

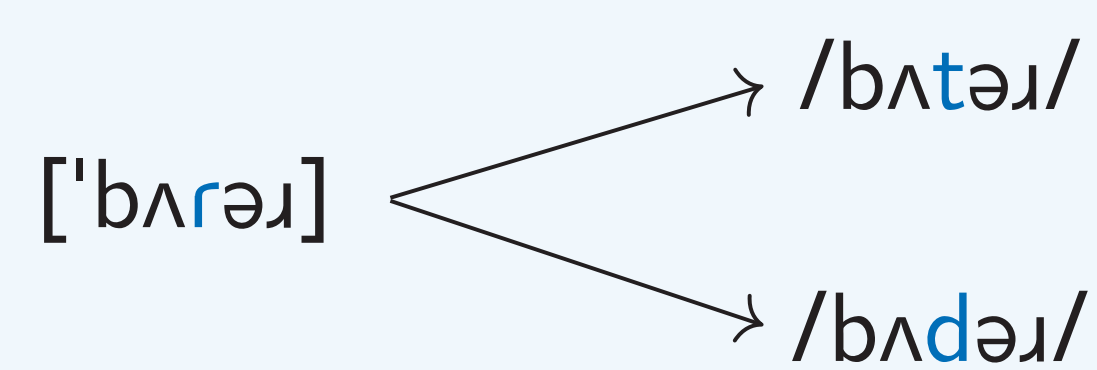
Markedness effects in paradigm reanalysis: Malagasy consonant alternations

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1 Overview

- How do learners reconstruct a neutralized form?



- Possible factors:

- distributional information (Ernestus and Baayen, 2003; Albright, 2002)
- innate biases (Moreton, 2008)

- Paradigm reanalysis** as window into phonological learning (Kiparsky, 1965)

- Case study:** Malagasy consonant alternations

- Results:** effects of **markedness bias**

- not predicted by existing models (e.g. Albright, 2002; Nosofsky, 2011)

2 Background: Malagasy

- (C)V syllables, mostly penult stress.
- Weak stems:** antepenult stress (if long enough) and end in "weak syllable" (ka, na, tr̄a [t̄ʂa])
- Weak syllable's consonant may alternate under suffixation:

pattern	stem	passive (-ana)
na ~	n a ⁿ drávina	a ⁿ drávana
	m aná ⁿ drana	a ⁿ drámana
ka ~	h a ⁿ gátaka	a ⁿ gátahana
	f anáhaka	anaháfana
tr̄a ~	r iána ⁿ tr̄a	ianána
	t aná ⁿ dra ⁿ tr̄a	ana ⁿ drátana
	f a ⁿ dráku ⁿ tr̄a	a ⁿ drakúfana

- Historically consonant-final (Dahl, 1951; Adelaar, 2012)

- Final consonant neutralization
- Vowel epenthesis to resolve codas

- Ex: development of tr̄a~r alternation:

*bukiD	*bukiD-ən	Historical
*wúkit	-	(*D > *t)
-	*wukírən	(*D > *r)
*wúhitr̄	-	(*t > *tr)
*wúhitra	*wuhírəna	(Epenthesis)
vúhitra	vuhírina	Modern

Possible reanalyses for [pákuⁿtr̄a]

Direction	passive (stem+ana)
t → r	pakut-ana → pakur-ana
r → t	pakur-ana → pakut-ana

3 Reanalysis in weak stems

Method: Compare historical and modern Malagasy

- Historical: Austronesian Comparative Dictionary (ACD; Blust and Trussel, 2010)
- Modern: Malagasy Dictionary & Encyclopedia of Madagascar (de La Beaujardière, 2004)

Predicted vs. Observed reanalyses:

- Distributional models predict reanalysis towards more likely alternant

(1) Historical distribution of alternants (Proto-Malayo-Polynesian).

Reanalysis should be towards historically more frequent alternant (green)

na	n (<*n,*ŋ)	m (<*m)
ka	h (<*k)	f (<*p,*b)
tra	t (<*t)	r (<*j,*r,*d,*D)

(2) Historical Distribution of tr̄a stems.

Reanalysis should observe r-dissimilation

Exp. alt	does stem have [r]?	
	yes	no
t	8	39
r	0	17

▷ Alternant never [r] when stem has preceding [r].

(3) Actual distribution of alternants (modern Malagasy).

Unexpected preference for [r] in modern Malagasy

na	n	m
ka	h	f
tra	t	r

(4) Documented reanalyses

Type	Change	Count
na (n=70)	m → n	3
	n → m	0
ka (n=60)	h → f	0
	f → h	4
tr̄a (n=65)	t → r	33 ← Not Predicted
	r → t	0
r...tr̄a (n=16)	t → r	0
	r → t	1

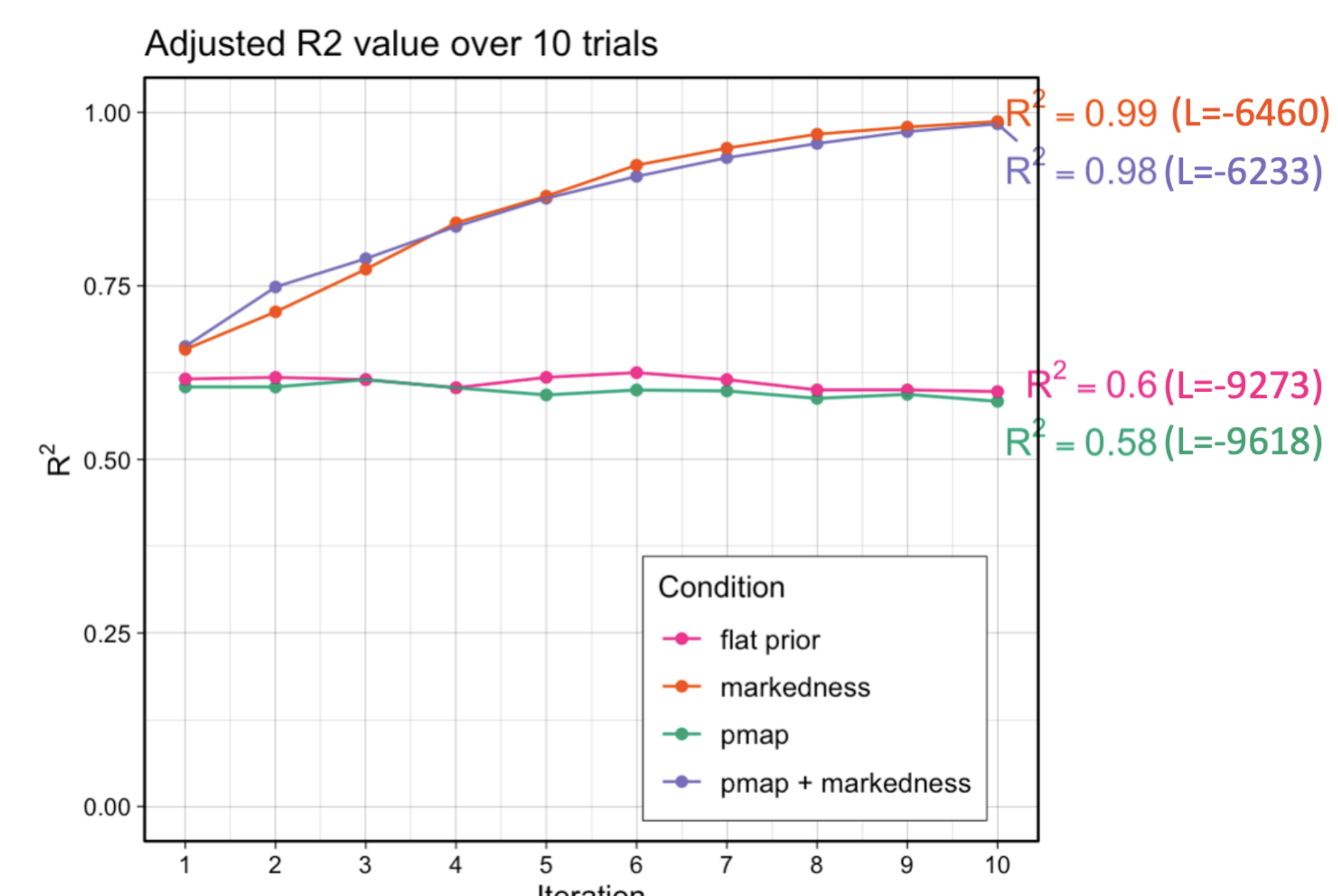
For tr̄a-final stems, reanalysis is t → r, NOT predicted by distributions

6 Model Results

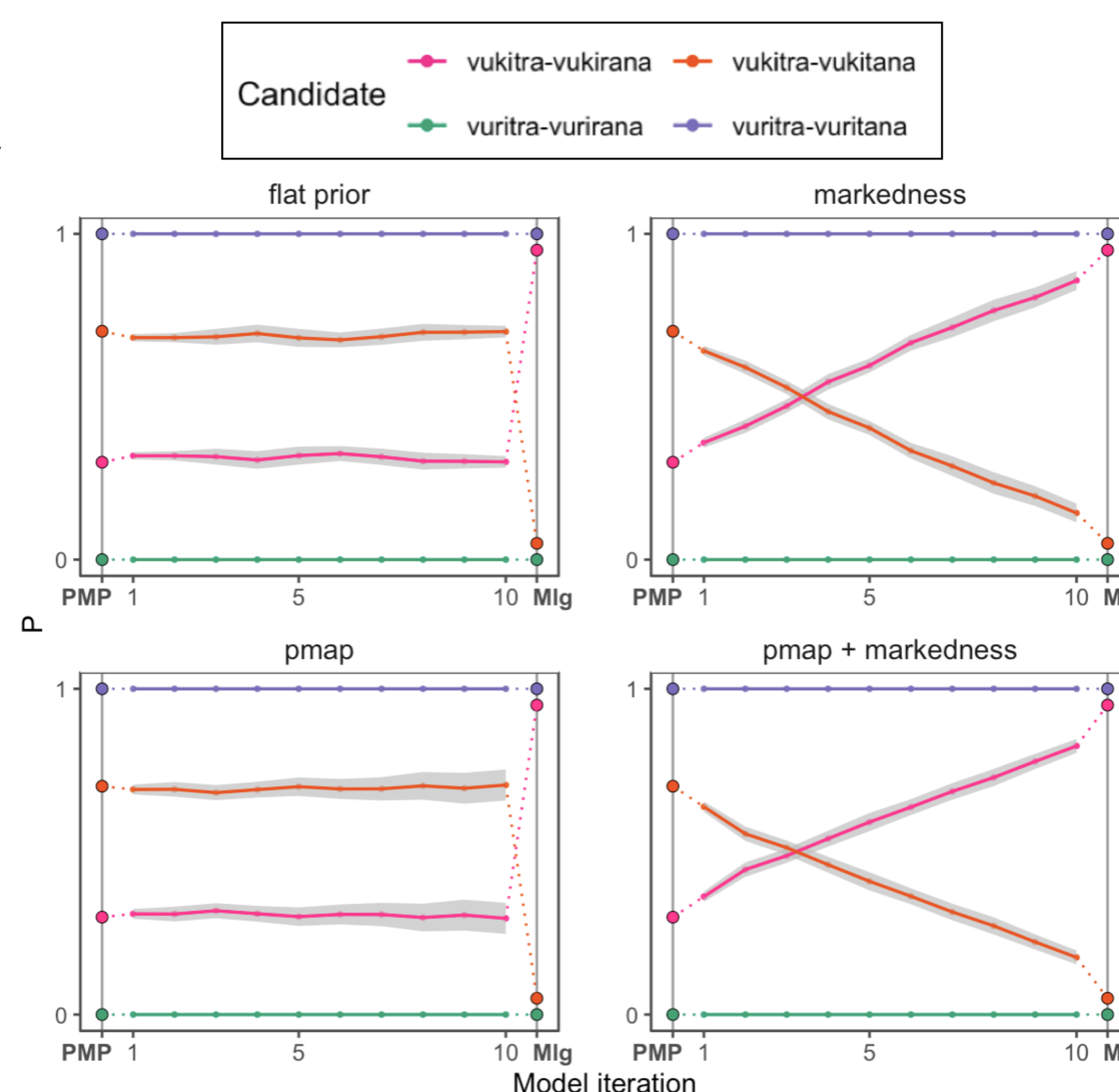
Result: Reanalysis in Malagasy explained by successive generations of learning modulated by markedness bias

Bias terms: ($\mu \approx$ preferred weight)

- Flat prior (control):** uniform μ
- P-map (control):** For *MAP, perceptually similar mappings get lower μ
- Markedness:** $\mu(*V[-cont]V) > \mu(\text{Faith})$
- Markedness + P-map**



△ **Figure: With markedness bias, model fit improves over iterations.** (high R² and low L ⇒ better fit)



△ **Figure: Models with markedness bias predict more tr̄a~r alternation.** (Change in P of tr̄a-final candidates over 10 iterations; PMP='old' Malagasy, Mlg='new' Malagasy; models whose predictions are closer Mlg are better.)

4 Markedness bias

Markedness bias against intervocalic stops explains t → r reanalysis

- Constraint: ***V[-cont]V**
- Historically, intervocalic lenition in Malagasy (*b > v, *p > f, *d > r, *k, *g > h)
- Typologically common (Kirchner, 1998; Kaplan, 2010; Katz, 2016)
- Active as statistical phonotactic tendency

5 Model Implementation

Goal: Show effect of markedness bias through modeling

Model components:

- MaxEnt Harmonic Grammar** (Goldwater and Johnson, 2003) to capture gradient alternations.
- Bias** implemented as a Gaussian prior (Wilson, 2006; White, 2013).
- Iterative:** Predictions of one iteration is input to next iteration.

Model constraints:

- Constraints enforcing alternation in weak stems: *tr̄aV, *k̄aV, *h̄aV
- Faithfulness constraints: *MAP (Zuraw, 2010, 2013)
- *r...r enforces r-dissimilation
- *V[-cont]V** penalizes tr̄a~t alternation.

Model evaluation:

- Compare models with markedness bias against controls with no bias.
- Results in Section 6

Takeaway

Markedness effects are found in reanalysis, and can be accounted for by augmenting distributional models with a **bias term**.

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