

Icy targets in Karajá ATR harmony as contrast preservation

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Icy targets, which are segments that harmonize but then block harmony from proceeding further, are a difficult phenomenon to analyze theoretically (Jurgec 2011). Particularly problematic is a rare type of icy target found in ATR harmony in Karajá (Macro-Jê; Brazil), in which the propagation of harmony depends on the underlying vowel quality. For most known cases of icy targets, the derived vowel would not trigger harmony if underlying (Jurgec 2011). This is not the case in Karajá, where the behaviour of [i,u] in harmony depends on whether the vowel is underlyingly /i,u/ or /ɪ,ʊ/ (Ribeiro 2002). This distinction between underlying and derived vowels is problematic to analyze, particularly in surface-oriented frameworks.

In this paper, we argue for an extension of Contrast Preservation Theory (Lubowicz 2003) to account for this type of icy target. This theory has previously been used for derived environment effects and chain effects, but not for icy targets or harmony systems. We show that viewing the behaviour of high vowels in Karajá as a form of contrast preservation allows for an effective analysis, situated within the typology of ATR harmony. In doing so, we not only provide an account for this previously unanalyzed, puzzling pattern, but also illustrate a novel application of Contrast Preservation Theory with many important implications.

Karajá exhibits a strictly regressive ATR-dominant harmony pattern, where ATR vowels trigger harmony exclusively to preceding RTR vowels, as in /rʊ-behe-re/ → [rube'here] 'he/she went down' (Ribeiro 2002:480). However, the high vowels /i/ and /u/ are icy targets: they will harmonize to [i] and [u], but then block harmony the further progress of harmony, as in /krɔbi-dĩ/ → [krɔbi'ni] 'a type of monkey' (Ribeiro, 2002:480). This behaviour contrasts with underlying /i/ and /u/, which act as triggers, causing vowels preceding them to harmonize, as in /r-ɔ-duhɔ-reri/ - → [rotʃu'hɔreɾi] '(they) had their bellies broken' (Ribeiro, 2002:482).

Karajá icy targets pose several major problems. First is a distinction between underlying and derived vowels: while underlying ATR high vowels trigger harmony, ATR high vowels derived through harmony do not. This distinction is a serious issue in surface-oriented frameworks, where underlying and derived vowels should behave the same way. Second is that Karajá icy targets appear to be in direct conflict with the typology of triggers of ATR-dominant harmony. Indeed, the best triggers of ATR-dominant harmony cross-linguistically are high vowels, yet in Karajá, these are the vowels that behave as non-triggers when derived.

We propose that icy targets in Karajá serve a purpose: they preserve an underlying contrast between RTR and ATR high vowels. This contrast is preserved in a different location, namely in any preceding vowels, yet there remains a distinction between underlying RTR high vowels, where harmony stops, and underlying ATR high vowels, where harmony proceeds. Using Lubowicz's (2003) Contrast Preservation Theory, we analyze this pattern by adopting input sets and PRESERVE constraints. Specifically, the constraint PRESERVE(ATR,+HI) preserves underlying ATR contrasts on [+high] vowels; formally, if two inputs differ in [ATR] on [+high] segments, then PRESERVE(ATR,+HI) is violated if they map to the same output. We adopt a general harmony constraint *RTRC₀ATR (violated for every RTR-ATR sequence across any number of consonants), plus one specific to high targets, *RTR,_{HI}C₀ATR (violated for every RTR-ATR sequence across any number of consonants when the RTR vowel is high). The latter follows Ozburn's (2019) target-oriented approach to harmony and arguments that high vowels are the best targets of ATR-dominant systems. Two faithfulness constraints, IDENT-IO(ATR) and IDENT-

IO(RTR), respectively penalize changes from ATR to RTR and the reverse. The separation of faithfulness constraints in this way can account for ATR dominance (see Ozburn 2019).

Table 1 illustrates how this approach can account for icy targets. Given that the only relevant Preserve constraint is one for ATR on high vowels, the relevant comparison is between an input with an RTR high vowel and one with an ATR high vowel. The constraint PRESERVE(ATR,+HI) is violated when two inputs differ only in the feature [ATR] on [+high] vowels, but the outputs do not differ. As such, it will be violated any time /ε... ε...ɔ...e/ and /ε... ε...u...e/ map to an identical output, as in candidates (d) and (e). The harmony constraint specific to high RTR vowels ensures that RTR high vowels harmonize, ruling out candidate (a). As shown, the preferred candidate is (b), where underlying RTR high vowels are icy targets, but ATR high vowels trigger harmony. Remaining candidates are ruled out by additional violations of either the general harmony constraint or RTR faithfulness. Note that the harmony constraints and faithfulness constraints check the total number of violations across both inputs.

		/ε... ε...ɔ...e/	/ε... ε...u...e/	IDENT-IO (ATR)	*RTR,HI C ₀ ATR	PRESERVE (ATR,+HI)	*RTR C ₀ ATR	IDENT-IO (RTR)
	(a)	ε... ε...ɔ...e	e... e...u...e		*!			**
☞	(b)	ε... ε...u...e	e... e...u...e				*	***
	(c)	ε... e...u...e	e... e...u...e				*	****!
	(d)	e... e...u...e	e... e...u...e			*!		*****
	(e)	ε... ε...u...e	ε... ε...u...e			*!	**	*
	(f)	ε... ε...u...e	e... e...u...e				**!	**

Table 1: Derivation of icy targets

This approach extends to correctly account for all the facts of the Karajá system, demonstrating a novel use of Contrast Preservation Theory to account for an unusual, previously unanalyzed pattern. This proposal has the advantage of turning the apparently anti-typological patterning of Karajá high vowels into a behaviour that fits well within our understanding of high vowels in ATR-dominant harmony. Indeed, high vowels have been argued to be ideal targets of ATR-dominant harmony (e.g. Archangeli & Pulleyblank 1994; Ozburn 2019); Karajá fits within this typology of preferring for high vowels to be ATR and of preferentially targeting high vowels in ATR harmony. Moreover, difficulties in the perception of ATR contrasts on high vowels is posited to be a motivating reason for harmony (e.g. Rose 2018); harmony allows additional opportunities to hear those difficult contrasts. In Karajá, the ATR contrast on high vowels is also allotted substantial importance, but in a different way, such that this contrast must be preserved. The result is icy targets: high vowels harmonize, but that difficult contrast is preserved on the preceding segments.

Beyond Karajá, we show that this approach has substantial implications to our understanding of icy targets, vowel harmony, and the role of contrast in phonology. We discuss how this analysis can be generalized to other types of icy targets, as well as how major issues in vowel harmony more broadly can be viewed as a choice in which contrastive information to uphold. In this way, we show that Contrast Preservation Theory extends beyond its original uses to unify diverse patterns within the typology of vowel harmony, where other approaches cannot.

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