A Q-THEORETIC SOLUTION TO A'INGAE POSTLABIAL ROUNDING

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ABSTRACT   I describe and analyze a process of postlabial rounding in A'ingae (isolate, ISO 639-3: con): after labial consonants, the diphthong /ae/ may surface as [oe]. However, a postlabial monophthongal /a/ always surfaces faithfully as [a]. To capture these facts, I propose an analysis couched in Q-Theory, where one vocalic target of a diphthong corresponds to fewer subsegments than a monophthong. This predicts that diphthongs might show an emergence-of-the-unmarked (TETU) effect, while monophthongs surface faithfully. The prediction is borne out by A'ingae postlabial rounding, contributing a novel argument for Q-Theoretic representations. Finally, I show that similar asymmetries between diphthongs and monophthongs have recurred throughout the language's history, further strengthening the proposal.

KEYWORDS   diphthong, labialization, TETU, Cofán, assimilation, subsegment

1   INTRODUCTION   This paper describes and analyzes the A'ingae process of postlabial rounding. In A'ingae (or Cofán, an Amazonian isolate, ISO 639-3: con), the underlying sequence /ae/ optionally rounds to [oe] after labial consonants ($p\ p^h\ {}^mb\ f\ v\ m$). While postlabial rounding has been reported in previous literature (e. g. Galloway, 1990; Lakshmi, 1982; Lionnet, 2017), the A'ingae pattern is unusual

in that it is restricted to a diphthong; the monophthongal /a/ never rounds to ˣ[o] in the same postlabial environments.

To account for the fact that the postlabial rounding may applied to /ae/, but not /a/, I adopt a Q-Theoretic (Garvin, Lapierre, and Inkelas, 2018; Garvin, Lapierre, Schwarz, et al., 2020; Inkelas and Shih, 2016, 2017) representation of vowels. I assume that the monophthongal *a* consists of three subsegments (a^1 a^2 a^3), but the *a*-component of a diphthong – only of two (a^1 a^2 e^2 e^3). As such, one vocalic target of a diphthong corresponds to fewer subsegments than a monophthong. Since each subsegment may be independently subject to feature IDENTITY constraints, Q-Theory predicts that diphthongs might show emergence-of-the-unmarked (TETU) effects (McCarthy and Prince, 1994), while monophthongs surface faithfully. The prediction is borne out by A'ingae postlabial rounding, contributing a novel argument for the subsegmental representations of Q-Theory.

The rest of the paper is structured as follows. Section 2 gives background on the language and its speakers. Section 3 presents basic aspects of the A'ingae phonemic inventory and describes the postlabial rounding of /ae/. Section 4 proposes a Q-Theoretic analysis of the process. Section 5 discusses the postlabial diachrony of other diphthongs. Section 6 concludes.

2 LANGUAGE BACKGROUND   A'ingae (or Cofán, ISO 639-3: con) is an Amazonian language spoken by about 1,500 native speakers in the northeast Ecuadorian province of Sucumbíos and the southern Colombian department of Putumayo. Despite previous claims to the contrary (e. g. Rivet, 1924, 1952; Ruhlen, 1987), A'ingae remains classified as an isolate (Hammarström et al., 2020). The language is endangered and under severe socioeconomic pressures. Despite challenges, language attitudes among the Cofán are uniformly positive (Dąbkowski, 2021a).

Previous work on A'ingae includes Brandt's (2024) and Repetti-Ludlow et al.'s (2019) phonetic studies, Borman's (1962) and Dąbkowski's (2024) phonological descriptions, Dąbkowski's (2023a) diachronic account of postlabial raising, Sanker and AnderBois's (t.a.) internal reconstruction of nasality, Repetti-Ludlow's (2021) analysis of laryngeal co-occurrence restrictions, Dąbkowski's (2021b, 2023b, t.a.) work on stress and glottalization, and Fischer and Hengeveld's (2023) grammatical sketch.

The data presented in this paper represents the Ecuadorian language variety and reflects the judgments of three native language consultants from Dureno and Sinangoé, Sucumbíos. All the fieldwork data has been deposited in the California Language Archive as Dąbkowski (2020). Section 5 incorporates data from Borman's (1976) dictionary, which reflects the language as spoken ca. 50–70 years ago.

3 DESCRIPTION   The A'ingae syllable structure can be schematized (C)V(V)(ʔ), with optional consonantal onsets, maximally diphthongal nuclei, and optional coda glottals (Dąbkowski, 2024). The language's phonemic inventory is moderately large, totaling 27 consonants and 5 monophthongal vowels (Borman, 1962; Repetti-Ludlow et al., 2019). Phonetically, the A'ingae vowels have the following properties: *i* is high and front; *ɨ* is high and central (to back); *e* is (high-)mid and front; *a* is central and low; and *o* is back, high-mid (to high), and rounded (Brandt, 2024; Repetti-Ludlow et al., 2019). The five vowel qualities form eleven contrastive diphthongs

PLAIN STOPS	*p*	*t*	*ts*	*tʃ*	*k*	*ʔ*
ASPIRATED STOPS	*pʰ*	*tʰ*	*tsʰ*	*tʃʰ*	*kʰ*	
PRENASAL STOPS	*ᵐb*	*ⁿd*	*ⁿdz*	*ⁿdʒ*	*ᵑg*	
FRICATIVES	*f*		*s*	*ʃ*		*h*
ORAL SONORANTS	*ʋ*	*ɾ*		*j*	*ɥ*	
NASAL STOPS	*m*	*n*		*ɲ*		

i, ĩ	ɨ, ɨ̃	
e, ẽ	a, ã	o, õ
ie, ĩẽ	ɨi, ɨ̃ĩ	io, ĩõ
ei, ẽĩ	oe, õẽ	oi, õĩ
ia, ĩã		oa, õã
ai, ãĩ	ae, ãẽ	ao, ãõ

Table 1: Phonemic inventory of A'ingae (based on Dąbkowski, 2023a, 2024)

(Dąbkowski, 2023a, 2024). Both monophthongs and diphthongs contrast oral and nasal articulations; diphthongs are either fully oral or nasal. The complete phonemic inventory is given in Table 1.

Word-initially (1a)¹ and after a non-labial consonant (1b-f), all of the A'ingae diphthongs are realized faithfully, including /ae/ (1d-e).

(1)   FAITHFUL REALIZATION OF DIPHTHONGS IN MOST CONTEXTS

    a. / ãĩ /   b. / tʃʰoi /   c. / kʰɨi /   d. / ãnãẽʔmã /   e. / ãkãẽ /

        [ãĩ]   [tʃʰoi]   [kʰɨi]   [ãnãẽʔmã]   [ãkãẽ]

        dog   row   lie down   hammock   install

However, after a labial consonant, the diphthong /ae/ is optionally (though often) rounded to [oe] (Dąbkowski, 2024). Rounded realizations ([oe]) predominate in regular and fast speech. Unrounded realizations ([ae]) can be heard in careful or drawn-out pronunciation. This variability finds a reflection in written language, with speakers choosing alternately "ae" or "oe" (/"ue," depending on the orthography) to represent the postlabial diphthong. Postlabial rounding is observed in roots (2) as well as derived environments (3), and is unaffected by nasality, with both /ae/ and /ãẽ/ optionally rounded to [oe] (2a-c, 3d) and [õẽ] (2d, 3a-c).

(2)   ROUNDING OF /ae/ AFTER LABIALS MORPHEME-INTERNALLY

    a. / fae /   b. / faesɨ /   c. / vaeji /   d. / mãẽ /

        [fae]   [faesɨ]   [vaeji]   [mãẽ]

        [foe]   [foesɨ]   [voeji]   [mõẽ]

        one   other   recently   command

(3)   ROUNDING OF /ae/ AFTER LABIALS ACROSS MORPHEME BOUNDARIES

    a. / atapa -ẽ /   b. / nã^mba -ẽ /   c. / sĩʔmã -e /   d. / tseʔfa -e /

       [atapãẽ]   [nã^mbãẽ]   [sĩʔmãẽ]   [tseʔfae]

       [atapõẽ]   [nã^mbõẽ]   [sĩʔmõẽ]   [tseʔfoe]

       breed -CAUS   turbid -CAUS   bruised -ADV   that side -ADV

The monophthongal /a/ does not undergo rounding after labial consonants, and is always faithfully realized as [a] (4).

(4)   NO ROUNDING OF MONOPHTHONGAL /a/ AFTER LABIALS

    a. / pa /   b. / fãʔfã /   c. / va /   d. / mãʔpʰã /

       [pa]   [fãʔfã]   [va]   [mãʔpʰã]

       die   diarrhoea   this   wash

4   ANALYSIS   I propose that postlabial rounding is an instance of assimilation, whereby the labial feature of a consonant spreads onto the following vowel, which results in rounding. I formalize this process with the LABIALASSIMILATION constraint (5).

(5)   LABIALASSIMILATION, or: *+P−P

Assign a violation mark for each non-labial (unrounded) segment after a labial segment.

Gratuitous labialization is prevented by the opposing force of input-output faithfulness. Specifically, I use a relativized IDENTITY constraint, which penalizes output

	i	*ɨ*	*e*	*a*	*o*
HIGH	+	+	−	−	−
FRONT	+	−	+	−	−
LABIAL	−	−	−	−	+

Table 2: A'ingae vowel features (based on Brandt, 2024)

candidates that differ from the input with respect to a specific feature. Following Brandt (2024), I assume featural specifications for the A'ingae vowels as given in Table 2. Since *a* and *o* only differ in the [±LABIAL] feature, the constraint relevant to postlabial rounding is IDENTITY(LABIAL) (6).

(6) IDENTITY[±LABIAL], or: IDENTP

Assign a violation mark each time the feature [±LABIAL] has a different value in the input than in the output.

To capture the optionality in A'ingae postlabial rounding, I adopt a weighted-constraint model of the grammar (Smolensky and Legendre, 2006). The relative counts of rounded and unrounded postlabial realizations of /ae/ are unavailable. In the analysis to be presented, I assume that both are equally frequent (although using any other ratio would not affect the core claim of the proposal).

Now, the markedness constraint *+P−P penalizes sequences of a labial consonant plus an unrounded vowel, but its activity is revealed only in its effect on the diphthong /ae/; monophthongs are unaffected. This is a challenge because—unless something more is said about the difference between monophthongs and diphthongs—the constraint *+P−P targets the two equally. This is to say, if *+P−P has a weight high enough to correctly predict that diphthongs undergo optional rounding, it will incorrectly predict that monophthongs should also be able to round after labials (Table 3).

Pae	*+P−P 10	IDENTP 10	$\mathcal{H}$
☞₀.₅ i. P*ae*	10		10
☞₀.₅ ii. P*oe*		10	10

Pa	*+P−P 10	IDENTP 10	$\mathcal{H}$
☹₀.₅ i. P*a*	10		10
✱₀.₅ ii. P*o*		10	10

Table 3: Monophthongs incorrectly predicted to optionally round after labials

If, on the other hand, *+P−P has a weight low enough to predict monophthongal faithfulness, it fails to predict the possibility of diphthongal rounding (Table 4).

	Pae	*+P−P 1	IDENTP 10	$\mathcal{H}$
💣$_{0.5}$ i.	Pae	1		1
☹$_{0.5}$ ii.	Poe		10	10

	Pa	*+P−P 1	IDENTP 10	$\mathcal{H}$
☞ i.	Pa	1		1
ii.	Po		10	10

Table 4: Diphthongs incorrectly predicted not to round after labials

To capture both the postlabial rounding seen in diphthongs as well as its underapplication to monophthongs, I adopt the subsegmental representations of Q-Theory (Inkelas and Shih, 2016). Q-Theory posits that each segment (Q) consists of multiple—most commonly three—subsegments (q) representing closure (q^1), hold (q^2), and release (q^3). In segments with one articulatory target, the three q's are identical. For example, the low vowel segment (Q) a is represented with three subsegments as (a^1 a^2 a^3). Internally complex segments have multiple articulatory targets. In Q-Theory, the different targets are mapped onto different q's. The affricate ts, for example, may be represented as (t^1 s^2 s^3) (Inkelas and Shih, 2017). The circumoralized nasal $^bm^b$ may be represented as (b^1 m^2 b^3) (Garvin, Lapierre, and Inkelas, 2018; Garvin, Lapierre, Schwarz, et al., 2020).

Building directly on Garvin, Lapierre, and Inkelas's (2018) treatment of geminates, $t{:} = (t^1\ t^2\ .\ t^2\ t^3)$, I propose that A'ingae diphthongs consist of four q's. The first two q's correspond to the first target of the diphthong; the other two q's correspond to the second target. Thus, for example, $ae = (a^1\ a^2\ e^2\ e^3)$ and $oe = (o^1\ o^2\ e^2\ e^3)$. This correctly predicts that while A'ingae diphthongs are longer than monophthongs, one component of a diphthong is shorter than a monophthong. Diphthongs arising in morphologically complex words involve two monophthongal vowels in the input. I

assume that the two vowels fuse into one and undergo a reduction of the transitional $(q^3\,q^1)$ subsegments, e. g. $a+e = (a^1\,a^2\,a^3)(e^1\,e^2\,e^3) \rightarrow ae = (a^1\,a^2\,e^2\,e^3)$, along with or before postlabial rounding. (For a similar subsegment reduction in Polish affricate gemination, see Inkelas and Shih, 2017, p. 14.)

Furthermore, I assume that changing the feature of one subsegment (q) between the input and the output incurs only one-third, or $\frac{1}{3}$, of a violation of the respective IDENTITY constraint. Under this assumption, changing a feature of a monophthongal vowel (which consists of three q's) incurs a full violation ($3 \times \frac{1}{3} = 1$), but changing a feature of one vocalic target of a diphthong (which consists of two q's) incurs only two-thirds of a violation ($2 \times \frac{1}{3} = \frac{2}{3}$).[2] This predicts that a monophthongal vowel may surface faithfully, whereas the same vowel in a diphthong exhibits a TETU effect. More specifically, if *+P−P has an appropriately low weight, the monophthongal /a/ will not round after labial consonants; rounding all three subsegments of a monophthong incurs sufficiently many IDENTITY violations to rule it out.

Additionally, I assume that the first subsegment (q^1 — the transition into a vowel) and the last subsegment (q^3 — the transition out of a vowel) must match the quality of the adjacent subsegment they transition into or out of. I formalize this with the *LONE-q constraint (7). The *LONE-q constraint rules out outputs where only one or two of a monophthong's subsegments become rounded.

(7)   *LONE-q

   Assign a violation for each subsegment that is not adjacent to an identical subsegment.

Finally, I assume that *+P−P is evaluated only with respect to segments, not subsegments. This is to say, a violation is incurred if a labial consonant is followed by an unrounded vowel. However, unrounded subsegments following rounded subseg-

ments do not incur any violations. The tableau capturing the fact that monophthongs do not round after labial vowels is given in Table 5. The (approximated) constraint weights were found using the Maxent Grammar Tool (Hayes, 2008).

P (a^1 a^2 a^3)	*+P−P 12.5	IDENTP 18.8	*LONE-q 14.4	$\mathcal{H}$
☞ i. P (a^1 a^2 a^3)	1			12.5
ii. P (o^1 a^2 a^3)		$\frac{1}{3}$	1	20.6
iii. P (o^1 o^2 a^3)		$\frac{2}{3}$	1	26.9
iv. P (o^1 o^2 o^3)		1		18.8

Table 5: Monophthongs correctly predicted not to round after labials

The diphthong /ae/, on the other hand, can optionally undergo rounding when preceded by a labial consonant, because its first portion has only two subsegments. This represents a case of the emergence of the unmarked (TETU; McCarthy and Prince, 1994)—with fewer subsegments come fewer faithfulness (IDENTITY) violations, making it possible for the unmarked structure (*+P−P) to emerge, where the labial features of the consonant and the first part of the diphthong match (Table 6).

P (a^1 a^2 e^2 e^3)	*+P−P 12.5	IDENTP 18.8	*LONE-q 14.4	$\mathcal{H}$
☞₀.₅ i. P (a^1 a^2 e^2 e^3)	1			12.5
ii. P (o^1 a^2 e^2 e^3)		$\frac{1}{3}$	2	35.0
☞₀.₅ iii. P (o^1 o^2 e^2 e^3)		$\frac{2}{3}$		12.5
iv. P (o^1 o^2 o^2 e^3)		1	1	33.2
v. P (o^1 o^2 o^2 o^3)		$1\frac{1}{3}$		25.0

Table 6: Diphthongs correctly predicted to optionally round after labials

(Since the actual counts of rounded and unrounded realizations of /*ae*/ are unavailable, the constraint weights were found assuming that both are equally likely.)

Finally, *+P−P does not show any activity when the onset consonant is not labial (e. g. coronal or velar). As such, the diphthong /*ae*/ never rounds after non-labial consonants (Table 7).

C ($a^1\ a^2\ e^2\ e^3$)	*+P−P 12.5	IDENTP 18.8	*Lone-q 14.4	$\mathcal{H}$
☞ i. C ($a^1\ a^2\ e^2\ e^3$)				0.0
ii. C ($o^1\ a^2\ e^2\ e^3$)	$\frac{1}{3}$	2		35.0
iii. C ($o^1\ o^2\ e^2\ e^3$)	$\frac{2}{3}$			12.5
iv. C ($o^1\ o^2\ o^2\ e^3$)	1	1		33.2
v. C ($o^1\ o^2\ o^2\ o^3$)	$1\frac{1}{3}$			25.0

Table 7: Diphthongs correctly predicted not to round after non-labials

In an interim summary, the adoption of Q-Theory's subsegmental representations captures the fact that while the diphthongal /*ae*/ undergoes optional rounding labial consonants, the monophthongal /*a*/ always surfaces faithfully.

5 DIACHRONY OF OTHER DIPHTHONGS   The Q-Theoretic analysis accounts for the fact that a phonological process aimed at markedness reduction (such as postlabial rounding) may target diphthongs, while monophthongs remain unaffected. In contemporary A'ingae, postlabial rounding applies only to /*ae*/. However, the language's diachrony reveals that other diphthongs also used to be affected.

Drawing on data from morphologically complex words and borrowings, Dąbkowski (2023a) identifies a diachronic *postlabial raising*, whereby postlabial **ai* developed into contemporary *ɨi*. I propose that the development of postlabial raising took place in two steps (8). First, postlabial **ai* rounded to **oi*, i. e. **ai* > **oi* / P _ (8i). Second, postlabial **oi* unrounded to *ɨi*, i. e. **oi* > *ɨi* / P _ (8ii).[3]

(8)   POSTLABIAL RAISING   (data from Borman, 1976; Dąbkowski, 2023a)

    o.   *koehefa -ite   *taʔva -ite   waita (Kichwa)[4]   baila (Spanish)

    i.   *koehefoite   *tavoite   *(ɾosa)voita   ᵐboiɾa

    ii.   koehefɨite   tavɨite   (ɾosa)vɨita   ᵐbɨiɾa

      summer -PRD   cotton -PRD   calendula   dance

Both sound changes are directly attested. First, the postlabial rounding of *ai* is observed in one borrowing from Spanish, reported in Borman's (1976) dictionary with *oi*. Additionally, there is one instance of postlabial rounding of *ei* (9i). (For comparison, non-postlabial diphthongs, e. g. *ai* in *aiɾo* 'mountain,' have not been affected.)

(9)   STEP I: POSTLABIAL ROUNDING OF *AI, *EI   (data from Borman, 1976)

    o.   SOURCE   baila (Spanish)   peineta (Spanish)   aiɾo (Secoya)[5]

    i.   BORMAN   ᵐboiɾa   ᵐbõĩnẽta   aiɾo

                    dance   comb   mountain

Second, all the words reported in Borman (1976) with a postlabial *oi* are nowadays realized with *ɨi* (10ii). Borman worked in the Cofán communities since 1954 (Hugo Lucitante, p.c.). As such, the postlabial unrounding of *oi* must have taken place in the past ca. 50–70 years. (Non-postlabial *oi*, as in *sõĩ* 'tamal,' has not been affected.)

(10)   STEP II: POSTLABIAL UNROUNDING OF *OI

    i.   BORMAN   põĩnẽ   pʰoikã   ᵐboiɾa   mõĩte   sõĩ

    ii.   PRESENT   pɨ̃ĩnẽ   pʰɨikã   ᵐbɨiɾa   mɨ̃ite   sõĩ

                    both   glimpse   dance   when not   tamal

Both postlabial rounding as well as postlabial unrounding applied only to diphthongs, with postlabial monophthongs in words such as *pa* 'die,' *pʰoɾo* 'be touching,' *ᵐbaʔve* 'more or less,' *ᵐbo* 'gather,' *fõɲõ* 'skirt,' *va* 'this,' and *mẽtʃo* 'not have' unaffected.

The postlabial rounding (or the telescoped postlabial raising) of *ai is not a productive phonological process.[6] Nevertheless, the rounding of *ai as well the subsequent unrounding of *oi affect postlabial diphthongs, to the exclusion of the monophthongal *a and *o. Since sound changes are the result of once active phonetic and phonological pressures, they provide additional evidence that A'ingae has—also in its past—shown less faithfulness to one component of a diphthong than to the corresponding monophthong, further strengthening the case for the representational apparatus of Q-Theory, which predicts this exact asymmetry.

6 CONCLUSION   In conclusion, I describe and analyze the process of postlabial rounding in A'ingae. After labials, the diphthongal /ae/ may optionally surface as [oe], but the monophthongal /a/ always surfaces as [a]. Similar asymmetries can be observed in the language's history: postlabial *ai rounded to *oi, and postlabial *oi unrounded to ɨi. Both sound changes affected only diphthongs, to the exclusion of postlabial *a and *o. Thus, we observe a recurring pattern where the language's diphthongs—but not monophthongs—are prone to assimilation and dissimilation.

To account for the systematic difference between monophthongs and diphthongs, I adopt the subsegmental representations of Q-Theory. A monophthong is longer and consists of more subsegments than one component of a diphthong. Thus, unfaithfulness to the features of the latter incurs fewer IDENTITY violations, creating conditions in which unmarked structures (such as labial assimilation) may be observed to emerge. As such, the A'ingae patterns bear out a new prediction of Q-Theory.

Finally, by allowing subsegments to incur partial constraint violations, Q-Theory has been demonstrated to have some of the same capacity for modeling gradient phonology as the Gradient Symbolic Representations framework (e. g. Rosen, 2016; Smolensky and Goldrick, 2016). The subsegments of Q-Theory, however, are phonetically motivated and discrete, making it the more restrictive of the two frameworks.

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[1]The following glossing abbreviations have been used: ADV = adverbial, CAUS = causative, PRD = periodic.

[2]Alternatively, the IDENTITY constraints could be defined as counting violations of subsegmental q's, as opposed to full segments. If this analysis were adopted, the

weight of IDENTITY(LABIAL) would be correspondingly lower, but the core mechanics of the account would remain unchanged.

[3]Dąbkowski ([2023a](#)) proposes a different trajectory, where the postlabial *ai first rounded to *ui (*ai > *ui / P _) and then *u unconditionally unrounded to ɨ (*u > ɨ). Either trajectory involves a postlabial rounding of *ai to the exclusion of *a, supporting the main claim of the present paper.

[4](ALDP, [2018](#); Chango A. and Potosí C., [2009](#))

[5](ALDP, [2018](#))

[6]First, postlabial raising sustains lexical exceptions, such as *paitsɨ* 'paiche.' Second, postlabial raising does not apply regularly to new derivatives (although it has been acquired as an optional derived-environment rule by some speakers). Third, many historically complex forms with ɨi, such as *koehefɨite* 'summer-PRD' and *tavɨite* 'cotton-PRD' ([8ii](#)) have been, for some speakers, leveled back to *koehefaite*, *tavaite*. For more information on postlabial raising, see Dąbkowski ([2023a](#)).