Phrase-level tone opacity as shared activity in Kere

Main Claim: In Kere (Trans-New Guina, Papua-New Guinea) three phrase-level tone processes interact in an opaque counterfeeding pattern. This is unexpected for many theories of phonology. I show that this pattern is expected if gradient symbolic representation are assumed. Spreading leads to reduction of gradient activity of tone-bearing units, which share the activity of the linked tone among themselves. This account makes the testable prediction that cases of phrase-level opacity should always involve a process that can be modeled as spreading. **Data**: The three relevant phrase-level tone processes in Kere are Upstep, Low Deletion and Boundary Tone Shift. First, Upstep (1) raises the register of a high tone H to an upstepped high tone ↑H if it follows another high tone at the phrase-level. Second, Low Deletion deletes a single low tone if it occurs between two high tones at the phrase-level (2). Note that this creates a sequence of two high tones, which would constitute the right context for upstep to apply. Upstep however, fails to apply. The pattern therefore is an instance of opaque counterfeeding. Third, Boundary Tone Shift applies at the right edge of a phrase. A low boundary tone assigned to the final tone bearing unit (TBU) shifts the original high tone of the final TBU one TBU to the left. This can create a sequence of two high tones (3a) or a single low tone between two high tones (3b), thus creating the contexts for Upstep and Low Deletion to apply. Neither applies. Therefore, Boundary Tone Shift counterfeeds both at the phrase-level.

(1) Upstep in Kere (Rarrick 2017)

a. níl íglà → níl ↑íglà
water in
'in the water'

b. kàgé tái → kàgé ↑tái
times INDEF.DET
'sometimes'

(2) Low Deletion in Kere (Rarrick 2017)

a. níl màré → níl máré
water near
'near the water'

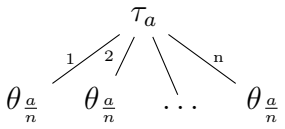
b. ìgé gòlé → ìgé gólé
house old
'old house'

(3) Boundary Tone Shift (Rarrick 2017)

a. níl màré% → níl márè%
water near
'near the water'

b. ìgé kwì òné% → ìgé kwì ónè%
house new very
'very new house'

(4) Shared Activity in Tone spreading



Analysis: The basic assumption of the proposed analyis is shared activity (cf. Faust & Smolensky 2017; Zimmermann 2021, Rosen 2021), more concretely TBUs share activity if they share tones, i.e. the activity of a TBU θ is the activity of its tone τ divided by the number n of TBUs that the tone τ is associated to. $a(\theta) = \frac{a(\tau)}{n}$. Therefore, spreading reduces the activity of TBUs. In a framework based on Gradient Symbolic Representations (Goldrick & Smolensky 2016; Rosen 2016) and Harmonic Grammar (Smolensky & Legendre), less activity can lead to less violations of relevant markedness constraints and thus to underapplication or opaque counterfeeding. More concretely, low deletion applies in (5) to remedy a violation of a gradient constraint against a LHL TBU sequence (cf. 5a). This leads to spreading of a high tone as in candidate (5b). Note however, that the TBUs associated to the spread high tone have a reduced activity of 0.5 ($=\frac{1}{2}$). Therefore it violates the gradient constraint *HH less than non-spread tones would and therefore an upstep repair as in (5c) is more costly in violating the categorical faithfulness constraint IDENT(R) than tolerating the violation of the higher ranked *HH constraint. Similarly, the opaque counterfeeding interaction between Boundary Tone Shift and low deletion can be derived. Assuming an undominated constraint triggering boundary shift and a spread-

ing analysis of boundary tone shift, the spread high tone in (6a) violates the gradient constraint against a single low tone between high tones (*HLH) less because one of the TBUs involved in the violation shares its high tone with a neighboring TBU and thus has less activation. Further spreading to repair this minor violation of *HLH (6b) would induce a violation of *HH since it would bring two high tones next to each other. Even this weak violation of a $0.\bar{3}$ ($=\frac{1}{3}$) high TBU and a fully activated high TBU would be fatal and incur a more severe violation than in the more faithful candidate (6a). Trying to remedy the violation of *HH by upstep (6c) would again lead to a violation of the categorical faithfulness constraints for register features IDENT(r) and render this candidate suboptimal.

(5) Low Deletion counterfeeds Upstep

I: $\mathcal{W}$=	H_1 L_1 H_1 nil$_1$ ma$_1$re$_1$	*HH$_g$ 42	*HLH$_g$ 33	IDENT(r)$_c$ 33	$\mathcal{H}$
a.	H_1 L_1 H_1 nil$_1$ ma$_1$re$_1$		-1.0		-33.0
☞b.	H_1 H_1 nil$_1$ ma$_{0.5}$re$_{0.5}$	-0.75			-31.5
c.	H_1 $^{\uparrow}H_1$ nil$_1$ ma$_{0.5}$re$_{0.5}$			-1.0	-33.0

(6) Boundary Tone Shift counterfeeding

I: $\mathcal{W}$=	L_1 H_1 L_1 L_1 H_1 i$_1$ge$_1$ kwi$_1$ o$_1$ne$_1$	*HH$_g$ 42	*HLH$_g$ 33	IDENT(r)$_c$ 33	$\mathcal{H}$
☞a.	L_1 H_1 L_1 H_1 L_1 i$_1$ge$_1$ kwi$_1$ o$_{0.5}$ne$_?$		-0.8$\bar{3}$		-27.5
b.	L_1 H_1 H_1 L_1 i$_1$ge$_1$ kwi$_{0.\bar{3}}$ o$_{0.\bar{3}}$ne$_?$	-0.$\bar{6}$			-28.0
c.	L_1 H_1 $^{\uparrow}H_1$ L_1 i$_1$ge$_1$ kwi$_{0.\bar{3}}$ o$_{0.\bar{3}}$ne$_?$			-1.0	33.0

Hypotheses on phrase-level opacity: Several theories of phonology rule out any opaque phrase-level interaction on architectural grounds, e.g. Lexical Phonology (Kiparsky 1985), Stratal OT (Kiparsky 2015), and Output-Output-Correspondence Theory (Benua 1997). Kere tone provides a clear counterexample. Other theories that employ extrinsically ordered phonological rules (e.g. Chomsky & Halle 1968) allow unrestricted phrase-level opacity. The present approach provides a restrictive yet empirically adequate theory predicting only two kinds of phrase-level opacity: underapplication, as found in Kere, where spreading unexpectedly fails to feed other processes, and derived-environment effects, where spreading unexpectedly feeds another process, that would not apply to singly linked tones. The latter pattern is found in Tiriki, where only high tones spread on the phrase-level undergo downstep (Paster & Kim 2011). Shared Activity might also derive other gradient and categorical effects of feature spreading, such as 'petering-out' effects' in vowel harmony (Mullin 2011, McCollum 2019, Kiparksy 2023). **Selected References:** •Benua, Laura. 1997. *Transderivational identity: Phonological relations between words.* UMass dissertation. •Faust, N. & Paul S. 2017. Activity as an alternative to autosegmental association. Talk given at mfm 25. •Goldrick, M. & P. Smolensky. 2016. Gradient symbolic representations in grammar: The case of French liaison. ROA-1286. •Kiparsky, P. 2023. Domains of vowel harmony. In N. Ritter & H. v.d. Hulst (eds.), *Oxford handbook of vowel harmony.* •McCollum, Adam. 2019. *Gradience and locality in phonology: Case studies from Turkic vowel harmony.* UC dissertation. •Mullin, Kevin. 2011. Strength in harmony systems: Trigger and directional asymmetries. Ms., UMass Amherst. •Paster, M. & Y. Kim. 2011. Downstep in Tiriki. *Linguistic Discovery* 9(1). •Rarrick, S. 2017. *A tonal grammar of Kere (Papuan) in typological perspective.* University of Hawai'i dissertation. •Rosen, E. 2016. Predicting the unpredictable: Capturing the apparent semi-regularity of rendaku voicing in Japanese through harmonic grammar. In *Proceedings of BLS* 42. •Rosen, E. 2021. Inflectional paradigms as interacting systems. *Proceedings of the Society for Computation in Linguistics* 4(1). •Zimmermann, E. 2021. Faded copies: Reduplication as distribution of activity. *Glossa*: 6(1).