Reduplicative Opacity in Malay Revisited: Preliminary Phonetic Evidence for Variable "Recopying" and BRCT

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Introduction

The big question

⋆ **What is the right theory of reduplication?**

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Opacity

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(1) **Overapplication:** A process *applies* in a reduplicated word even though the environment *isn't met*.

(2) **Underapplication:** A process *doesn't apply* in a reduplicated word even though the environment *is met*.

- Different theories differ in exactly which types of patterns they predict.

→ Understanding the empirical landscape is crucial to decide between theories.

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Overview

- One putative pattern stands out: **nasal spreading in Malay**.
  - As reported by Onn (1976), it constitutes "recopying" overapplication.
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- Proponents of other theories of reduplication have questioned the veracity of this data (Inkelas & Zoll 2005, Kiparsky 2010, McCarthy, Kimper, & Mullin 2012).

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- To our knowledge, the pattern has not been phonetically documented.

  ⇒ It is urgent to resolve this question.

Introduction

Preview

- This paper reports new acoustic documentation of the interaction between nasal spreading and reduplication in Malay.
- Our preliminary findings confirm the existence of the putative "recopying" pattern reported by Onn (1976), but as part of a system of free variation.
- The confirmation of the recopying pattern bolsters the argument for BRCT.

Roadmap

Background

Malay

- Malay (*Bahasa Melayu*) belongs to the Western Malayo-Polynesian subgroup of the Austronesian language family (Blust 2013:30-32).
- It is primarily spoken in Malaysia, Brunei, Singapore and Indonesia.

Background

Nasal spreading

- In Malay, nasalization on vowels and glides is fully allophonic:
  - Nasal stops trigger iterative rightward spread of nasalization onto vowels and glides.
  - Spread is blocked by supralaryngeal consonants (e.g., k, s, l, etc.).
  - All other vowels/glides surface as oral.

(3) Distribution of nasalized vowels/glides in Johore Malay (Onn 1976:69-70)

'to drink'	[mĩnõm]		
'to eat'	[mãkan]	(*[mãk**ã**n], *[m**a**kan])	
'to rise'	[baŋõn]	(*[b**ã**ŋõn], *[baŋ**o**n])	
'to be luxurious'	[mẽw̃ãh̃]	(← /mewah/)	
'supervision'	[pəŋãw̃ãsan]	(← /pəŋ-awas-an/)	**Alternations**
'central focus'	[pənẽŋãh̃ãn]	(← /pəŋ-təŋah-an/)	

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Interaction between nasal spreading and reduplication

- Malay has total reduplication. *How does this interact with nasal spreading?*

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- For a root like /waŋi/ (→ [waŋĩ]) 'fragrant' (left-side target, right-side trigger) there are four conceivable outputs:

(4) Potential outputs

		Base	
		Oral	**Nasal**
Reduplicant	**Nasal**	d. [w̃ãŋĩ-waŋĩ]	c. [w̃ãŋĩ-w̃ãŋĩ]
	Oral	a. [waŋĩ-waŋĩ]	b. [waŋĩ-w̃ãŋĩ]

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Option 1: [waŋĩ-waŋĩ] (4a)

- Base- and reduplicant-initial spans are both oral

→ UNDERAPPLICATION of nasal spreading (no spread across juncture)

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	Oral	a. [waŋĩ-waŋĩ]	b. [waŋĩ-w̃ãŋĩ]

Option 2: [waŋĩ-w̃ãŋĩ] (4b)

- Base-initial span is nasalized but reduplicant-initial span is oral

→ NORMAL APPLICATION of nasal spreading (obeys allophonic distribution)

Background

Interaction between nasal spreading and reduplication

- Malay has total reduplication. *How does this interact with nasal spreading?*
- For a root like /waŋi/ (→ [waŋĩ]) 'fragrant' (left-side target, right-side trigger) there are four conceivable outputs:

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	Oral	a. [waŋĩ-waŋĩ]	b. [waŋĩ-w̃ãŋĩ]

Option 3: [w̃ãŋĩ-w̃ãŋĩ] (4c)

- Base- and reduplicant-initial spans **both nasal**

→ OVERAPPLICATION of nasal spreading (reduplicant-initial span nasal but no local trigger) — "**recopying**" (Kiparsky 2010:3)

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Interaction between nasal spreading and reduplication

- Malay has total reduplication. *How does this interact with nasal spreading?*
- For a root like /waŋi/ (→ [waŋĩ]) 'fragrant' (left-side target, right-side trigger) there are four conceivable outputs:

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		Base	
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	Oral	a. [waŋ̃ĩ-waŋĩ]	b. [waŋ̃ĩ-w̃ãŋĩ]

Option 4: [w̃ãŋ̃ĩ-waŋĩ] (4d)

- ◦ Base-initial span is oral but reduplicant-initial span is nasal

→ Pathological output (nasalization in only the wrong place)

Background

Recopying overapplication in Malay reduplication

⋆ **Which is the real output?**

Background

Recopying overapplication in Malay reduplication

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- According to Onn (1976:180), it's the recopying overapplication output (4c):

(5) Nasalization in Johore Malay reduplication

	Root in isolation	Reduplicated form
'fragrant/(intensified)'	[waŋĩ]	[w̃ãaŋĩ-w̃ãaŋĩ]
'germ/germs'	[hamə̃]	[h̃ãmə̃-h̃ãmə̃]
'reverie/ambition'	[aŋãn]	[ãŋãn-ãŋãn]
'wind/unconfirmed news'	[aŋẽn]	[ãŋẽn-ãŋẽn]

Background

Derivational/serial theories fail to generate recopying

⋆ This is significant because process ordering theories can't derive this pattern!

- McCarthy & Prince (1995:43–46) show that no ordering of nasalization and copying can derive recopying overapplication:

(6) Nasalization > Copy = UNDER

Input	/ RED-waŋi /
Rule 1: Nasalization	RED-waŋ̃
Rule 2: Copy	**waŋ̃**-waŋ̃
Output:	[wa ŋ̃i-wa ŋ̃]

(7) Copy > Nasalization = NORMAL[1]

Input	/ RED-waŋi /
Rule 1: Copy	**waŋ**i-waŋi
Rule 2: Nasalization	waŋ**ĩ**-**w̃ãŋ̃**
Output:	[wa ŋ̃i-w̃ãŋ̃]

[1] Persistent nasalization would also derive normal application.

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⋆ Derivational/serial theories would thus undergenerate this pattern, if it truly exists. Proponents of such theories have thus questioned this data.

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→ We conducted an acoustic experiment to determine which output(s) is/are actually attested.

[1] Persistent nasalization would also derive normal application.

Roadmap

Procedure

Experimental design

- Online production study with 9 native speakers of Peninsular Malay.
- Speakers produced 9 target words in reduplicated and unreduplicated form.
- The first syllables of the target words consisted of three different strings that undergo nasal spread, three words of each type:
  - *wa* : /waɲi/, /wajaŋ/, /waruŋ/
  - *ha* : /hama/, /haiwan/, /haram/
  - *a* : /aŋan/, /ajam/, /araŋ/
- All words were embedded in a carrier sentence that had no nasal segment:
  - *Sila tulis* __ *satu kali lagi.* "Please write __ one more time".
- Participants produced each sentence once, in randomized order, yielding 162 tokens in total.

Procedure

Acoustic measure of nasality: A1−P0

- A1−P0 values as an acoustic measure of nasality (Chen 1997, Styler 2017).
- A1−P0 values were extracted at midpoint of the first syllable [a] in the target words:
  - In unreduplicated context (e.g., /wa_{U}ŋi/)
  - In reduplicated context (e.g., /wa_{R}ŋi-wa_{B}ŋi/)
- Normalized A1−P0 values for each reduplicated word for each speaker were calculated as follows:

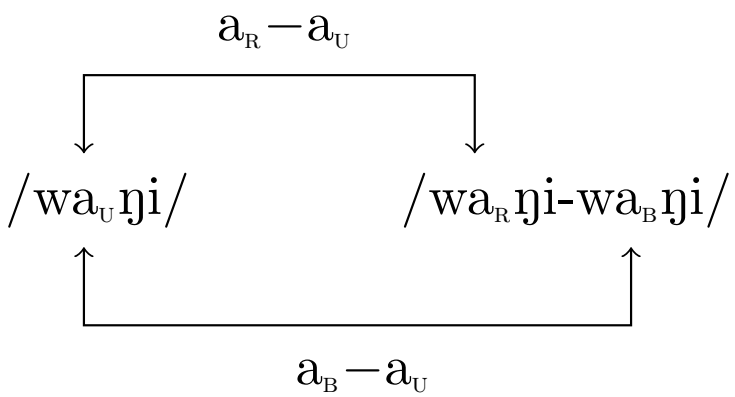


Figure 1: Calculating normalized A1−P0 values

Results

Aggregated results

- The aggregated results are given in Figure 2 below.
- The [a] vowel in the base (a_B) has a higher degree of nasality (lower A1−P0 value) compared to the same vowel in the reduplicant (a_R).

  → Normal application as the typical output (e.g., waŋĩ-w̃ãŋĩ).

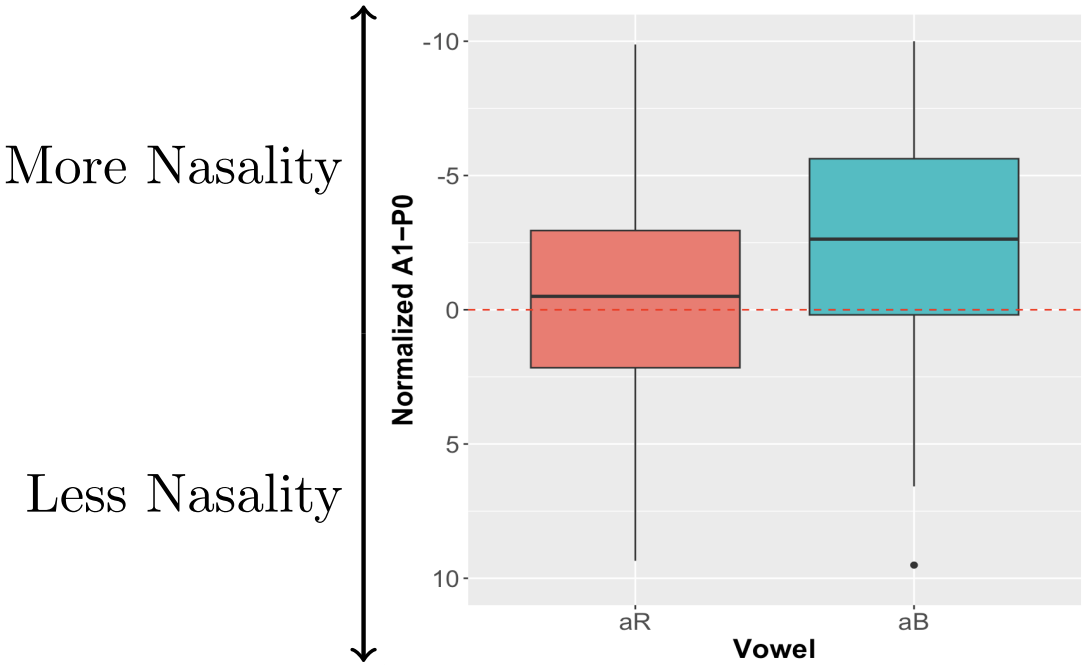


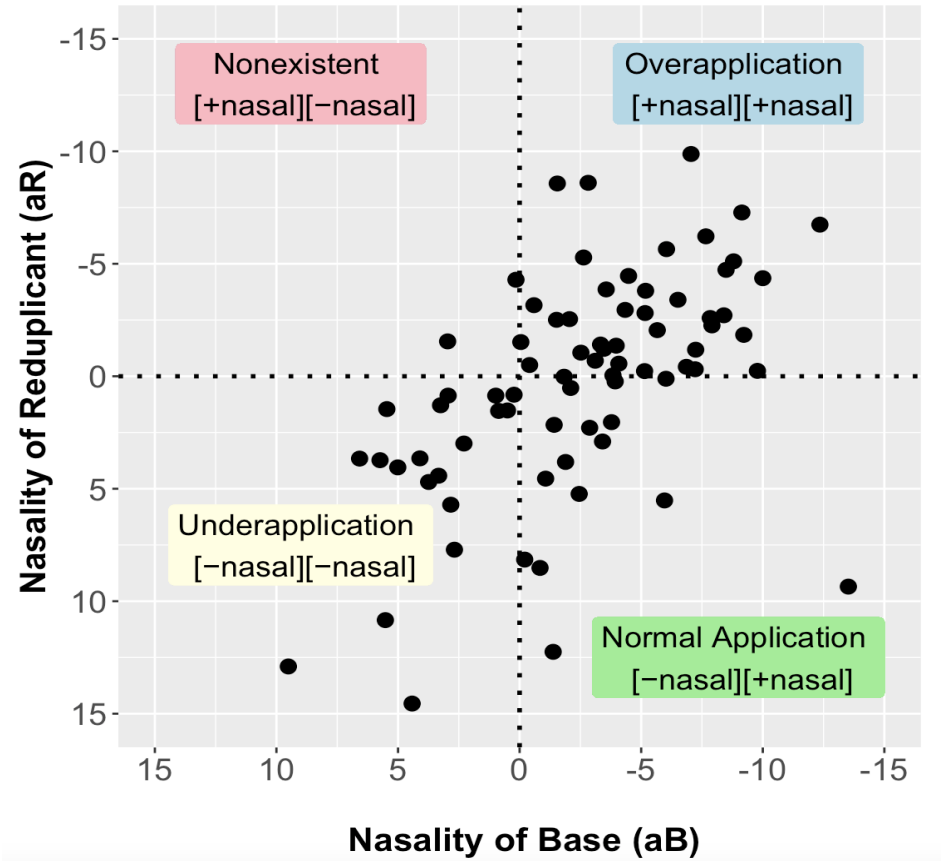
Figure 2: Overall nasality of a_R and a_B

Results

Scatter plot of aggregated results

- Figure 3 visualizes a scatter plot of the aggregated results.

[w̃ãŋĩ-waŋĩ̃] [w̃ãŋĩ-w̃ãŋĩ̃]



[waŋĩ-waŋĩ̃] [waŋĩ-w̃ãŋĩ̃]

Figure 3: Scatter plot of aggregated results

Results

Scatter plot of results by speaker

- Individual speakers demonstrate substantial intraspeaker variation.
  - Speaker F6 (filled square) vacillates between over-, under- and normal application in her production.

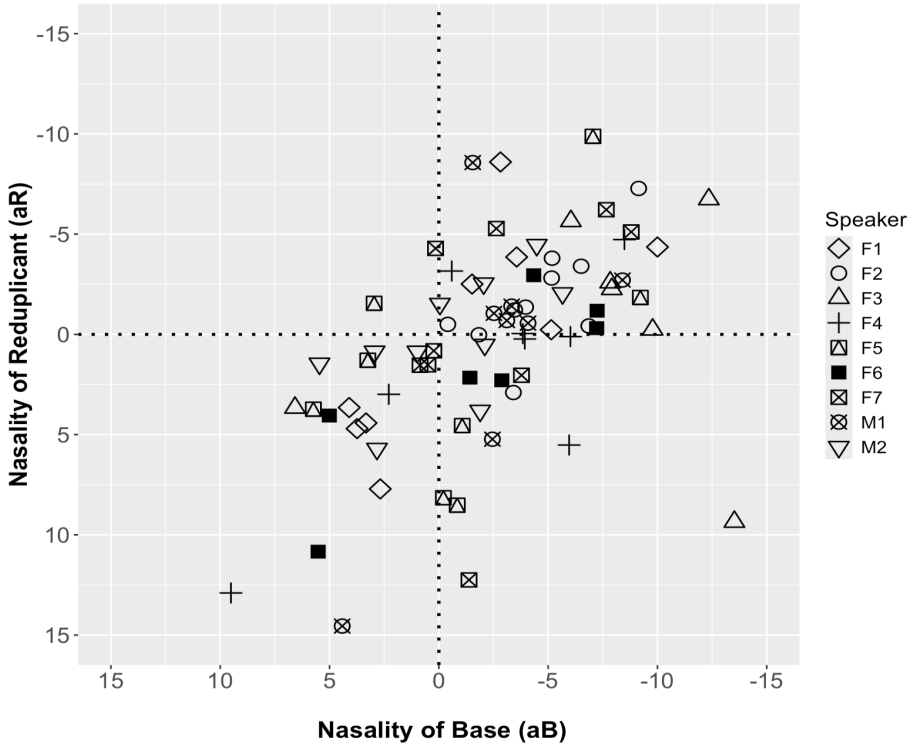


Figure 4: Scatter plot of results by speaker

Results

Scatter plot of results by word

- The same variation is seen in individual words.
  - Reduplicated word /waŋi-waŋi/ (filled triangle) is variably produced with over-, under- and normal application of nasal spreading.

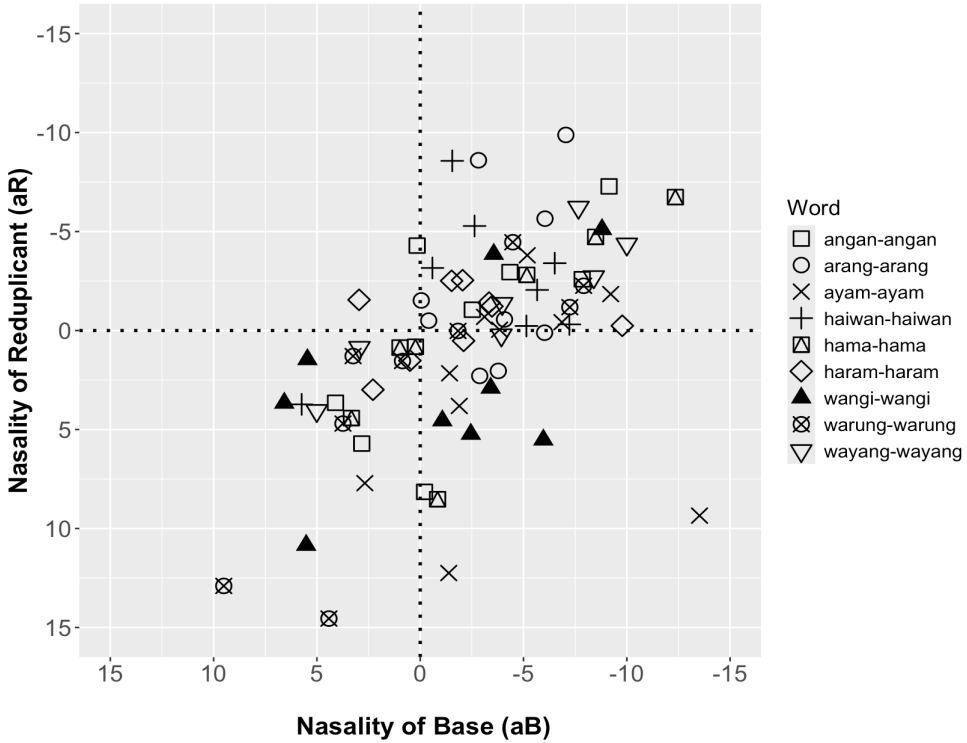


Figure 5: Scatter plot of results by word

Roadmap

Analysis

Overview

- We model the experimental results using Optimality Theory (Prince & Smolensky 1993).
  - Reduplication and its interaction with phonology is modeled with Base-Reduplicant Correspondence Theory (McCarthy & Prince 1995 [M&P]).
  - To account for the variable outputs, we will propose a grammar with partially ordered constraints (Anttila 1997).

- Structure of the analysis:
  1. M&P's OT analysis of the basic allophonic spreading pattern.
  2. Adaptation of M&P's BRCT analysis of the reduplication pattern, supplemented to account for the newly observed variation.

Analysis

Nasal spreading: Constraints

- M&P derive the allophonic distribution using the constraints in (8–10), ranked as below.

(8) ***NV (*[+nas][−nas,−cons]):** Assign a violation * for each non-nasal vowel or approximant which immediately follows a nasal(ized) segment.

(9) ***$\tilde{\text{V}}$ (*[+nas,−cons]):** Assign a violation * for each nasalized vowel or approximant.

(10) **Ident[±nas]/[−cons]-IO:** Assign a violation * for each [−consonantal] segment whose output value of [±nasal] does not match its input value.

Ranking

*NV $\gg$ *$\tilde{\text{V}}$ $\gg$ Ident[±nas]/[−cons]-IO

Analysis

Nasal spreading: static patterns

- This analysis derives the correct result for the static distribution of nasality:

(11) Nasalization in Johore Malay (w/ maximally unfaithful input)

/makãn/	*NV	*Ṽ	Id[±nas]/[−cons]-IO
a. makan	*!		*
b. ☞ mãkan		*	**
c. makãn	*!	*	
d. mãkãn		**!	*

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- *NV $\gg$ *Ṽ: Nasal vowels/approximants after nasals [(11b) $\succ$ (11a,c)].

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- *NV ≫ *Ṽ: Nasal vowels/approximants after nasals [(11b) ≻ (11a,c)].
- *Ṽ ≫ Id[±nas]: All other vowels/approximants are oral [(11b) ≻ (11d)].

Analysis

Nasal spreading: Iterative spread

- The same ranking causes nasality to spread iteratively when there is an extended vowel/approximant span (12):

(12) Iterative nasal spreading in Johore Malay

/pəŋ-awas-an/		*NV	*Ṽ	Id[±nas]/[−cons]-IO
a.	pəŋ-awas-an	*!		
b.	pəŋ-ãwas-an	*!	*	*
c.	pəŋ-ãw̃as-an	*!	**	**
d. ☞	pəŋ-ãw̃ãs-an		***	***
e.	pəŋ-ãw̃ãs-ãn		****!	****
f.	pə̃ŋ-ãw̃ãs-an		****!	****

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b. pəŋ-ãwas-an	*!	*	*
c. pəŋ-ãw̃as-an	*!	**	**
d. ☞ pəŋ-ãw̃ãs-an		***	***
e. pəŋ-ãw̃ãs-ãn		****!	****
f. pə̃ŋ-ãw̃ãs-an		****!	****

- Prefix /ŋ/ induces a *NV violation when concatenated with the root (12a).
- *NV $\gg$ *Ṽ prefers nasalizing the root-initial /a/ [(12d) $\succ$ (12a)].

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e.	pəŋ-ãw̃ãs-ãn		****!	****
f.	pə̃ŋ-ãw̃ãs-an		****!	****

- But to fully alleviate the *NV violation, the whole span must be nasalized [(12d) ≻ (12b,c)].

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d. ☞	pəŋ-ãw̃ãs-an		***	***
e.	pəŋ-ãw̃ãs-ãn		****!	****
f.	pə̃ŋ-ãw̃ãs-an		****!	****

- Spreading terminates at [+cons] /s/ ([ãs] doesn't violate *NV), so the /a/ following the /s/ doesn't nasalize [(12d) ≻ (12e)].

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a.	pəŋ-awas-an	*!		
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c.	pəŋ-ãw̃as-an	*!	**	**
d. ☞	pəŋ-ãw̃ãs-an		***	***
e.	pəŋ-ãw̃ãs-ãn		****!	****
f.	pə̃ŋ-ãw̃ãs-an		****!	****

- Likewise, since the /ə/ of the prefix does not follow a nasal consonant, it doesn't nasalize either [(12d) ≻ (12f)].

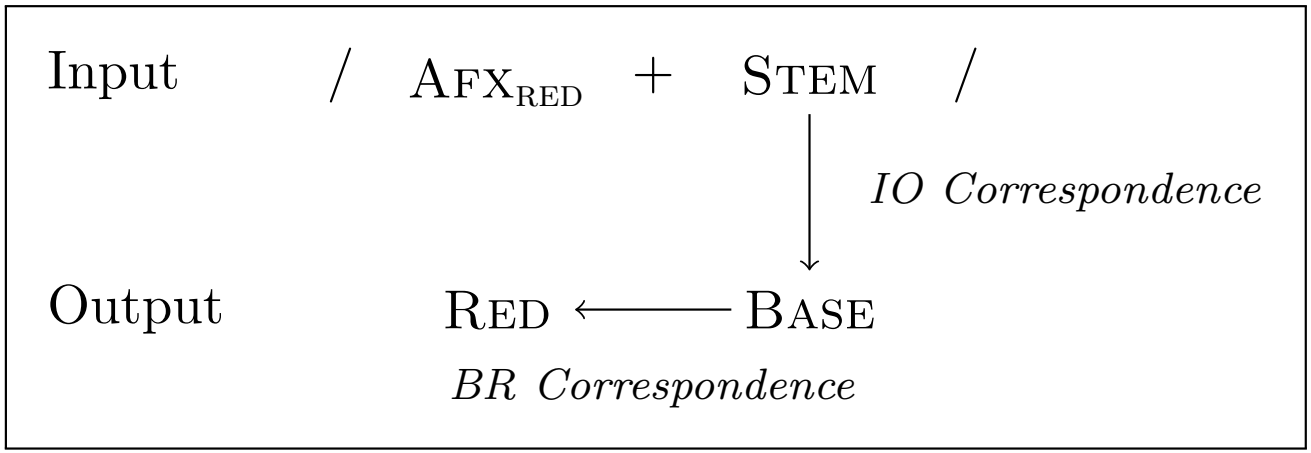
→ But this is the same kind of position where we find nasalization in the "recopying" output in reduplication.

Analysis

Reduplication: Base-Reduplicant Correspondence Theory

- To generate recopying overapplication in reduplication, we need to adopt Base-Reduplicant Correspondence Theory [BRCT] (McCarthy & Prince 1995):
  - A correspondence relation (BR) holds between the output base and the output reduplicant.
  - Faithfulness constraints act over this relation to encourage similarity between the base and the reduplicant.

(13) Base-Reduplicant Correspondence Theory (McCarthy & Prince 1995:4)

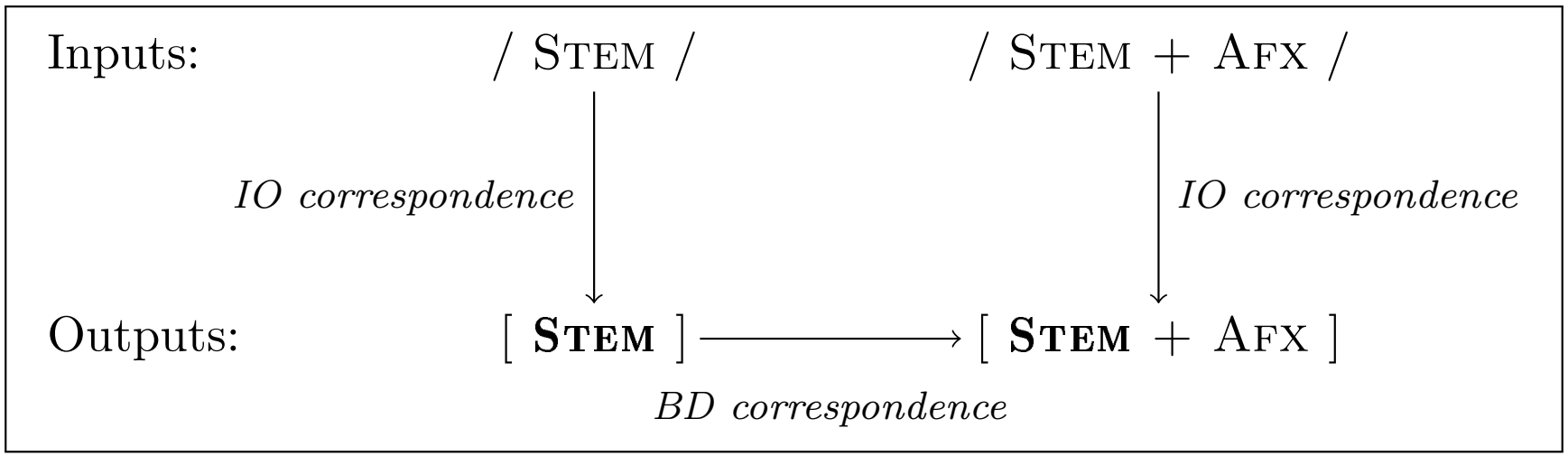


Analysis

Reduplication: Base-Derivative Correspondence Theory

- To capture the underapplication output, we adopt an additional component of Correspondence Theory: Output-Output / Base-Derivative (BD) correspondence (Benua 1995, 1997, Burzio 1996, Kenstowicz 1996, Kager 1999, *et seq.*).
  - A complex derivative corresponds, and may be faithful to, its morphological base.
  - This is a parallelist alternative for capturing cyclic effects.

(14) Base-Derivative Correspondence (cf. Benua 1997:7)

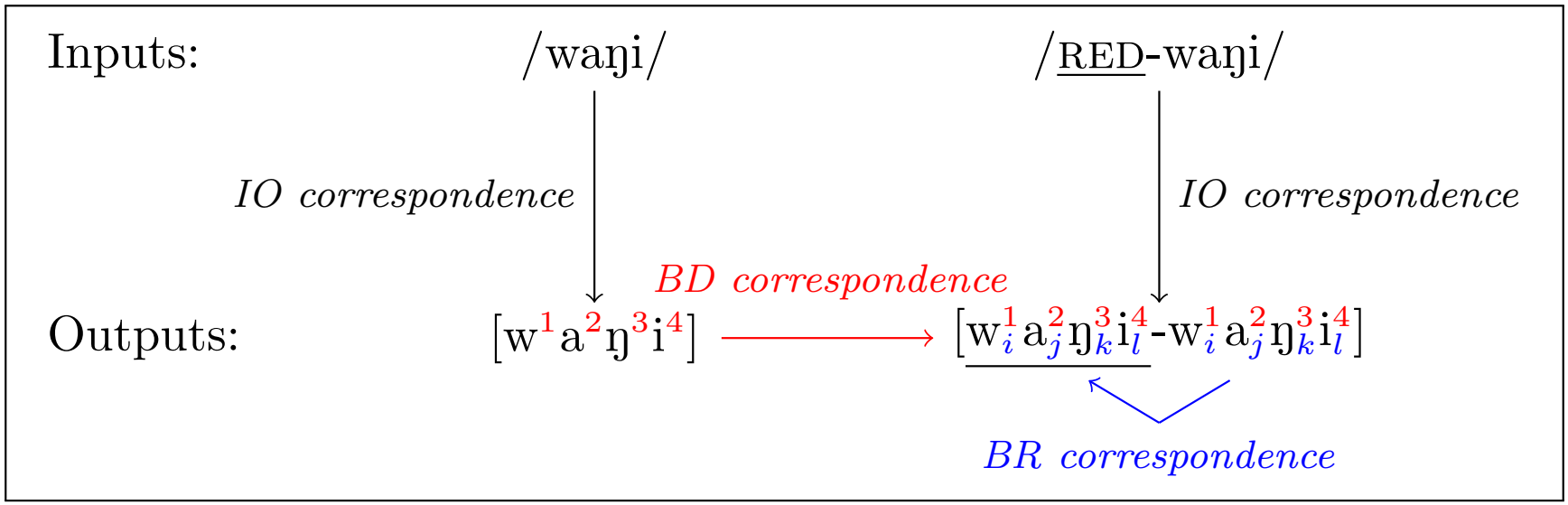


Analysis

Reduplication: BD Correspondence in Malay reduplication

- Claim: The BD correspondence relation in Malay reduplication must hold between the morphological base (the unreduplicated output root) and **both**:
  1. The reduplicative base, and
  2. The reduplicant

(15) Correspondence relations in Malay reduplication (nasalization suppressed)



Analysis

Reduplication: Variation

- Following our experimental results, we want to model variation between three outputs:

Option 1: [waŋ̃i-waŋi] UNDERAPPLICATION
Nasalize just the /i/'s following the [ŋ]'s

Option 2: [waŋ̃i-w̃ãŋ̃i] NORMAL APPLICATION
Do iterative nasal spreading like normal

Option 3: [w̃ãŋ̃i-w̃ãŋ̃i] OVERAPPLICATION ("recopying")
Do iterative nasal spreading like normal, *and* nasalize the reduplicant-initial span to match the base

Analysis

Reduplication: Constraints

- The only new constraints: IDENT[±nasal] constraints on these two new correspondence relations.

(16) **IDENT[±nas]-BR:** Assign a violation * for each segment in the reduplicant whose value of [±nasal] does not match its correspondent in its reduplicative base.

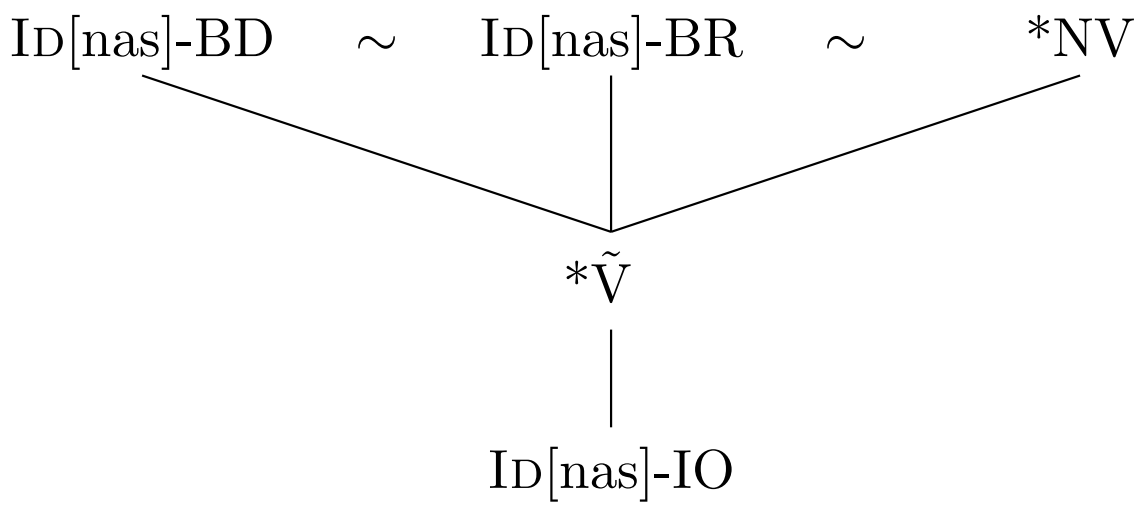
(17) **IDENT[±nas]-BD:** Assign a violation * for each segment in the derivative whose value of [±nasal] does not match its correspondent in its morphological base.

Analysis

Reduplication: Rankings

- The observed variation is derived via a variable ranking (cf. Anttila 1997) between Id[nas]-BD, Id[nas]-BR, and *NV (all ranked above *$\tilde{\text{V}}$):

(18) **Ranking**



- The factorial resolution of the three mutually unranked top constraints leads to our three attested outcomes.

Analysis

Reduplication: Deriving variation

- The following tableau shows the violation profile of the relevant outputs.

(19) Variable realization of nasalization in Malay reduplication

Morph Base: [waŋĩ] / Input: /RED, waŋi/	Id[nas]-BD	Id[nas]-BR	*NV	*Ṽ
a. ☞ waŋ̲ĩ-waŋĩ UNDER			* (ĩ̲-w)	**
b. ☞ waŋ̲ĩ-w̃ãŋĩ NORMAL	** (w̃,ã)	** (w,a)		****
c. ☞ w̃ãŋ̲ĩ-w̃ãŋĩ OVER	**** (w̲̃,ã̲,w̃,ã)			******
d. w̃ãŋ̲ĩ-waŋĩ	** (w̲̃,ã̲)	** (w,a)	* (ĩ̲-w)	****

Analysis

Reduplication: Deriving variation

- The following tableau shows the violation profile of the relevant outputs.

(19) Variable realization of nasalization in Malay reduplication

Morph Base: [waŋĩ] / Input: /RED, waŋi/	Id[nas]-BD	Id[nas]-BR	*NV	*Ṽ
a. ☞ waŋĩ-waŋĩ UNDER			* (ĩ-w)	**
b. ☞ waŋĩ-w̃ãŋĩ NORMAL	** (w̃,ã)	** (w,a)		****
c. ☞ w̃ãŋĩ-w̃ãŋĩ OVER	**** (w̃,ã,w̃,ã)			******
d. w̃ãŋĩ-waŋĩ	** (w̃,ã)	** (w,a)	* (ĩ-w)	****

- Candidate (19d) (nasalization in reduplicant but not base) is harmonically bounded by (19a,b).
  - This is equivalent to the non-existent quadrant from Figure 3.
  - It will be omitted moving forward.

Analysis

Reduplication: Deriving underapplication

UNDERAPPLICATION

ID[nas]-BD ≫ *NV

- Underapplication (20a) maintains isolation form of the root – in both base and reduplicant – at the expense of a nasal-oral sequence at the juncture.
  - Both other outputs nasalize segments which were oral in the morphological base.

(20) Variable realization: UNDERAPPLICATION

MORPH BASE: [waŋĩ] / INPUT: /RED, waŋi/	ID[nas]-BD	ID[nas]-BR	*NV	*Ṽ
a. ☞ waŋĩ-waŋĩ UNDER			* (ĩ-w)	**
b. waŋĩ-w̃ãŋĩ NORMAL	*!* (w̃,ã)	*!* (w,a)		****
c. w̃ãŋĩ-w̃ãŋĩ OVER	*!*** (w̃,ã,w̃,ã)			******

Analysis

Reduplication: Deriving normal application

Normal Application

*NV ≫ Id[nas]-BD ≫ Id[nas]-BR

- Normal application (21b) occurs when it is least important to maintain identity between base and reduplicant.
  - As long as the "reduplicant" stands in BD correspondence with the morphological base, this candidate has 2 fewer violations of Id[nas]-BD than does the overapplication candidate (21c).

(21) Variable realization: NORMAL APPLICATION

Morph Base: [waŋĩ] / Input: /RED, waŋi/	*NV	Id[nas]-BD	Id[nas]-BR	*Ṽ
a. waŋĩ-waŋĩ UNDER	*! (ĩ-w)			**
b. ☞ waŋĩ-w̃ãŋĩ NORMAL		** (w̃,ã)	** (w,a)	****
c. w̃ãŋĩ-w̃ãŋĩ OVER		***!* (w̃,ã,w̃,ã)		******

Analysis

Reduplication: Deriving overapplication

Overapplication

*NV, Id[nas]-BR ≫ Id[nas]-BD

- Recopying overapplication (22c) occurs when maintaining BD-identity is least important.
  - Realizing nasalization on the reduplicant-initial span both eliminates all nasal-oral sequences *and* maintains BR identity.
  - This comes at the expense of diverging from the root in isolation.

(22) Variable realization: OVERAPPLICATION

Morph Base: [waŋĩ] / Input: /RED, waŋi/	*NV	Id[nas]-BR	Id[nas]-BD	*Ṽ
a. waŋĩ-waŋĩ UNDER	*! (ĩ-w)			**
b. waŋĩ-w̃ãŋĩ NORMAL		*!* (w,a)	** (w̃,ã)	****
c. ☞ w̃ãŋĩ-w̃ãŋĩ OVER			**** (w̃,ã,w̃,ã)	******

Roadmap

Conclusion

Summary

- Our acoustic experiment revealed three attested outputs for the interaction between nasal spreading and reduplication in Malay, in free variation:

  Option 1: [waŋĩ-waŋĩ] (UNDERAPPLICATION)

  Option 2: [waŋĩ-w̃ãŋĩ] (NORMAL APPLICATION)

  Option 3: [w̃ãŋĩ-w̃ãŋĩ] (Recopying OVERAPPLICATION)

- While this paints a more complex picture than what was originally reported by Onn (1976), it crucially **confirms the existence of the recopying pattern**, which has been of great interest in the theoretical literature.

- We showed that BRCT can generate all three outputs in a grammar with variable constraint ranking.

Conclusion

Recopying fails in process ordering

- Recopying is significant because it can't be derived serially (M&P:43–46):

(23) Nasalization > Copy = UNDER

Input	/ RED-waŋi /
Rule 1: Nasalization	RED-waŋĩ
Rule 2: Copy	**waŋĩ**-waŋĩ
Output:	[wa ŋĩ-wa ŋĩ]

(24) Copy > Nasalization = NORMAL

Input	/ RED-waŋi /
Rule 1: Copy	**waŋi**-waŋi
Rule 2: Nasalization	waŋ**ĩ-w̃ãŋĩ**
Output:	[wa ŋĩ-w̃ãŋĩ]

Conclusion

Recopying fails in process ordering

- Recopying is significant because it can't be derived serially (M&P:43–46):

(23) Nasalization > Copy = UNDER

Input	/ RED-waŋi /
Rule 1: Nasalization	RED-waŋĩ
Rule 2: Copy	**waŋĩ**-waŋĩ
Output:	[wa ŋĩ-wa ŋĩ]

(24) Copy > Nasalization = NORMAL

Input	/ RED-waŋi /
Rule 1: Copy	**waŋi**-waŋi
Rule 2: Nasalization	waŋ**ĩ-w̃ãŋĩ**
Output:	[wa ŋĩ-w̃ãŋĩ]

- This holds of recent constraint-based serial theories, many of which have contested the existence of the recopying data in Malay.
  - Morphological Doubling Theory (Inkelas & Zoll 2005:221, n. 18)
  - Reduplication in Stratal OT (Kiparsky 2010:3–4)
  - Serial Template Satisfaction in Harmonic Serialism (McCarthy, Kimper, & Mullin 2012:203)

Conclusion

Recopying fails in process ordering

- Recopying is significant because it can't be derived serially (M&P:43–46):

(23) Nasalization > Copy = UNDER

Input	/ RED-waŋi /
Rule 1: Nasalization	RED-waŋĩ
Rule 2: Copy	**waŋĩ**-waŋĩ
Output:	[wa**ŋ**ĩ-wa**ŋ**ĩ]

(24) Copy > Nasalization = NORMAL

Input	/ RED-waŋi /
Rule 1: Copy	**waŋi**-waŋi
Rule 2: Nasalization	waŋ**ĩ-w̃ãŋĩ**
Output:	[wa**ŋ**ĩ-w̃ãŋĩ]

- This holds of recent constraint-based serial theories, many of which have contested the existence of the recopying data in Malay.

⋆ **On the other hand, recopying overapplication *can* be derived with a parallel theory like BRCT!**

Conclusion

Ramifications

- In the literature, everyone agrees that the existence of recopying overapplication would argue conclusively for BRCT.

⋆ Since we've shown that the pattern does exist, **BRCT must be the correct theory of reduplication**.

Thank you!

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Analysis

Nasal spreading: avoiding denasalization

(25) **IDENT[±nas]/[+cons]-IO:** Assign a * for each [+consonantal] segment whose output value of [±nasal] doesn't match its input value.

(26) **Ranking**
IDENT[±nas]/[+cons]-IO, *NV ≫ *Ṽ ≫ IDENT[±nas]/[−cons]-IO

(27) Nasalization in Johore Malay (w/ maximally unfaithful input)

/makãn/		ID[±nas]/[+cons]-IO	*NV	*Ṽ	ID[±nas]/[−cons]-IO
a.	makan		*!		*
b. ☞	mãkan			*	**
c.	makãn		*!	*	
d.	mãkãn			**!	*
e.	bakan	*!			*

- IDENT[±nas]/[+cons]-IO ≫ *Ṽ ensures that nasal stops don't denasalize to avoid *NV violations [(27b) ≻ (27e)].