A simple account of chain shifts and saltations in Optimality Theory

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It has been universally accepted (e.g., Kager, 1999; Hayes and White, 2015) that "classical OT" (without, e.g., local constraint conjunction) can generate neither chain shift patterns (e.g., /b/ $\sim$ [β] and /p/ $\sim$ [b] in the same contexts) nor saltations (/p/ $\sim$ [β] but /b/ stays [b]). We provide existence proofs for classic OT grammars (inputs and ranked constraints) that, in fact, generate both patterns, as long as **reconceptualization of the problems** is granted: e.g., for chainshifts, instead of considering derivations between fully specified segments (/b/ →[β] and /p/ →[b]), we select an underlyingly underspecified segment that surfaces, depending on context, as [b] or [β], and another that surfaces as [p] or [b]. Our solutions are thus **weakly equivalent** to the versions of the chain shift and saltation problems as traditionally considered, because, although they involve the same surface alternations, they do not involve the exact same input-output mappings. Our point is not to compare our solutions with others (involving, e.g., local constraint conjunction, applied to chain shifts most famously by Kirchner (1996)) but rather to show that failure to generate surface chain shift and saltation patterns can no longer be invoked against models using only "classical OT" machinery.

A key aspect of our analysis is the use of **underspecified inputs** that are fully specified in output, and we follow Inkelas' (1994) defense of underspecification, that "virtually all objections to underspecification have actually been objections to various principles designed to regulate [its] distribution", adding that "such criticisms sometimes fail to clearly decouple the situation of underspecification from the tainted principles intended to govern it, leading to the implicit, sometimes explicit, conclusion that underspecification is equally untenable". Inkelas shows that "**underspecification is necessary**, even in Optimality Theory" but takes an attractively restrictive view that the "only motivation for underspecification is to **capture alternations** in the optimal way". We add to Inkelas's arguments Keating's 1988 demonstration of *phonetic* underspecification as well as conceptual arguments by Reiss (2021) that underspecification simplifies UG, and Magri's (2018) discussion of "partial phonological features" to justify the exploration pursued here, in spite of murmurs to the contrary such as Tesar (2014, p.387, fn. 2) stating that "[i]t has been suggested that Optimality Theory reduces or eliminates the need for such underspecification".

Kager (1999, p. 394) explains the chain shift problem along these lines: if /b/ surfaces as [β], then faithfulness to −CONT must not outrank whatever markedness constraint is violated by underlying /b/ in the relevant context; but then a [b] derived from /p/ should also not be constrained by faithfulness to remain [b], and it should surface as [β], too. The problem is to somehow encode **distance faithfulness**, so that the output of /p/ can be a bit unfaithful (surfacing as [b]) but not so unfaithful as to change all the way to [β]. In derivational frameworks, chain shifts are generated with **counterfeeding ordering**; in OT, mechanisms beyond "classical" OT, were proposed, like local conjunction and scalar faithfulness (Gnanadesikan, 1997). The problem for saltations is in a sense the inverse: How can the output of /p/ be so unfaithful as to surface as [β], while /b/'s output remains faithful to its underlying −CONT value? Here, being *extra* unfaithful is *required* of /p/, but /b/ must not surface as [β]. As White (2017) puts it "saltations cannot be derived in 'classical OT"' because of "the excessive nature of the change involved in such alternations". Like chain shifts, saltations have driven OT practitioners to propose enhancements to the framework, most prominently the version proposed by White (White, 2017; Hayes and White, 2015) involving the P-Map (Steriade, 2008, 2001) and *MAP constraints (Zuraw, 2007).

Accepting underspecification, our approach to chain shift patterns can change. Instead of modeling input-ouput relations among segments *p,b,β*, we can think about the possibility of positing two segments to "capture alternations", call them P and B, such that P maps to p and b in environments X and Y, respectively; and B maps to b and β in environments X and Y, respectively. We use **underspecification to mimic distance faithfulness** without extending "classical OT". In this vein, we can derive the surface chain shift pattern, not from underlying /p/ and /b/, but by defining /P/ as a bilabial stop unspecified for VOICE, but specified −CONTINUANT and /B/ as a +VOICED bilabial obstruent, unspecified for CONTINUANT. Once we accept underspecification we can adopt the MAX and DEP constraints that treat insertion and deletion of feature values as separate violations of faithfulness (see Lombardi 2001/1995 and McCarthy 2011, sec. 4.6). With this machinery, a feature-filling mapping can violate a single DEP constraint, whereas a feature-changing mapping will violate at least a MAX constraint and a DEP constraint. Constraints assumed are given in (1) and (2):

(1) Faithfulness constraints: (i) MAX-F constraints penalize deletion of +F or −F. (ii) DEP-F constraints penalize insertion of +F or −F. (We make no use of IDENT-F).

(2) Markedness constraints: (i)SURFACE-SPEC: This (here) undominated constraint is violated by output segments that manifest surface underspecification. (ii)*VTV: no stops between vowels. (iii)*VSV: no voiceless obstruent between vowels. (iv)*FRIC: Obstruents should be stops; e.g., /β/ is more marked than /b/ (A typologically justified constraint.) (v)STOP-VLESS: Stops should be voiceless; e.g., /b/ is more marked than /p/.

These *are* analogous to constraints in the literature, but we are primarily concerned with the **logical structure** of the patterns, as in McCarthy (2002, 17): "OT is a general framework for constraint interaction, and . . . does not entail a particular set of constraints in CON"; and Moreton (1999, 142): "Optimality Theory is a theory of constraint interaction, not of representations. We want our deductions about OT to hold even if the theory of representations changes"—so even when underspecification is allowed.

In the talk we present tableaux (3-6) deriving [pa, aba] from input /Pa, aPa/, and [ba, aβa] from /Ba, aBa/. Crucially, this is an existence proof—it is not weakened, but is rather strengthened, by the fact that there are other ways to derive these results. We derive saltations with similar reasoning. We also present outcomes for fully specified inputs involving /p/, /b/, etc.

(3) /P/ surfaces as [p] when not intervocalic

/Pa/	SURFACE-SPEC	MAX-CONT	DEP-VOICE	*VTV	DEP-CONT	*VSV	*FRIC	STOP-VLESS
☞ a. pa			*					
b. ba			*					*!
c. βa		*!	*		*		*	
d. Pa	*!							*
e. Ba	*!							

(4) /P/ surfaces as [b] between vowels

/aPa/	SURFACE-SPEC	MAX-CONT	DEP-VOICE	*VTV	DEP-CONT	*VSV	*FRIC	STOP-VLESS
a. apa			*	*		*!		
☞ b. aba			*	*				*
c. aβa		*!	*		*		*	
d. aPa	*!			*				*
e. aBa	*!							

(5) /B/ surfaces as [b] when not intervocalic

/Ba/	SURFACE-SPEC	MAX-CONT	DEP-VOICE	*VTV	DEP-CONT	*VSV	*FRIC	STOP-VLESS
a. pa			*!		*			
☞ b. ba					*			*
c. βa					*		*!	
d. Pa	*!							*
e. Ba	*!							

(6) /B/ surfaces as [β] between vowels

/aBa/	SURFACE-SPEC	MAX-CONT	DEP-VOICE	*VTV	DEP-CONT	*VSV	*FRIC	STOP-VLESS
a. apa			*!	*	*	*		*
b. aba				*!	*			*
☞ c. aβa					*		*	
d. aPa	*!			*				*
e. aBa	*!							

With binary features, underspecification, and MAX-F and DEP-F constraints, there is a lexicon and a constraint ranking that a learner can posit to generate surface chain shift and saltation patterns, without the use of local conjunction or scalar faithfulness. OT has been criticized for a lack of concern with representational issues. This paper demonstrates how computational and representational issues (like underspecification) can interact, and thus contributes to understanding of OT as a theory of grammar.

References: ⋆Gnanadesikan, Amalia Elisabeth. 1997. Phonology with ternary scales. University of Massachusetts Amherst. ⋆Kager, René. 1999. *Optimality Theory*. CUP ⋆Keating, Patricia. 1988. Underspecification in phonetics. Phonology 5:275–292. ⋆Kirchner, Robert. 1996. Synchronic chain shifts in optimality theory. *LI* 27:314–350. ⋆Lombardi, Linda. 2001/1995. Why place and voice are different: Constraint-specific alternations in optimality theory. *Segmental phonology in Optimality Theory: Constraints and representations* 13–45. ⋆Magri, Giorgio. 2018. Output-drivenness and partial phonological features. *LI* 49:577–598. ⋆McCarthy, John. 2002. *A thematic guide to optimality theory*. CUP ⋆McCarthy, John J. 2011. *Doing optimality theory: Applying theory to data*. John Wiley & Sons. ⋆Moreton, Elliott. 1999. Non-computable functions in optimality theory. Ms., UMass, Amherst. ROA-364. ⋆Reiss, Charles. 2021. Towards a complete Logical Phonology model of intrasegmental changes. *Glossa* 6:107. ⋆Smolensky, Paul. 1995. On the internal structure of the constraint component Con of UG, Handout at UCLA . ⋆Steriade, Donca. 2001. Directional asymmetries in place assimilation: A perceptual account. The role of speech perception in phonology 219–250. ⋆Steriade, Donca. 2008. The phonology of perceptibility effects: the P-map and its consequences for constraint organization. In *The nature of the word: Studies in honor of Paul Kiparsky*, ed. K. Hanson and Sharon Inkelas, 151–180. MIT Press. ⋆Tesar, Bruce. 2014. *Output-driven phonology: Theory and learning*. CUP. ⋆White, James. 2017. Accounting for the learnability of saltation in phonological theory: A maximum entropy model with a p-map bias. *Lg.* 93:1–36. ⋆Zuraw, Kie. 2007. The role of phonetic knowledge in phonological patterning: corpus and survey evidence from tagalog infixation. *Lg.* 277–316.