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Too much, too little, too late:
Hybrid opacity in Berbice Dutch Creole

Overview:
- Rule-based serialism and Optimality Theory with Candidate Chains (OT-CC) both predict the existence of HYBRID OPACITY (my terminology; underapplication and overapplication of the same process within the same derivation).
- The standard definition of opacity does not allow for the coexistence of underapplication and overapplication, thus precluding the above interaction type.
- I present an interaction from Berbice Dutch Creole which meets the criteria for hybrid opacity, depending on choice of UR: Nasal place agreement is blocked by consonant deletion after it has (over)applied (e.g. /maNg-tɛ/ → [maŋ-tɛ], *[man-tɛ] 'run-ANT').
- While several elements concerning hybrid opacity are still unclear, either its attestation or non-attestation will prove theoretically informative.

1. Data

Berbice Dutch Creole: Dutch lexifier, Eastern Ijo substrate, spoken in Guyana from the end of the 17th century till its death in 2005 (Kouwenberg 1994).

(1) Non-alternating environments: the contrast between [m] and [n] is neutralized before oral stops. The velar nasal arises only preceding a homorganic stop.

Word-initial	Intervocalic	Word-final	NC
m n	m n	m n	m n ŋ
[mafu] 'leech'	[huma] 'piranha'	[kam] 'comb'	[kamba] 'drum'
[nati] 'wet'	[kunu] 'stench'	[alen] 'alone'	[tondi] 'grease'
			[juŋgu] 'young'

(2) Nasal place agreement is almost completely categorical within monomorphs and optionally applies across a morpheme boundary, such as with anterior marker /-tɛ/ ("[nimi]-type" verbs).

	Bare forms	Anterior forms	Gloss
a.	[nimi] ~ [nim]	[nim-tɛ] ~ [nin-tɛ]	'know'
b.	[pama] ~ [pam]	[pam-tɛ] ~ [pan-tɛ]	'tell'
c.	[komu] ~ [kom]	[kom-tɛ] ~ [kon-tɛ]	'come'

This interaction can also be seen for /n/ → [m] in compounding, e.g. [sampoto] 'pepperpot' < [sani] 'pepper' + [poto] 'pot'.

(3) A certain set of verbs ("[maŋgi]-type") shows alternations between homorganic nasal + voiced stop sequences (+ vowel) and nasal-final forms. This results in a superficial place contrast in the nasal series both word-finally (N# below) and before the anterior marker.

	NCV#	*N#*	*Anterior form*	*Gloss*
a.	[tambu]	[tam]	[tam-tɛ], *[tan-tɛ]	'pound'
b.	[fɛndɛ]	[fɛn]	[fɛn-tɛ]	'find'
c.	[maŋgi]	[maŋ]	[maŋ-tɛ], *[man-tɛ]	'run'

Voiced stop coda deletion effectively blocks NC place assimilation. NB: this analysis takes the URs of this verb type to be NC-final (e.g. /tamb/ or /taNb/) but is not dependent on this assumption (e.g. /tambu/ → |tamb| → [tam]).

2. Analysis

2.1 Rule-based
Rule-based serialism captures interactions via rule ordering, enforcing the principle that rules can only apply once in a derivation.

(4) V-deletion optionally feeds Assimilation, provided V-deletion applies before Assimilation (a). Assimliation is blocked in the inverse application (b).

	a. /nimi-tɛ/		b. /nimi-tɛ/
V-deletion	nim-tɛ	Assimilation	—
Assimilation	nin-tɛ	V-deletion	nim-tɛ
	[nin-tɛ]		[nim-tɛ]

As NC agreement in monomorphs is predictable, rule-based frameworks require the place of nasals underlyingly adjacent to stops to be derived from a placeless archiphoneme via Assimilation, even in the absence of alternations, e.g. /kaNpɛlɛ/ → [kampɛlɛ] 'butterfly'.

(5) Assimilation must be ordered before C-deletion for the proper results to hold.

	a. /maNg/		b. /maNg/
Assimilation	maŋg	C-deletion	maN
C-deletion	maŋ	Assimilation	—
	[maŋ]		*[maN]

Derivation (5a) is an example of standard counterbleeding: the impetus for Assimilation was removed by C-deletion. Note that the inverse ordering (5b) is bleeding.

(6) As for the suffixed forms, the counterbleeding aspect still holds in that the motivation for Assimilation is removed.

	a. /maNg-tɛ/		b. /maNg-tɛ/
Assimilation	maŋg-tɛ	C-deletion	maN-tɛ
C-deletion	maŋ-tɛ	Assimilation	man-tɛ
	[maŋ-tɛ]		*[man-tɛ]

However, Assimilation cannot reapply to the new [ŋt] sequence. It thus appears to fail to apply, indicative of a counterfeeding interaction—but crucially *only* because it has already (over)applied. Note also that the inverse ordering (6b) is now a feeding interaction.

C-deletion both removes the motivation for Assimilation and creates a new environment for it to apply, to which it crucially does not. This is the essence of hybrid opacity: it has elements of both underapplication and overapplication simultaneously. But is it its own type of interaction? Is it "counterfeeding nested in counterbleeding"? All loaded questions…

2.2 What is opacity?
More generally, opacity results when generalizations (processes, rules, etc.) are not surface-true, usually due to interaction with another process. Typically two categories: UNDERAPPLICATION, where a process seemingly fails to apply, and OVERAPPLICATION, where a process seemingly applies where it should not have.

(7) Standard formalization of opacity from Kiparsky (1973):

> A phonological rule P of the form A → B / C_D is opaque if there are surface structures with either of the following characteristics:
>
> a. instances of A in the environment C_D
> b. instances of B derived by P that occur in environments other than C_D

(8) Typology of rule interactions (Baković 2011), (c, d) being opaque:

> Given two rules A, B such that A precedes B,
> a. A FEEDS B iff A creates additional inputs to B.
> b. A BLEEDS B iff A eliminates potential inputs to B.
> c. B COUNTERFEEDS A iff B creates additional inputs to A.
> d. B COUNTERBLEEDS A iff B eliminates potential inputs to A.

In other words:

	counterfeeding		*counterbleeding*
A	—	A	applies
B	applies	B	applies

As a result of B, the structural description for A is met, but it crucially cannot reapply.	B removes the part of the structural description that motivated the prior application of A.

Counterfeeding and counterbleeding are the counterfactual inverses of their transparent counterparts (feeding and bleeding, respectively). For example, reversing the order of application of counterfeeding traditionally yields a feeding interaction.

2.3 Optimality Theory
Classic Optimality Theory famously fails to derive opacity, motivating several amendments over the past few decades. In Berbice, the behavior of [maŋgi]-type verbs entails a ranking paradox.

(9) Constraints

Markedness
   a. AGREE: Heterorganic nasal + oral stop sequences are banned.
   b. SYNCOPE: Unstressed, root-final vowels are banned.
   c. *VOC: Voiced obstruent codas are banned.

Faithfulness
   d. ID[place]: The place values of input segments have identical specification in their output correspondents (particular reading: no changes in place).
   e. MAXV: Input vowels have corresponding output vowels (no vowel deletion).
   f. MAXC: Input consonants have corresponding output consonants (no consonant deletion).

(10) AGREE >> ID[place] ensures NC agreement in monomorphs.

a.

/…Ng…/	AGREE	ID[place]
a. Ng	*!	
b. ☞ ŋg		*

b.

/…mg…/	AGREE	ID[place]
a. mg	*!	
b. ☞ ŋg		*

(11) Place assimilation fed by V-deletion is captured if SYNCOPE and AGREE >> faithfulness.

/nimi-tɛ/	SYNCOPE	AGREE	ID[place]	MAXV
a. nimi-tɛ	*!			
b. nim-tɛ		*!		*
c. ☞ nin-tɛ			*	*

(12) The attested outputs of [maŋgi]-type verbs cannot survive under this ranking.

/maŋg-tɛ/	*VOC	AGREE	ID[place]	MAXC
a. maŋg-tɛ	*!			
b. ☜ maŋ-tɛ		*!		*
c. ☞ man-tɛ			*	*

(13) Optimality Theory with Candidate Chains (OT-CC) offers a possible solution, using a PRECEDENCE constraint, which specifies an optimal order of faithfulness violations.

> PREC(ID[place], MAXC): Every violation of MAXC must be preceded by and must not be followed by a violation of ID[place].

Deviation from either condition entails a violation mark, e.g. <MAXC, ID[place]> violates this constraint twice.

(14) Entertaining for now input /Nɡ/, valid chains for /maNɡ-tɛ/:

    a. <maNɡ-tɛ>
        (fully faithful)

    b. <maNɡ-tɛ, maN-tɛ>   → Deletion first
        MAXC
    c. <maNɡ-tɛ, maN-tɛ, man-tɛ>
        MAXC, ID[place]

    d. <maNɡ-tɛ, maŋɡ-tɛ>   → Assimilation first
        ID[place]
    e. <maNɡ-tɛ, maŋɡ-tɛ, maŋ-tɛ>
        ID[place], MAXC
    f. <maNɡ-tɛ, maŋɡ-tɛ, maŋ-tɛ, man-tɛ>
        ID[place], MAXC, ID[place]

(15) Ranking PREC >> AGREE ensures the proper results.

/maNɡ-tɛ/		*VOC	MAXC	PREC	AGREE	ID[place]
a.	<maNɡ-tɛ> Ø	*!			*	
b.	<maNɡ-tɛ, maN-tɛ> MAXC		*	*!	*	
c.	<maNɡ-tɛ, maN-tɛ, man-tɛ> MAXC, ID[place]		*	*!*		*
d.	<maNɡ-tɛ, maŋɡ-tɛ> ID[place]	*!				*
e. ☞	<maNɡ-tɛ, maŋɡ-tɛ, maŋ-tɛ> ID[place], MAXC		*		*	*
f.	<maNɡ-tɛ, maŋɡ-tɛ, maŋ-tɛ, man-tɛ> ID[place], MAXC, ID[place]		*	*!		**

The input of (15) is in the spirit of Richness of the Base (also hypothetical /mɡ/ and so on; Smolensky 1996) and Archiphonemic Prudence (Bermúdez-Otero 2003).

(16) If we assume /ŋɡ/ under Lexicon Optimization:

/maŋɡ-tɛ/		*VOC	MAXC	PREC	AGREE	ID[place]
a.	<maŋɡ-tɛ> Ø	*!				
b. ☞	<maŋɡ-tɛ, maŋ-tɛ> MAXC		*	*	*	
c.	<maŋɡ-tɛ, maŋ-tɛ, man-tɛ> MAXC, ID[place]		*	**!		*

(16) represents a typical case of underapplication. With no evidence for /Ng/ or /mg/ in the language, the overapplication aspect is debatable. However, these input types are still derivable within the grammar. Whether or not the Berbice example is truly one of hybrid opacity, OT-CC allows for such a case.

3. Discussion

Hybrid opacity is predicted to result from the interaction of an assimilation, agreement or spreading process with another process (provided the overapplication aspect can be motivated). While it is still too early to make any steadfast claims about its implications, identification of more concrete examples (or failure to find any) will move the discussion along.

(17) Deletion rubric for hybrid opacity (or, "you can't have your cake and eat it too"):

$$S_1 \quad S_2 \quad S_3$$

S = segment; f = feature

$$[+f] \quad [-f] \quad [+f]$$
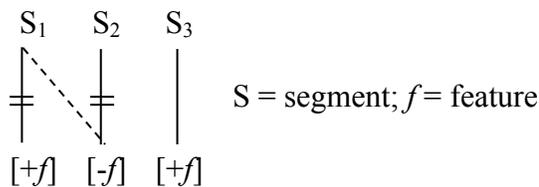
a. S_1 and S_2 either have disagreeing coefficients of f **or** mutually exclusive monovalent values for the same property (e.g. place features). S_1 may also be underspecified for f, as long as the default value disagrees with that of S_2.
b. S_1 may participate in a process adjacent to either S_2 or S_3, such that S_1 may inherit the feature of the other S; call this process P.
c. The feature value of S_2 spreads to S_1 via P.
d. S_2 is marked in its position for reasons independent of P and thus deletes.
e. P does not re-occur, i.e., $[+f]$ does not spread from S_3 to S_1.

(18) Hypothetical example:
a. Regressive [voice] assimilation in consonant clusters:
/al-ta/ → [al̥-ta], /at-ba/ → [ad-ba]
b. Reduction of complex codas, such that C_1C_2 clusters to C_1:
/ald/ → [al], /ald-ba/ → [al-ba]

Input /alt-ba/ → [al̥-ba] (vs. transparent [al-ba]):

$$l \qquad t \qquad b$$

$$[+voice] \quad [-voice] \quad [+voice]$$
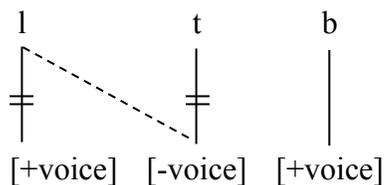
Again, assuring /l/ over /l̥/ is crucial for our purposes.

(19) Epenthesis rubric for hybrid opacity (or, "the loosey-goosey postlexical rule"):

[-*f*]
|

S₁   ə   S₂

S = segment; *f* = feature

[+*f*]   [-*f*]

   a. S₁ and S₂ bear disagreeing coefficients of feature *f*. S₂ may also be underspecified for *f*, as long as the default value disagrees with that of S₁.
   b. S₁ participates in a process in the environment S₁S₂, such that S₂ may inherit the feature value of S₁; call this process P.
   c. [+*f*] spreads from S₁ to S₂ via P.
   d. The contiguous sequence of S₁S₂ is marked for reasons independent of P and thus a vowel, e.g. [ə] (*necessarily* bearing the [-*f*]), is epenthesized between the two.
   e. P does not re-occur, i.e., [+*f*] does not spread from S₁ to [ə].

(20) Hypothetical example:
   a. Nasality spreading from nasal consonant over vowels and sonorants:
      /tin-ara/ → [tin-ãr̃ã]
   b. Epenthesis repairs coda consonants:
      /pat-ri/ → [patə-ri]

Input /tin-ri/ → [tinə-r̃ĩ] (vs. transparent [tinə̃-r̃ĩ]):

[-nasal]
|

n   ə   r

[+nasal]   [-nasal]

4. Remaining questions
Either the existence or non-existence of hybrid opacity may prove theoretically informative.

If attested, some framework-specific blocking mechanisms may need to be explored, since both rule-based serialism and OT-CC both allow for the derivation of hybrid opacity.

If clearer cases of hybrid opacity are attested, our formal definition of opacity may need to take this into account. Recall the formulation of Kiparsky (1973), repeated from (7):

A phonological rule P of the form A → B / C_D is opaque if there are surface structures with either of the following characteristics:

a. instances of A in the environment C_D
b. instances of B derived by P that occur in environments other than C_D

As such, the notation (A vs. B) and mutually exclusive language preclude the possibility of the same interaction to display both effects within the same derivation. The taxonomy of opacity is at issue: the expanded diversity of opaque effects and interactions has already suggested there is something about the theory we can no longer claim to understand. See recent calls in the literature to refine the formal definition of opacity (not just expand the inventory of opaque interactions and derivational mechanisms), most notably Baković (2011).

(21) The matter lends itself to experimentation with artificial languages: can participants learn a language with hybrid opacity, such as the deletion scenario below?

a. C → Ø/ C_{C, #}
b. Nasal place assimilation

/lata/	→ [lata]	/nap/	→ [nap]	/sam/	→ [sam]
/lata-g/	→ [lata-g]	/nap-g/	→ [nap]	/sam-g/	→ [saŋ]
/lata-te/	→ [lata-te]	/nap-te/	→ [nap-te]	/sam-te/	→ [san-te]
/lata-g-te/	→ [lata-g-te]	/nap-g-te/	→ [nap-te]	/sam-g-te/	→ [saŋ-te]

5. Summary
Depending on the underlying nature of certain nasal consonants, the interaction between consonant deletion and nasal place assimilation in Berbice Dutch Creole displays simultaneous effects of underapplication and overapplication, dubbed hybrid opacity. Rule-based serialism forces a hybrid opacity analysis, while OT-CC allows for one.

Different findings will imply different theoretical revisions: the non-attestation of hybrid opacity suggests the need for framework-specific blocking effects, while the attestation of hybrid opacity reinforces the growing body of work calling for a revision of opacity theory.

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