)

e. Extrinsically ordered rules

	e. /glɛst+z/		
R	glɛsz		
B	glɛsəz	↫	*feeds*
A		↫	*bleeds*
output	glɛsəz		

f. Intrinsically ordered rules (as in KSN)

	f. /glɛst+z/
A, B, **R**	glɛss
A, **B**, R	glɛsəs
output	*glɛsəs

this segmental change fails to trigger AYE-distribution, cf. (9-c).

(9) Scottish English dialect (Noske et al. 1982)

a. [–son, +cont] → [+voice] / __ $\#_z]_N$ — Noun Plural Fricative Voicing (PFV)

b. ʌi → æ/ __ ([+cont, +voice])$^+$ — AYE-distribution (AYE)

c. /wʌif-$\#_z$/ → [wʌivz] ('wife', PL)

d. /strʌiv/ → [stræv] ('to strive')

e. /hʌiv$\#_z$/ → [hævz] ('hive', PL)

f. Extrinsically ordered rule application

	/hʌiv$\#_z$/	/wʌif-$\#_z$/
AYE	hævz	
PFV		wʌivz ↰ *counterfeeds*
output	hævz	wʌivz

g. Intrinsically ordered rule application (as in KSN)

	/hʌiv$\#_z$/	/wʌif-$\#_z$/
PFV, AYE	hævz	wʌivz
PFV, AYE		wævz ↲ *feeds*
output	hævz	*wævz

While a theory with extrinsically ordered rules could simply order Fricative Voicing after AYE-distribution to result the correct output, cf. (9-f), KSN cannot account for these data since a rule has to apply as soon as its context is met. Noun Plural Fricative Voicing is predicted to feed AYE-distribution, contrary to fact, cf. (9-g). And there is no way to restate the rules to capture a counterfeeding interaction. By integrating the negative of the structural description of the counterfeeding rule into the counterfed rule, cf. (10), even derivations are excluded that should be maintained: namely structures where the structural description of the counterfed rule is already present underlyingly but which accidentally also meet the context that could trigger the counterfeeding rule. If AYE-distribution would only apply in contexts other than before a voiced plural suffix it should neither apply to plural forms of stems with an underlyingly voiced fricative following /ʌi/, cf. (9-e) and (10-b). The 'ungrammatical overapplication-problem' of KSN with respect to putative counterfeeding interactions can only be replaced by an 'ungrammatical underapplication-problem' by this means.

(10) Scottish English dialect (temporarily modified for illustratory reasons)

a. ʌi → æ/ __ [+cont, +voice] {#,[-strid, -voice]} — AYE-distribution' (AYE')

b. Intrinsically ordered rule application (as in KSN)

	/hʌiv$\#_z$/	/wʌif-$\#_z$/	/strʌiv/
PFV, AYE'	hʌivz	wʌivz	
output	*hʌivz	wʌivz	stræv

Furthermore, for principled reasons there cannot possibly be a third interacting rule causing a Duke-of-York effect as it could be the case for alleged bleeding interactions. As rules are forced to apply over and over again, the output of this third interacting rule would again be the input for the putative counterfed rule – and feed it. Since there are facts across natural languages like the Scottish English counterfeeding data where it seems impossible to think of a generalization about the counterfed process that might have been overlooked, KSN-theory proves to be too restrictive. Its predictions are summarized in table 1 below.

Anyway, given that the KSN theory was actually quite successful in illuminating that a single universal principle is, indeed, sufficient to derive all cases of feeding and counterbleeding process interactions, it is inappropriate to completely reject the KSN approach and restate a theory of rule-based phonology that builds on extrinsic process order with its full expressive power just due to the fact that it was too restrictive with respect to certain kinds of facts across natural languages. The coherent question rather is if these certain kinds of facts

Table 1: Predictions in KSN

Process interaction			KSN
transparent		feeding	✓
		bleeding	(X)
opaque	overapplication	counterbleeding	✓
	underapplication	counterfeeding	X

→ undergeneration problem

can be accounted for by allowing for a *minimal degree* of extrinsic power with respect to process order. One reasonable way to do this is to implement a more fine grained modular organization; concretely, to organize the phonological component into strata.

1.2 Extrinsic power in Stratal Phonology

On the basis of observed correlations between morphosyntactic constituency and phonological regularities[5], it was claimed – implicitly already in *SPE* and explicitly in the literature of Lexical Morphology and Phonology – that the phonological component may be organized into morphologically conditioned strata ordered in correspondence with the assigned morphosyntactic unit (e.g. stem, word, phrase) which interface via their input and output representations and which may exhibit their own subphonology (Kiparsky 1982); precisely, different blocks of rules assigned to different strata. Stratal OT adopted that principle and combined stratal architecture with parallel constraint systems in which markedness and faithfulness constraints interact transparently, but each stratum potentially with its own respective constraint ranking (Kiparsky 2000, 2015; Bermúdez-Otero 2018). The decision to implement strata into OT was mainly motivated by the need to solve the undergeneration problem of strictly parallel OT with respect to opaque process application, but in a way that was argued to be among other things more restrictive and by this empirically more adequate than adopting e.g. a rich theory of faithfulness whose means are not transitive in nature (Kiparsky 2000, 351; Kiparsky 2015, 2; Bermúdez-Otero 2018, 30). Strata in OT add some degree of derivational *seriality* to the theory (Kiparsky 2000, 352, Kiparsky 2015, 3). Hence they allow in fact processes to interact, not basically constraints resulting epiphenomenal applicational relations between processes; allowing processes to interact even opaquely. Opaque application of phonological processes (including counterfeeding and counterbleeding interactions), thus, is predicted to occur due to the interaction of processes triggered at different strata: A process P_2 triggered at stratum S_2 which destroys contexts triggering process P_1 won't hinder P_1 from applying if P_1 is exclusively triggered at stratum S_1 ($S_1 \ll S_2$). And a context created by process P_2 triggered at stratum S_2 cannot trigger P_1 if P_1 is exclusively triggered due to the constraint ranking at S_1 ($S_1 \ll S_2$). Transparent application of phonological processes may be conditioned by processes triggered at different strata or within a single stratum, cf. table 2.

Table 2: Stratal OT: predictions

		process 'interaction'/interaction	intrastratal	across strata
transparent		feeding	✓	✓
		bleeding	✓	✓
opaque	overapplication	counterbleeding	X	✓
	underapplication	counterfeeding	X	✓

Yet do strata not only add seriality to OT but also even some degree of extrinsic power to phonological theory. For a system with extrinsically ordered rules (as broadly assumed in the LPM literature) this is completely irrelevant. For OT and KSN it matters because the extrinsic power added by strata is weaker than the possibility

[5] E.g. morphologically induced underapplication or morphologically induced misapplication of stress.

to extrinsically order rules in rule-based systems, where each two processes get assigned their relative applicational order. It has been argued that such excessive degree of extrinsic power neither in OT, here adapted e.g. with PREC-Constraints (McCarthy 2007), is necessary to face the OT specific undergeneration problem (Kiparsky 2015). Still, with a stratal organization of the phonological component, it is determined on a language specific basis: 1st which processes are possibly triggered at / assigned to which stratum, hence, which *set of processes* may interact opaquely/inhibitorily with which *other set of processes*; 2nd which (types of) morphemes are assigned to which stratum; and 3rd in principle, it could also be determined extrinsically how many strata are active in a particular language. But even if there might be parametrical variation with respect to the absolute number of active strata, the assumption of relatively few strata which are required to be independently detectable by morphological means restricts the possibilities of how which processes may interact enormously compared to the extrinsic ordering of pairs of processes; and as a side-effect, in theory, it should provide an ordering independent tool to proof generalizations about the applicational order of two processes. The main empirical argument to assume a stratal organization of the phonological component is, thus, facts analyzable as morphologically induced counterfeeding as in the Scottish English case above, where a process can effect structures already present in deeply embedded constituents (stem) while it is blind for structures derived by the phonological environment of less deeply embedded constituents (word level, stem plus affixes). If AYE-DISTRIBUTION is a process assigned to or triggered at the stem stratum while it is not available for application at the word stratum anymore, environments created by word level affixes as in the case of the plural affix in that Scottish English dialect won't contribute possible inputs to it.

As these properties are currently explored in great detail within the research program of Stratal OT, the question may arise why it should be interesting to additionally explore the properties of a stratal version of KSN. The answer is that, while both theories are similar and hence comparable with respect to their extrinsic power, they necessarily make different predictions with respect to which kinds of facts may exist and which may not as OT maximizes process interaction whereas KSN maximizes process action as will be discussed in more detail below. The second part of the paper aims to focus on the functioning of a stratal version of KSN and the resulting empirical predictions.

2 Stratal KSN

In the stratal version of KSN, phonological rules still apply in accordance to the *Obligatory Precedence Principle* but the phonological component devides into strata affiliated with independently morphosyntactically identifiable domains (stem, word, phrase), where each stratum gets assigned its own rule block. Besides the intrinsic cyclic nature of KSN (the number of representational levels within a stratum depends on the number of applicational cycles intrinsically determined by the *Oligatory Precedence Principle*), Stratal KSN is even cyclic in the sense as other stratal theories of phonology are and phonological material, thus, subject to cyclic containment: a linguistic expression copies its phonological properties from a constituent that defines an immediate stratal subdomain. In that respect Stratal KSN employs also some extrinsically conditioned transitive relation of processes affiliated with a particular stratal domain. This is why Stratal KSN makes different predictions from KSN.

According to Stratal KSN, instances of real (= no overlooked generalizations) counterfeeding and bleeding process interactions are predicted to be due to the involved rules being assigned to different strata. A rule R2 can counterfeed a rule R1 only if R2 applies to a stratal domain D2 larger than the stratal domain D1 of R1. Furthermore, phonological material not accessible in D1 but in D2 (e.g. through affixation) cannot trigger the application of R1. R1 will underapply in D2 and D2 will inherit this opaque property even to larger domains. For the Scottish English dialect described by Noske et al. (1982), the assumption of intrinsically ordered rules results the correct predictions as soon as the generalization is acknowledged that the rule which changes /ʌi/ to [æ] before voiced fricatives crucially exclusively applies to underived environments in the stem. If the adjacent fricative is voiced underlyingly it's going to apply. If the underlying fricative is voiceless it won't. Voiceless

fricatives can become voiced at the word stratum, when e.g. the plural suffix is accessible, triggering word level voicing. But beeing affiliated with the stem stratum, at this point, AYE is not available for application anymore, AYE underapplies, cf. (11-e).

(11) Stem level rules

a. (AYE): ʌi → æ/ _ ([+cont, +voice])$^{+}$

Word level rules

b. (PFV): [–son, +cont] → [+voice] / _ #$_z$]$_N$

		c.	d.	e.
		/strʌiv/	/hʌiv#$_z$/	/wʌif-#$_z$/
stem level:	AYE	⟦stræv⟧	⟦⟦⟦hæv⟧z⟧⟧	⟦⟦wʌif⟧z⟧⟧
word level:	PFV			⟦⟦wʌivz⟧⟧ ↺ *counterfeeds*
output		stræv	hævz	wʌivz

With respect to counterfeeding (and feeding) interactions, Stratal KSN makes exactly the same predictions as Stratal OT, namely that, while two processes in a feeding relation may be affiliated with the same stratum or with different strata, two processes in a counterfeeding relation must be affiliated with different strata. Underapplication originates from the different stratal affiliation of two processes and is thus morphosyntactically conditioned. Stratal KSNs predictions differ, however, from those implicit to Stratal OT with respect to bleeding (and counterbleeding) interactions. In Stratal KSN, a rule R1 can bleed a rule R2 if the domain D1 in which R1 applies is a subdomain of the domain D2 in which R2 applies, such that both domains are affiliated with different strata (D1=S1, D2=S2), where R1 is affiliated with S1 but R2 is exclusively affiliated with S2 and not S1. Coda Devoicing in Standard German, cf. (12-a, c), is bled by resyllabification of a coda consonant into onset before vowel initial affixes in the inflected word, cf. (12-b, d). Phrasal Resyllabification across word boundaries, cf. (12-f, g), however, fails to bleed Coda Devoicing, cf. (12-g). This pattern is expected in Stratal KSN if Coda Devoicing is a phrase level process: Phrase level resyllabification and Coda Devoicing apply simultaneously in (13-f) as the description for both rules is met at the phrase level input. Phrase level resyllabification obscures the context for Coda Devoicing but applies too late to actually bleed it. To bleed phrase level Coda Devoicing, syllabification must apply at an earlier stratum, and this is exactly what happens with word level syllabification in the inflected word, cf. (13-e).

(12) German (Wiese 1996, Hall 1999, 119, Bermúdez-Otero 2018)

a. fettig ~ [fɛ.tɪç] 'faty'
b. fettiges ~ [fɛ.tɪ.gəs] 'faty-N.NOM/ACC.SG'
c. leg ~ [leːk] 'put-IMP away'
d. legen ~ [leː.gən] 'put away'
e. spiel ~ [.ʃpiːl.] 'play'
f. spiel es ~ [ʃpiː.ləs] 'play it'
g. leg es ~ [leː.kəs] 'put it away'

(13) Word level rules

a. (S): Syllabification

Phrase level rules

b. (D): Coda Devoicing: [C, +voice] → [-voice] / _.
c. (RS): Resyllabification

		d.	e.	f.
		/leːg/	/leːg-ən/	/leːg ɛs/
word level:	S	⟦⟦leːg⟧⟧	⟦⟦leː.gən⟧⟧	⟦⟦leːg ⟧⟦ɛs⟧⟧
phrase level:	D, S	⟦leːk⟧	↻ *bleeds*	⟦leː.kɛs⟧ RS *cb* D
output		leːk	leː.gən	leː.kɛs

In Stratal OT the opposite conclusion must be drawn. As (counterbleeding) opacity can only evolve across strata in Stratal OT, Bermúdez-Otero (2018, 10f.) argues that Coda Devoicing in German is actually a word level process and occurrences of word level syllabification bleeding Coda Devoicing as in (12-b, d) tell us that the word domain is not cyclic[6] in itself (in contrast to the stem domain). It is impossible to decide which of the both analyses is the more adequate one without considering a complete system of interacting processes and the corresponding morphosyntactical regularities of a language. It is not even clear that, given such an extensive consideration, it could possibly be decided on an empirical basis. However, it is clear that Stratal OT and Stratal KSN need to make different assumptions about the stratal affiliation of processes, already given by the fact that in KSN, it is inputs triggering the efficaciousness of phonological processes (maximization of process application: 'apply as many processes as possible'), not outputs (maximization of transparent process 'interaction': 'apply only those (sets of) processes that (together) result the best output'), which has the consequence that the distinction between unrestricted and morphosyntactically restricted process interaction in Stratal KSN goes along the line inhibitory-exhibitory process interaction[7] and not along the line opaque-transparent process interaction as in Stratal OT. One criterion to decide between different theories is the question how many helping hypothesis are needed in one or the other analysis to account for the same facts or, to state it differently, the question how many facts are already explained by the core assumptions of a theory. To investigate a bit further which kinds of facts are already predicted by the core assumptions of Stratal KSN, the next section provides a Stratal KSN analysis of a more complex system of process interaction in Catalan.

Table 3: Stratal KSN: Preliminary predictions

		rule interaction	intrastratal	across strata
transparent		feeding	✓	✓
		bleeding	X	✓
opaque	overapplication	counterbleeding	✓	✓
	underapplication	counterfeeding	X	✓

2.1 Complex process interaction in Catalan

In Catalan (Mascaró, 1976), nasals assimilate in place to the following consonant (NA), cf. (14). Additionally, there is a process of cluster simplification, affecting syllable-final stops preceded by a homorganic consonant (HCS), (15-a–c, e). The two processes are in a mutual feeding (feeding-feeding) relationship. First, as shown in (15-a–c), HCS can be fed by NA. Non-homorganic clusters don't simplify, cf. (15-d). This is an instance of *self-destructive feeding* (Baković 2007) as nasal assimilation feeds a process that destroys the context that triggered nasal assimilation in the first place. Thus, it's a case of a feeding interaction that is obscured in the output.

(14) Nasal Assimilation (NA)

a. kəmp-ɛ́t 'field' (DIM)

b. bəŋk-ɛ́t 'bench' (DIM)

[6]Whereby Bermúdez-Otero (2018) assumes another kind of cyciclicity not discussed in this paper, namely cyclic in contrast to non-cyckic affixes triggering a new cycle of application each. If Stratal KSN needs to make reference to such a flavor of cyclicity besides the intrinsic cyclicity and the stratal one cannot be discussed within the scope of this article but it should definitely investigated in future research.

[7]Note that Stratal KSN merely by privileging feeding and counterbleeding relations of rules as the so to say unmarked case due to the requirement of obligatory rule application does not necessarily contribute any claims to the debate which process relations are to be maximized in the course of language change, cf. Kiparsky (1968, 200): *Maximal utilization hypothesis*, and Kiparsky (1971, 623): *Maximal transparency hypothesis*. This is, for the time being, a completely orthogonal question.

(15) Homorganic Cluster Simplification (HCS)

a.	kam	'field'
b.	baŋ	'bench'
c.	bɛŋ	'I sell'
d.	mɔl-k	'I grind'
e.	məlal	'sick' (person)
f.	məlalt-ɛt	'sick' (person, DIM)

Second, non-velar nasals which become word final through homorganic cluster simplification can undergo nasal assimilation by assimilating to the onset of the following word, (16-b, c): HCS can feed NA.

(16) Homorganic Cluster Simplification feeds Nasal Assimilation

a.	bint-ɛ	'twentieth'
b.	bim pans	'twenty breads'
c.	biŋ kaps	'twenty heads'

A third process on the other hand is counterfed by HCS: While underived word final nasals delete in Catalan (ND), cf. (17-b), deletion is excluded for nasals that become word final due to homorganic cluster simplification, cf. (15-a–c).

(17) Nasal Deletion (ND)

a.	pan-s	'breads'
b.	pa	'bread'

The empirical picture is further complicated by the appearance of words ending in a sequence of a nasal followed by a velar stop. According to Mascaró (1976, 80), when such a word precedes a vowel-initial one within the same clause, the cluster unexpectedly fails to undergo HCS. Instead, the velar stop resyllabifies into the onset of the following syllable, due to a process of phrase-level resyllabification (RS), cf. (18).

(18) Phrase level Resyllabification (counter)bleeds Harmonic Cluster Simplification

a.	ka.m#es	'field is'
b.	baŋ.k#es	'bench is'

This contrast can be attributed to a distinction observed by Mascaró (1976, 65) who posits the lack of distinctive velar nasals at the underlying level. The suggestion is supported by the distribution of the three nasals: while [m] and [n] can occur in any context, [ŋ] is limited to the position before velars (possibly deleted by HCS at a later stage, cf. 15-b, c). While postulating underlying homorganic morpheme-internal clusters would leave their systematic occurrence unaccounted for, the idea can be adapted by arguing that velar nasals are absent from the input to the phrase stratum and that nasal assimilation counterfeeds cluster simplification in (18-b), allowing the word-final consonant to be resyllabified. Since resyllabification takes the velar stop out of the purview of cluster simplification, the generalization expressed by the latter process remains surface-true, yielding a case of *surface-true counterfeeding* Baković (2011, 57f.).

To sum up, an analysis of the Catalan data presented by Mascaró (1976) needs to cover the following process interactions:

- HCS counterfeeds ND.

- HCS feeds NA.
- NA self-destructively feeds HCS. (HCS counterbleeds NA.)
- RS counterbleeds HCS.

and under certain conditions:

- RS bleeds HCS.
- NA counterfeeds HCS transparently.

2.1.1 Stratal KSN analysis

(19) Stem level rules (simplified)

a. Nasal coronal Assimilation (NCA)

$$[+\text{nas}] \rightarrow [\alpha \text{ place}] \,/\, \_\_ \begin{bmatrix} \text{C} \\ \alpha \text{ place} \\ +\text{cor} \end{bmatrix}$$

Word level rules (simplified)

b. Nasal Deletion (ND)

$$[+\text{nas}] \rightarrow \emptyset \,/\, [+\text{syl}] \_\_ \#\#$$

Phrase level rules (simplified)

c. Homorganic Cluster Simplification (HCS)

$$\begin{bmatrix} -\text{cont} \\ \alpha \text{ place} \end{bmatrix} \rightarrow \emptyset \,/\, \begin{bmatrix} \text{C} \\ \alpha \text{ place} \end{bmatrix} \_\_]_\sigma$$

d. Nasal Assimilation (NA)

$$[+\text{nas}] \rightarrow [\alpha \text{ place}] \,/\, \_\_ \begin{bmatrix} \text{C} \\ \alpha \text{ place} \end{bmatrix}$$

e. Phrase-level Resyllabification (RS)

In the analysis I propose, ND which is sensitive to word boundaries applies at the word stratum while HCS, NA and RS are assigned to the phrase stratum. Applying at a later stratum, HCS systematically fails to feed ND, cf. (20).

(20)

SL output	/pan/	/bint/	
ND	pa		
WL output	pa	bint	↰ *counterfeeds*
HCS		bin	
PL output	pa	bin	

The mutual feeding of HCS and NA in (21-a, b) would naturally be derived if both rules apply at the same stratum, given that rules are forced to apply again and again as often as their context is met. NA must be phrase level, as it applies across word boundaries, as in (21-a). Given that it feeds HCS, as in (21-b), the affiliation of

HCS to the phrase stratum becomes evident. Furthermore, if HCS applies at the phrase stratum, hence at the same stratum as phrase level RS (across word boundaries), both rules will apply simultaneously in case that the structural description of both rules is already met in the output of word level phonology, as in (21-d), yielding a counterbleeding interaction as observed in (18-a). Of course, the structural description of HCS can only be met at word level output, if the nasal already shares the place features with the following consonant. This would be the case if there is also an earlier instance of nasal assimilation in the stem, which is in fact what was argued for in earlier stratal analyses of these data (LPM: Kiparsky 1985, Stratal OT: Kiparsky 2015).

With sight on the environmental restrictions for velar in contrast to non-velar nasals and the contrast of RC systematically counterbleeding HCS of non-velar clusters but apparently bleeding HCS of velar clusters within the same sentence, cf. (18), the whole picture falls out if stem level nasal assimilation is restricted to the context of non-velar consonants, cf. (19-a), preventing velar nasals from appearing beyond phrase level. Then the output of word phonology in (21-c) only exhibits the context for RS and NA, the context for HCS first needs to get created through NA, similar to (21-b). But as NA and RS will apply simultaneously, at the moment the nasal is assimilated, there won't be a cluster to simplify anymore. NA eventually fails to feed HCS. Besides successfully deriving the Catalan pattern, this analysis provides the insight that *derived* intrastratal counterfeeding / bleeding – based on an *intrinsically* determined timing effect – is predicted to exist by Stratal KSN.

(21)

	a.	b.	c.	d.	e.
SL output	bint kaps	bɛnk	bank es	kamp es	pan
ND					pa
WL output	bint kaps	bɛnk	bank es	kamp es	
NA, HCS, RS	bin HCS *feeds* NA kaps	bɛŋk NA *feeds* HCS	baŋ.kes RS *bleeds* HCS, NA *cf* HCS	RS *cb* HCS kam.Øes	
NA, HCS, RS	biŋ kaps	bɛŋ		ka.mes	
PL output	biŋ kaps	bɛŋ	baŋ.kes	ka.mes	pa

However, it should be noted that this case of derived bleeding crucially differs from the underivable one abstractly discussed in footnote 4: Intrastratally derived bleeding is only possible in Stratal KSN such that it is the context of the *bled* rule that gets created due to the application of another rule within the same stratum. Derived bleeding where it is the context of the bleeding rule that gets created due to the application of another rule within the same stratum can still not be derived in Stratal KSN because due to the OPP the potentially bled rule will apply simultaneously with the rule that feeds the potentially bleeding rule. Also KSN sets clear restrictions to which kinds of intrastratally derived counterfeeding is possible: it crucially must be transparent counterfeeding such that it is the *counterfed* process that is bled by another one applying simultaneously with the potentially feeding processes. Depending on the definition of bleeding and counterfeeding interaction, it might, thus, be debatable if it is adequate to use these terms here. As in Stratal KSN, rules are allowed to apply simultaneously, a meaningful definition of these applicational relations would dispense with referring to the sequential order of a pair of rules as tentatively suggested in (22). But adopting the definition in (22), (21-c) is, strictly speaking, no case of bleeding because RS doesn't destroy possible inputs to HCS. At the point where it applies, the nasal is not velarized yet, hence the context for HCS is not met. – It won't be met at any point of the derivation, hence it cannot be destroyed. The same reasoning applies to the cases of intra-stratally derived 'counterfeeding' possible in Stratal KSN: NA doesn't create additional inputs to HCS because, at the point where the nasal is velarized, the syllable structure doesn't meet the requirement of HCS anymore. – The context for HCS is not met at any point of the derivation. There won't be any additional inputs to it at any point of the

derivation. Anyway, referring to the broader understanding of bleeding and counterfeeding interaction left over from approaches that extrinsically order or only look at the output evident relation of a *pair of processes*, respectively, (without making note of a third process taking effect), the terms might still be useful in some sense. They allow, for instance, for comparing Stratal KSN with Stratal OT, the latter probably having no similar need to make this more fine grained distinction (as there is no intrastratal sequentiality, which means no real interactions of processes within a stratum) but partly predicting the same kinds of facts to exist.

(22) Rule relations (adapted from Baković 2011, 41)

Given two rules A and B,

a. A feeds B iff A creates additional inputs to B and B applies.
b. A bleeds B iff A eliminates potential inputs to B and B does not apply.
c. A counterfeeds B iff A creates additional inputs to B but B does not apply.
d. A counterbleeds B iff A eliminates potential inputs to B but B applies.

2.1.2 Sketch of an alternative analysis in Stratal OT

Interestingly, while the Catalan pattern described above naturally falls out by Stratal KSN's core means, it poses in fact a challenge to Stratal OT approaches - even the dialectal pattern of velar clusters aside. Kiparsky (2015) in his Stratal OT analysis of the data described by Mascaró (1976) states that, as resyllabification across word boundaries must be triggered at the phrase level, HCS should be a word level process, since this is how the opaque (counterbleeding) interaction of RS and HCS can be derived. As he only looks at the interaction of the three processes NA, HCS, RS his analysis works. But as soon as the counterfeeding interaction of HCS and ND is taken into consideration, a Stratal OT analysis that aims to account for every instance of opacity with strata ordering runs into a problem: ND must be a word level process as it exclusively targets word final nasals. It will be blocked by any suffixal environment, cf. (23). Which stratum should HCS be asigned, then? Of course, it is always possible to stipulate another stratum as in (24). However, finding ordering independent arguments for such a stratum (in Catalan) appears to be rather improbable. Another option would be to combine Stratal OT with other theories like autosegmental phonology and to argue in favor of the hypothesis that the relation of ND and HCS is no case of true counterfeeding, as e.g. in the non-stratal analysis of Faust and Torres-Tamarit (2017). However, the question which kinds of facts are predicted to exist in an autosegmental OT with strata and hence, in which sense such a theory can be compared to Stratal KSN in a meaningful way – though the right question to ask – goes beyond the scope of this paper. Also, there is certainly far more to say about nasal deletion in Catalan. However, it can be stated clearly, that Stratal KSN fully accounts for the basic pattern described by Mascaró (1976) without any further assumptions while 'pure' Stratal OT doesn't in a meaningful way.

(23) Nasal Deletion (ND)

a.	pa	'bread'
b.	pan-s	'breads'
c.	pan-ɛt	'bread (DIM)'

(24) Stratal OT approach

SL output		/pan/	/kamp es/
word stratum:	ND	pa	
WL output		pa	kamp es
? stratum:	HCS		kam es
? output			kam es
phrase stratum:	RS		ka.mes
phrase output		pa	ka.mes

counterfeeds ↷

↶ *counterbleeds*

2.2 Refined predictions and limits of Stratal KSN

Since a system that organizes the applicational hierarchy of processes merely by means of the OPP, Stratal KSN maximizes non-vacuous application of rules. This is why counterbleeding and feeding (including opaque feeding) process interactions as the default case so to say are predicted to occur not only across strata but also intrastratally in Stratal KSN. With respect to what kinds of facts are expected to be found in natural languages, this is where the main difference to Stratal OT systems is founded, since Stratal OT predicts opaque exhibitory process interactions to occur exclusively across strata.

Stratal KSN, though, restricts true inhibitory process interactions to occur exclusively across strata. But there is a range of facts that might look like reflecting inhibitory process interactions (being, in other theories, also analyzable as such) which are predicted to exist by Stratal KSN even within a single stratum: That concerns, 1st, kinds of facts in other theories describable as a process A transparently bleeding a process B, which are re-analyzable in Stratal KSN as a) two non-interacting processes A and B of the kind that the structural description of B is specified as such that B only applies to representations that invert (parts of) the structural description of A as discussed in section 1.1 above. Or b) as two non-interacting processes applying both plus an additional process C revoking the structural changes of B at a later point of the derivation where the structural description of B is not met anymore, cf. e.g. (Koutsoudas, 1980, 13f.). The 2nd kind of facts concerns cases describable as 'derived bleeding and counterfeeding' involving three rules at action, such that a rule A applies simultaneously with a rule B, B having the potential to feed a rule C but only when it applies to contexts where the structural description for A is not met, as A has the potential to bleed C. The result of A and B applying simultaneously eventually is, that C transparently fails to apply. In a theory with extrinsically ordered pairs of rules these facts would be describable as derived bleeding and counterfeeding iff A would be ordered before B ordered before C, such that A succeeds to create additional inputs to B resulting an immediate representation that meets the structural description of C which then gets destroyed by B before C applies, cf. (25).

(25) Extrinsically ordered rules

PL input		/bank es/	
NA (A)		baŋk es	
RS (B)	*counterfeeds* ↳	baŋ.kes	
HCS (C)			↲ *bleeds*
output		baŋ.kes	

Since these two kinds of facts are cases of transparent non-application, they are equally predicted to exist by Stratal OT. Stratal KSN, however, is more restrictive than Stratal OT when it comes to facts identifiable as true intrastratal bleeding interactions in Stratal KSN, namley when the bleeding rule is fed by another rule of the same stratum. Similar restrictive are Stratal OT and Stratal KSN when it comes to intrastratal counterfeeding[8]: As rules have to apply as soon as there context is met, there is only feeding within a stratum in Stratal KSN, no counterfeeding, and there are for principled reason no formal possibilities to restate the rules to reanalyze the interaction as non-interaction. These cases remain as the so called 'hard facts' to falsify both theories (without additional mechanisms). To restate this differently: Stratal KSN (as Stratal OT) predicts that there is no intrastratal counterfeeding in natural languages. Hence, every analysis of facts that needs intrastratal counterfeeding to be necessary to assume is claimed to miss some generalization that can be stated about the particular language. The next section discusses one of such cases in Catalan.

Table 4: Refined predictions of intrastratal process relations in Stratal KSN compared Stratal OT

			SKSN	SOT
transparent	application	feeding	✓	✓
	non-application	bleeding	(X)	✓
		derived bleeding (fed bleeding process)	X	✓
		derived bleeding (fed bled process)	(✓)	✓
		transparent counterfeeding (bled counterfed process)	(✓)	✓
opaque	overapplication	counterbleeding	✓	X
		opaque feeding	✓	X
	underapplication	counterfeeding	X	X
		derived counterfeeding (fed counterfeeding process)	X	X

3 Reanalysis of alleged intrastratal Counterfeeding in Catalan

For Catalan, Bermúdez-Otero (2019) describes two processes, both evidently applying at the phrase stratum, but apparently interacting in an opaque manner analyzable as intrastratal counterfeeding. At first, consonants assimilate to the voice feature of a following consonant (VA) across word boundaries, cf. (26-a–d). Thus, underlyingly voiceless consonants as in the word for 'to puff', cf. (26-e), or underlyingly voiced consonants that got devoiced by a word level process affecting word final consonants can get voiced at the phrase level, cf. (26-a, c) and (28-a) below.

(26) Regressive Voice Assimilation (VA)

a. bu/f/ brusc → bu[**v**.b]rusc 'abrupt puff'
b. bu[f] calent 'warm puff'
c. escu/p/ molt → escu[**b**.m]olt 'she spits a lot'
d. escu[p] tot 'she spits everything'

but:

e. b[u.far] 'to puff'
f. escup aixo → [əs.ku.pə.ʃo] 'spit this'

Second, voiced stops spirantize between two continuants (SP) within words or across word boundaries if the preceding continuant and the voiced stop differ with respect to their place feature, cf. (27-a–e).

[8] And of course, with respect to alleged anticyclic process interactions, which cannot be discussed within the scope of this paper. But cf. Gleim (to appear) and Fritzsche (to appear) ???????ADD SOME EXISTING REFERENCES

(27) Spirantization (SP)

a. llo/b/a → llo[**β**a] 'she-wolf'
b. e/z/ /bl/au → e[z.# **β**l]au 'is blue'
c. e/ʎ/ /b/a → e[ʎ.#**β**a] 'he goes'
d. l/ə/ /b/aca → l[ə.#**β**a]ca 'the cow'
e. ma/r/ /b/onic → ma[r.#**β**o]nic 'pretty sea'

but:

f. e/ʎ/ /d̪/iu → e[ʎ.#**d̪**]iu 'he says'
g. bu/f/ /b/rusc → bu[v.#**b**]rusc

Given the generalizations described so far, the question arises why in (28-a), a labial stop voiced due to VA fails to undergo Spirantization between a vowel and a lateral. Both Stratal OT and Stratal KSN would predict phrase level VA to feed SP on focus in this case. For a stratal KSN analysis the generalizations drawn by Bermúdez-Otero (2019) are stated as rules in (29). The expected interaction resulting an ungrammatical output is illustrated in (31).

(28) Regressive Voice Assimilation counterfeeds Spirantization?

a. /ʎop ʎiwrə/ → [ʎo**b** ʎiwrə], *[ʎoβ ʎiwrə] 'free he-wolf'

(29) Phrase level rules

a. Regressive Voice Assimilation (VA)
C → [+voice] / _ [C, +voice]

b. Spirantization (SP)

$$\begin{bmatrix} -\text{cont} \\ -\text{son} \\ +\text{voice} \\ \alpha\ \text{place} \end{bmatrix} \rightarrow [+\text{cont}]\ /\ \begin{bmatrix} +\text{cont} \\ \beta\ \text{place} \end{bmatrix}\_\ [+\text{cont}] \qquad \textit{with } \beta \neq \alpha$$

(30) Extrinsic ordering

PL input	/ʎop#ʎi.wrə/	
SP		
VA	ʎob.ʎi.wrə	*counterfeeds*
output	ʎob ʎiwrə	

(31) Stratal KSN

PL input	/ʎop#ʎi.wrə/	
SP, VA	ʎob.ʎi.wrə	
SP, VA	ʎoβ.ʎi.wrə	*feeds*
output	*ʎoβ ʎiwrə	

These data seem to challenge even Stratal KSN - recall from above that cases of true opaque counterfeeding in contrast to bleeding interactions remain as so called 'hard facts'. The first question to ask in such a case, thus, must be if there might be some generalizations about the language missed in the current analysis. And for the Catalan data described here it turns out that there are two of those: First, as can be observed in (27), spirantization only applies in onset positions. But, second, in Catalan, even if codas resyllabify to simple onsets across word boundaries, cf. (26-f), they never resyllabify to to complex ones, cf. (26-c) and the data described by Jiménez (1999) in (32).

(32) Jiménez (1999)

a. cap límit [kab.ˈli.mit] 'no limit'
b. pot lamentar [ˌpɔd.la.men̪.ˈtar] 'you may regret it'
c. bec ràpid [beg.ˈra.pit] 'fast beak'

Thence, restating the spirantization rule to only apply in onset position as in (33), stratal KSN will derive the grammatical output, cf. (34): Phrase level VA cannot possibly feed phrase level SP' in (34) as the context of SP' will still not be met after VA of a consonant in coda position. The data in (28-a) and (32-a, b) therefore don't

reflect a case of counterfeeding at all, hence neither a case of intrastratal counterfeeding.

(33) Spirantization of onsets (SP')

$$\begin{bmatrix} -\text{cont} \\ -\text{son} \\ +\text{voice} \\ \alpha\ \text{place} \end{bmatrix} \rightarrow [+\text{cont}]\ /\ \begin{bmatrix} +\text{cont} \\ \beta\ \text{place} \end{bmatrix}]_{\sigma}\ \_\ [+\text{cont}] \qquad \textit{with } \beta \neq \alpha$$

(34) Stratal KSN

PL input	/ʃop#ʃi.wrə/
SP',VA, RS	ʃob.ʃi.wrə
output	ʃob ʃiwrə

4 Conclusion

Kiparsky's (2015) hypothesis that introducing stratal modularity into the phonological component is sufficient to eliminate the need for extrinsic ordering of pairs of processes seems to hold true not only for OT systems but for rule-based systems, as well. In Stratal KSN, the system introduced in this paper, where rules intrastratally apply according to the Obligatory Precedence Principle, a stratal organization assigning each morphosyntactically identifiable stratum a particular rule block, provides the theory with the minimal degree of extrinsically conditioned transitivity that is needed to solve KSN's undergeneration problem with respect to the counterfeeding (and bleeding) interactions examined in this paper and the context of this work. Therefore, as long as no clear counterevidence to the predictions made by Stratal KSN can be found, Stratal KSN should replace rule-based systems with extrinsically ordered rules as it allows to account for the data with greater generality. One such case of alleged counterevidence from Catalan was presented and reanalyzed in the last section. However, while the aim of this paper was to clarify Stratal KSN's core predictions, it is, as always, necessary to test these with a complete rule system of a single language in order to be able to draw some meaningful conclusions. Within such an excessive investigation it would be, then, of special interest if a certain language can be shown to exhibit 1) clear cases of intrastratally derived bleeding (such that the bleeding process is fed by another process assigned to the same stratum) – providing an strong argument for Stratal OT and against Stratal KSN or 2) a clear case of intrastratal counterbleeding/opaque feeding – providing a strong argument for Stratal KSN and against Stratal OT.

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