What the f? F-elements behind labiodentals and crazy rules*

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Abstract: This paper is dedicated to Doug Pulleyblank on the occasion of his retirement. It contends with the generative-innatist-modular claim that there is a phonological component which is furnished by Universal Grammar (UG) with a set of F-elements (Archangeli and Pulleyblank's term for distinctive feature specifications and class nodes) and that—as luck from natural selection would have it—[labiodental] is not part of "the furniture of the world," as Bromberger and Halle have put it. This paper examines why and how generativists have avoided using a distinctive feature [labiodental], and it contrasts their general approach with Archangeli and Pulleyblank's Emergent Phonology, which is resolutely non-generativist, non-innatist, and non-modularist. Allophonic and contrastive labiodental phenomena are considered from a wide range of languages, including English, Ndrumbea (Southern Oceanic), Tenyidie (Tibeto-Burman), and Volta-Congo languages ranging from Gbe lects (East Kwa) to Teke (South Bantoid). Generativists score some points along the way, but the patterns discussed—not a few of them 'crazy' in Bach and Harms's sense—generally support an Emergentist viewpoint.

Keywords: labiodentals, distinctive features, crazy rules, Universal Grammar, Emergent Phonology

1 Introduction

Hockett's (1985) proposal that "*f*-sounds are an innovation of the last few thousand years" (p. 276) has received attention and support in recent years. Notably, Blasi et al. (2019) argue forcefully that a "post-Neolithic decline of edge-to-edge bite enabled the innovation and spread of a new class of speech sounds that is now present in nearly half of the world's languages: labiodentals" (p. 1; see also Blasi et al. 2020; Chen & Everett 2020; Everett & Chen 2021; Everett 2021; Dediu et al. 2021). This claim is significant because Hockett argued contra Sapir (1921: 8–9) that "the exigencies of vocal-auditory communication" (Hockett 1985: 276) helped to shape the basic structure of the human speech system by natural selection tens of thousands of years before the Neolithic. "So, already 10,000 years ago, language had become what it remains today" (ibid.).

Of special interest in this light is that [labiodental] is typically excluded from the score of distinctive features used to describe and analyze segmental phonology across spoken languages

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(Hall 2007: 323; pace Palmada 1995).[1] This snub is glaring given "the primacy of distinctive features in phonological theory" (Cairns & Raimy 2009: 12) and the just-mentioned fact that labiodentals are "now present in nearly half of the world's languages" (Blasi et al. 2019: 1).

Labiodental sounds include obstruents—f, v, pf, bv—as well as sonorants—ɱ, ʋ, ⱱ. The obstruent ones have long been treated as labials enhanced with [strident] (Trubetzkoy 1939; Jakobson et al. 1952: 23; Halle 1959: 140; SPE / Chomsky & Halle 1968: 329). Chomsky and Halle (1968: 314) additionally suggested treating all labiodentals as non-[distributed] labials. This was possible on the SPE view that virtually all sounds are specified + or − for every feature, but phonologists (including Halle) abandoned that assumption in the 1980s. The feature [distributed] is now generally understood as specific to [coronal] sounds, roughly equivalent to "laminal," and thus irrelevant to labial sounds (McCarthy 1988). Moreover, most phonologists no longer assume that labiodental obstruents are [strident] (e.g., LaCharité 1993; Kehrein 2002; Hall 2007; Rice 2011; Lin 2011; Berns 2013), perhaps because this feature is also specific to [coronal] sounds, equivalent to "sibilant" (Shaw 1991).

Thus, building on Hall (2007), Rice (2011) presents a table of distinctive features for obstruents (including /ɸ/ and /f/) which "perhaps represents an overall North American consensus about place of articulation features" (p. 542). She then immediately asks: "What distinguishes bilabials and labio-dentals? Hall leaves this open, suggesting that a feature [labio-dental] might be required" (ibid.). This issue is unresolved for affricates, too—"it is unclear which feature should be used to differentiate /p/ and /pf/. If the traditional feature [strident] is not used, an alternative must be considered" (Lin 2011: 381, fn. 12). But once again, affricate studies resist using [labiodental] as a distinctive feature (LaCharité 1993; Kehrein 2002; Lin 2011; Berns 2013). The question also remains for sonorants, e.g. Hajek (2009b: 113) claims that he is forced to resurrect the SPE use of [–distributed] for [ɱ] in Tenyidie (formerly Angami), a Tibeto-Burman language, against current understanding of this feature.

Huybregts (2020) accepts that phonologies shoehorn labiodentals into a standard set of distinctive features, e.g., "labiodentals (f/v) share the positively charged feature [Strident] with sibilants (s/z) and uvular fricatives (χ/ʁ)" (p. 178). He then boldly claims that the lack of [labiodental] is due to an historical accident in the evolution, not of phonological theory, but of the phonological component of the human language faculty (cf. Chomsky & Halle 1965: 109, 136):

> the set of possible distinctive features has more plausibly remained fixed since pre-Neolithic times, and this part of the human initial state for language at birth (sometimes called 'uniformity in capacity for language' or 'UG') was never modified but has remained deeply conserved. (Huybregts 2020: 179)

[1] The consensus set includes [nasal], the liquid features [lateral] and [rhotic], the obstruent features [fricative], [stop], and [strident], the lip features [labial] and [round], the tongue-front features [coronal], [posterior] and [laminal] (or [distributed]), the tongue-back features [dorsal], [front], [high], and [low], the tongue-root feature [retracted tongue root] and/or [advanced tongue root], and the laryngeal features [voice], [spread glottis], and [constricted glottis] (Hall 2007; Rice 2011; Flynn 2012; Miller 2012: 22; etc.).

Moran and Bickel (2020: 186) take Huybregts to task for "brushing away" Mielke's (2008) counter-arguments that distinctive features emerge in language acquisition, and they insist: "Adopting a [labiodental] feature (or whatever one wants to call it) solves the long standing issue of how to encode the bilabial-labiodental distinction" (Moran & Bickel 2020: 185). This paper will show that Moran and Bickel's points are especially well taken in approaches to phonology without Universal Grammar (Archangeli & Pulleyblank 2015), notably Emergent Phonology (Archangeli & Pulleyblank 2018, 2022, 2023).

This paper will show how and why generativists have avoided adopting a [labiodental] feature: by combining [labial] with [fricative][2] (section 2), with [strident] (section 3), and with [round] (section 4). A wide range of languages are analyzed along the way, focusing on differences between Emergent Phonology and traditional generative approaches. Idiolectal variation is also considered in this light (section 5). Overall the patterns discussed—not a few of them 'crazy' in Bach and Harms's (1971) sense—generally support an Emergentist viewpoint (section 6).

2 [labial, fricative] vs. [labiodental]

2.1 Ndrumbea

The variety of Ndrumbea (Southern Oceanic) which is spoken in Païta, New Caledonia, has a labiodental nasal [ɱ] which is standardly understood as "v nasalisé" (Rivierre 1973: 31). Drawing on Païta and Shintani's (1990) detailed description, Hajek (2009a) explains that "/w/ and /v/, both of which can be grouped together as a natural set involving some kind of labial continuant articulation, ... have predictable nasal(ized) allophones before nasal vowels" (p. 485). Hajek (2009a) formulates this process as in (1), and illustrates it with the examples in (2).

(1) Regressive nasal assimilation in Païta Ndrumbea: rules (Hajek 2009a: 485)
   a. /w/ → [ŋʷ] / __Ṽ
   b. /v/ → [ɱ] / __Ṽ

(2) Regressive nasal assimilation in Païta Ndrumbea: data (Hajek 2009a: 485)[3]

a.	/wã/	[ŋʷã]	'basket'	but	/wa-ɽe/	[waɽe]	'sharpen'
	/wĩ/	[ŋʷĩ]	'banana tree'		/wee-ɽe/	[weeɽe]	'carry in arms'
	/wõ/	[ŋʷõ]	'turtle'		/we/	[we]	'fetus'
b.	/vãã/	[ɱãã]	'part of palm'	but	/vaɽa/	[vaɽa]	'baby 1st steps'
	/vẽ-ɽe/	[ɱẽɽe]	'leave'		/ve/	[ve]	'stingray'
	/võɽõ-ɽe/	[ɱõɽõɽe]	'steal'		/vou-ɽe/	[vouɽe]	'speak'

Emergent Phonology views [ɱ] and [ŋʷ] in Ndrumbea very differently: as-is. Emergentists deny that "there is a rich, innate, species-specific component of the mind dedicated to language" (Boeckx & Piattelli-Palmarini 2005: 448), let alone isolated components of a human language

[2] [+continuant, −sonorant] in a binary feature system.

[3] Hajek does not transcribe tones in his examples.

faculty which are individually dedicated to phonetics, phonology, and morphology.[4] The goal is to account for all sound patterns using only general cognitive principles. In this vein, Emergent Phonology denies such abstract notions as underlying representations and phonemes (Archangeli & Pulleyblank 2022: 69–76). Accordingly, there can be no sense that [ɱ] derives from /v/ in Ndrumbea. The surface-apparent morphs {ɱɛ̀} and {vé}, say, simply belong to the different morph sets 'leave' and 'stingray,' respectively (Païta & Shintani 1990: 2).

Moreover, learners are not constrained by a fixed set of innate universal distinctive features; rather, "featural classifications are established on the basis of experience" (p. 93). Thus, learners will notice that the "sound chunk" (Archangeli & Pulleyblank 2022: 5) at the beginning of the morph {ɱɛ̀} 'leave' has a different articulation from the one at the beginning of the morph {mɛ̀} 'eventual' (Païta & Shintani 1990: 39). Upon noticing the same articulation in comparing the morph sets {vé} 'stingray' and {wé} 'fetus' (Païta & Shintani 1990: 2), Ndrumbea learners will classify and label {ɱ, v} with "a [labiodental] feature (or whatever one wants to call it)" (Moran & Bickel 2020: 185).

The morph sets {ɱɛ̀} 'leave' and {mɛ̀} 'eventual,' among others, may further suggest to learners that certain nasal sounds always occur before nasal vowels. Conversely, morph sets like {vé} 'stingray' and {wé} 'fetus' (Païta & Shintani 1990: 2), among others, may suggest to learners that certain oral sounds always occur before oral vowels. As it turns out, oral and nasal vowels are contrastive only after voiceless obstruents; all voiced consonants in Ndrumbea agree with the nasality/orality of a following vowel (Rivierre 1974). This complementary distribution will lead learners to classify and label the relevant sounds, and to posit the following phonotactic well-formedness condition:[5]

(3) Nasal assimilation phonotactic

*[+voice, αnasal][−αnasal], Focus: segments, Domain: morph

For all segments, assign a violation to a morph for each sequence of a [+voice, αnasal] (consonant) followed by a [−αnasal] (vowel), where α is + or –.

The phonotactic in (3) is similar to a morpheme structure constraint (MSC) in generative phonology (Booij 2011), so it can be applied as-is to a generativist account of Ndrumbea set in Optimality Theory (Pulleyblank 1997; Archangeli 1999), say. However, additional questions must be addressed in such an account: what are the distinctive features of /v/, and how do they lead to labiodental [ɱ]?

It is unlikely that /v/ is [strident] in this language, as there are no other plausibly [strident] sounds: Ndrumbea has no sibilants, whether fricative or affricate, nor uvular fricatives (Rivierra 1973; Païta & Shintani 1990; Hajek 2009a). So on standard structuralist/generativist assumptions,

[4] Cf. Bacanlı et al. (2020: 26): "there is no need for phonology to access morphological information in a modular model of grammar."

[5] Emergent Phonology currently disfavours binary features as labels, and consequently, α is avoided, but it is unclear to me how else to formalize the nasal assimilation phonotactic; cf. "complementary classes" in Archangeli & Pulleyblank (2022: 97–98).

/v/ is probably just [labial, fricative, voice];[6] cf. Ndrumbea /ɣ/, which is [dorsal, fricative, voice]. If so, the phonological outcome of regressive nasal assimilation for /v/ is [labial, fricative, voice, nasal], i.e. [ṽ]. Thus, its phonetic realization as [ɱ] requires more explanation.

Structuralists/generativists regularly assume that the feature combination [labial, fricative] is interpreted on a language-specific basis as a labiodental gesture in a separate phonetics component of grammar. For example, Clements (2006) writes regarding Spanish: "while [f] is characterized as [labial], [–nasal] and [+continuant] ... [it] acquires a labiodental rather than a bilabial realization ... [as an] articulatory interpretation at the phonetic level" (p. 435).[7] Likewise, Goldsmith (1990) notes that labial fricatives are labiodental in Catalan and adds, "it does *not* follow that there must be a feature to distinguish the labio-dental position from the bilabial. Nonsegmental rules of phonetics may clarify the nature of the gestures available in the language" (p. 295; emphasis in original). This is also what Padgett (1994) means here:

> the specification of labiodental place is entirely redundant in English, predictable from the value of [cont]. That is, f and v are underlyingly simply labial, and so a condition based on a feature [labiodental] is not obviously relevant. (Padgett 1994: 473, fn. 10)

Such thinking reflects the generative-innatist-modular assumption that the human faculty of language comprises distinct phonological and phonetic components. This point is worth spelling out over a page or so, before addressing the status of [ɱ] in Ndrumbea. Keyser and Stevens (2006) is a representative guide:

> Underlying this view is the assumption that representation and sound are fundamentally different in character. The former is digital in that it is composed of a variety of discrete entities: for example, features, syllables, feet. The latter, however, is primarily—though not exclusively—a continuous sound stream generated by a flow of gestures in the vocal apparatus from one intention to the next. (Keyser & Stevens 2006: 34)

This is why generative phonologists are not easily swayed by the argument that a new feature like [labiodental] would model phonetic realities more accurately. Distinctive features were never intended to be used directly in the phonetics:

> [W]hile the input to the gesture-calculations component is a phonological representation, the output is not. Rather, the output is a series of instructions to the musculature. This entails that the phonological representation disappears at this point, being replaced by motor instructions. Hence, if the birthplace of lexical representation is in the lexicon, its demise is in the gesture-calculations component. (Keyser & Stevens 2006: 36)

Moreover, even theorists who reduce distinctive features to particular defining gestures or auditory effects still place greater importance on other accompanying cues in the phonetics. Keyser

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[6] [labial, +continuant, –sonorant, +voice] with binary features.

[7] Again, such phonetic interpretation is language-specific. For instance, the feature combination [labial, fricative] would be interpreted as bilabial fricatives in the phonetics of Itelmen, a Chukotko-Kamchatkan language of Russia (Volodin 1976).

and Stevens (2006) offer /t/ in *batman* as an example (among many others): [t] may not surface, and yet, its distinctive features [coronal] and [stop] are cued

> by a rising second-formant transition during the vowel that distinguishes the alveolar place of articulation from a velar or a labial; ... in addition, the /t/ is glottalized ... Once again this is a case of conservation. In this case glottalization constitutes an additional enhancing gesture that distinguishes the alveolar from the labial and velar. (Keyser & Stevens 2006: 55)

Crucially, generativists take enhancement gestures like glottalization in *batman* to be introduced in the phonetics, not in the phonology, and as such, these gestures prove to be more reliable phonetic cues than feature-defining gestures—"the alveolar closure may not occur" (p. 55).

> [W]hile feature-defining gestures are, in certain contexts, subject to severe weakening up to and including obliteration, enhancement gestures are far more robust and are apparently never obliterated… We hypothesize that overlap is responsible for the deviations in careful speech. We also suppose that, unlike feature-defining gestures, enhancement gestures are never subject to overlap severe enough to mask their acoustic consequences. (Keyser & Stevens 2006: 57–58)

It turns out to be relatively common for an enhancement gesture to serve as a proxy for a phonological feature whose defining gesture is obliterated in the phonetics (e.g., Stevens & Keyser 1989, 2010; Keyser & Stevens 2001, 2006; Stevens 2002; Flynn 2011). So for generativists it is defensible to use the specification [labial, fricative, voice, nasal] in Ndrumbea phonology, on the understanding that the feature combination [labial, fricative] is implemented with a labiodental gesture in the phonetics, and that this enhancement gesture can act as a proxy for that feature combination in nasalization contexts.

In sum, a structuralist/generativist account of Ndrumbea involves a three-level-deep distinction between the phonetic realization [ɱ], a surface phonological representation [labial, fricative, nasal], i.e. [ṽ], and an underlying representation [labial, fricative], i.e. a phoneme /v/. By contrast, the Emergentist account treats Ndrumbea [ɱ] as-is, i.e. [labiodental, voice, nasal].

2.2 English

Archangeli and Pulleyblank (2022) note that the English negative prefix *in-* has "an {ɪɱ} morph which occurs before labiodentals" (p. 96, fn. 5). This variant of *in-* before {f, v} can be chalked up to gestural overlap in a generative, innatist, modular framework which assumes a non-trivial phonetic component (e.g., Keyser & Stevens 2006; Kingston 2007; de Lacy 2009). Padgett's (1994) well-known analysis of *in-* is representative of this approach: "the casual speech pronunciation

‘i[ɱ]famous’ or ‘i[ɱ]variable’ (with the labiodental nasal) ... is not a rule of phonological feature spreading but a phonetic process involving the overlap of gestures” (p. 490).[8]

By contrast, Emergent Phonology denies that there is a separate, independent phonetics module where labiodentals can be explained away. On Archangeli and Pulleyblank’s (2022) approach, a label is needed to partition {ɪɱ} from other members of the morph set: {ɪn, ɪm, ɪŋ}$_{\text{NEGATIVE}}$. In this exercise, learners are free to posit, simply and directly, “a [labiodental] feature (or whatever one wants to call it)” (Moran & Bickel 2020: 185). Alternations such as {ɪn, ɪm, ɪŋ, ɪɱ}$_{\text{NEGATIVE}}$ as well as static generalizations inside morphs then lead learners to posit the following syntagmatic well-formedness condition:[9]

(4) Nasal place assimilation phonotactic (Archangeli & Pulleyblank 2022: 96)

*[nasal, ^place$_i$][obstruent, ^place$_i$], Focus: segments, Domain: morph, word

“For all segments, assign a violation to a morph or a word for each nasal-obstruent sequence where the nasal’s place is in the complement class of the place of the obstruent.” (ibid.)

The term *place* here may be understood as a Padgettian feature class that results from learners “generalising over generalisations” (Archangeli & Pulleyblank 2022: 3): “Place simply stands for the set {[labial], [coronal], [dorsal], ...}” (Padgett 2002: 81). Archangeli and Pulleyblank (2022) imply that [labiodental] is a member of the place set, so the term *labial*, too, may also be understood as a feature class or set: {[bilabial], [labiodental]}$_{\text{LABIAL}}$. Thus, the nasal place assimilation phonotactic in (4) is also responsible for the “{ɪɱ} morph which occurs before labiodentals” (p. 96, fn. 5).

However, the assimilation of the prefix *in-* to {f, v} is uniquely optional (Zsiga 2011: 1919–1920), so the condition in (4) must be tempered by a condition which either disfavours the morph {ɪɱ} or else favours the morph {ɪn} before {f, v}. The first, most obvious candidate is *{ɱ}, which Borowsky (1990: 93) proposed as a condition on featural co-cooccurence: *[nasal, labiodental]. This condition must be unranked (or variably ranked) relative to the nasal place assimilation phonotactic in (4), to allow for optional labiodental assimilation in English grammar.

For his part, Padgett (1994) imputes labiodentals in English to a separate phonetics module which interprets the feature combination [labial, fricative], as discussed earlier. He therefore objects to Borowsky’s use of a [labiodental] feature and her proposed condition:

[8] Similarly, Mohanan’s (1993) influential analysis of *in-* in Lexical Phonology and Morphology assumes a separate “postlexical module, where place assimilation creates dental and labiodental nasals” (p. 115, n. 36). However, the postlexical phonology also deals in features, so theorists are forced to represent labiodentals. For instance, Kiparsky (1985: 100–101) argues that /f/ is specified [labial] in the (lexical) phonology and only becomes labiodental postlexically by the introduction of a non-distinctive feature [–distributed]. The postlexical phonology adds the non-contrastive feature [–distributed] to /f/ because it is [labial, +continuant].

[9] Another syntagmatic condition is needed to account for the fact “that there is an {ɪ} morph which occurs before sonorants” (Archangeli & Pulleyblank 2022: 96, fn. 5), e.g. *immature, innumerable, illegitimate, irrelevant*. Archangeli and Pulleyblank (2022) do not specify this condition.

> First, the specification of labiodental place is entirely redundant in English, predictable from the value of [cont]. That is, f and v are underlyingly simply labial, and so a condition based on a feature [labiodental] is not obviously relevant to the facts here. More importantly, an examination of other languages reveals many instances of failed place assimilation involving bilabial fricatives (e.g., Kikuyu, Rosenthall 1992; Padgett 1991) or other places of articulation. The use of [labiodental] could not extend to these cases. (Padgett 1994: 473, fn. 10)

Padgett's objections have merit in a generative framework, but they do not carry over into Emergent Phonology. If English learners notice that the negative prefix *in-* uniquely varies between {ɪŋ} and {ɪn} before {f, v}, they cannot be asked to ignore the obvious fact that the conditioning sound chunks are labiodental. Nor can these same learners be asked to factor in the non-obvious fact that other languages show "many instances of failed place assimilation involving bilabial fricatives" (Padgett 1994: 473, fn. 10).

Padgett's own solution builds on a cross-linguistic generalization that "nasals typically assimilate to stops" (p. 469; see also Mohanan 1993). Padgett argues that sharing a place feature in the autosegmental sense is only possible between a nasal and a stop. The English prefix *in-* is special, he says, because "the nasal is placeless underlyingly and receives coronal place by default rule" (p. 472). Crucially, *in-* receives a default [coronal] not only before vowels, but also before fricatives—even [coronal] ones, because a nasal cannot share a place feature with a fricative (again, in the autosegmental sense):

> Since the nasal assumes the alveolar place when assimilation cannot apply (*inappropriate*, etc.), we cannot observe the stop-fricative asymmetry before alveolar consonants. I assume that the facts are as with the labials: the nasal receives its place by assimilation in *indelible* but not in *insensitive*. (Padgett 1994: 471, fn. 8)

Emergent Phonology eschews abstract notions such as underlying and autosegmental representations (Archangeli & Pulleyblank 2022, 2023). Nevertheless, as it happens, Padgett's general analysis is easily (if roughly) translated into Emergent Phonology. English learners may well notice that the first member of the morph set {ɪn, ɪm, ɪŋ, ɪŋ}$_{\text{NEGATIVE}}$ is regularly selected before sound chunks which can collectively be labeled [nonstop], e.g. (5).[10]

(5) a. *inappropriate, insensitive, inhumane*, *insincere, inattentive*, *inhospitable, insane,* etc.
b. *informal*, *invisible, infrequent, invaluable*, *inflexible*, *invalid, infallible, invariant,* etc.

These learners may therefore posit the syntagmatic condition in (6), which selects a coronal nasal-final morph before any nonstop sound. If they acquire this condition in their phonological grammar, it must also be unranked (or variably ranked) relative to the nasal place assimilation

[10] The variable use of {ɪŋ} in (5b) was addressed above and will again be addressed below. Note that some of the words in (5) may implicate learners who are not young children. Indeed, Emergent Phonology entertains learners of all ages: "there will also be differences between an individual's grammar at different points in their life, due to maturation and to the impact of continually acquiring language knowledge" (Archangeli & Pulleyblank 2022: 26).

phonotactic in (4), to allow for optional labiodental assimilation in words like (5b); again, see Zsiga (2011: 1919–1920).

(6) Coronal nasal default before nonstops

*[nasal, ^coronal][nonstop], Focus: segments, Domain: word

For all segments, assign a violation to a word for each nasal-nonstop sequence where the nasal's place is in the complement class of coronal.

Several aspects of this phonotactic are worth highlighting. First, it is not specific to the negative prefix *in-*. Although the present section focuses on *in-* (after Archangeli & Pulleyblank 2022), Borowsky (1990), Mohanan (1993) and Padgett (1994), among others, argue that the same alternation pattern occurs in other (less transparent) prefixes in English, notably *con-*. Second, this phonotactic favours coronal nasals before vowels as well as before fricatives, including labiodental [f, v] and glottal [h]. As such, it resembles a 'crazy rule' (Bach & Harms 1972) and yet, it represents an easy-to-learn adaptation of Padgett's (1994) typologically-grounded analysis of English *in-* (and *con-*). Finally, this phonotactic does not include *morph* in its Domain.[11] Therefore, it does not penalize morphs wherein [nonstop] sounds are preceded by nasals which are [bilabial] (7a), [labiodental] (7b), or [dorsal] (7c).

(7) a. *imagine* {ɪˈmædʒən, ɪˈmædʒɪn}, *hamster* {ˈhæmstɚ, ˈhæmpstɚ}, *clumsy* {ˈkʰɬʌmzi}, *Tsimshian* {ˈsɪmʃiən, ˈɸʰɪmʃiən, ...}, *Amharic* {æmˈhɛɹɪk, æmˈhɑɹɪk}, *woman* {ˈwʊmən}, *crimson* {ˈkʰɹɪmsən}, *damsel* {ˈdæmzəɬ}, *memory* {ˈmɛmɹi, ˈmɛməɹi}, etc.

b. *comfy* {ˈkʰʌɱfi}, *Humvee* {ˌhʌɱˈviː, ˈhʌɱˌviː},[12] *emphasis* {ˈɛɱfəsəs, ˈɛɱfəsɪs}, *dicemvir* {dɪˈsɛɱvɚ}, *symphony* {ˈsɪɱfəni}, *(tri)umvirate* {ˈʌɱvəɹət, ˈʌɱvəɹɪɾ}, *circumference* {sɚˈkʰʌɱfəɹəns, sɚˈkʰʌɱfɹəns, sɚˈkʰʌɱfɚns, sɚˈkʰʌɱfɹəns, ...}, etc.

c. *dinghy* {ˈdɪŋi}, *gangster* {ˈgæŋstɚ}, *strengthen* {ˈstɹɛŋθən, ˈstɹɛŋkθən, ...}, *sanction* {ˈsæŋʃən, ˈsæŋkʃən}, *Shanhai* {ˈʃæŋˌhaɪ, ʃæŋˈhaɪ}, *gingham* {ˈgɪŋəm}, etc.

The equally-ranked conditions presented in this section can bring about [n ~ ŋ] variation in morphological concatenations, e.g. *informal:* {ɪn, ɪm, ɪŋ, ɪŋ, ...}{ˈfɔɹməɬ}. However, these conditions are hamstrung when morph sets lack particular nasal-final members. For instance, the prefix *circum-* lacks a [coronal]-final member in its morph set: {ˈsɜɹkəm, ˈsɜɹkəŋ}$_{\text{AROUND}}$. It therefore incurs violations of the nasal place assimilation condition in (4), e.g. *circu*[m]*terrestrial*, and of the coronal nasal condition in (6), e.g. *circu*[m]*solar*, *circu*[m]*ambient*. Note that the [bilabial]-final morph {ˈsɜɹkəm} is used in such cases. The [labiodental]-final morph {ˈsɜɹkəɱ}

[11] Incidentally, Emergent Phonology implies that "the language learner acquires the notions of *word* and of *morph* from observing the data, not because these are innate categories" (Archangeli & Pulleyblank 2022: 29, fn. 9).

[12] *Humvee* may be a compound for some speakers, in which case "nasal place assimilation is not required" (Archangeli & Pulleyblank 2022: 98). In Emergent Phonology, this may be understood simply as *Hum* being a single-member morph set {hʌm}. The latter will therefore present no labiodental alternation in concatenation with *vee* (short for *vehicle*).

(e.g., *circu*[ɱ]*vascular*) is presumably disfavoured by Borowsky's (1990) condition *[nasal, labiodental], discussed above.

Similarly, Archangeli and Pulleyblank (2022: 96–100) present the negative prefixes *un-* and *non-* as single-member morph sets: {ʌn} and {nɑn}. As such, they are immune to the nasal place assimilation phonotactic in (4). Over time, however, such morph sets may be expected to increase their membership under phonotactic pressure. For example, the assimilation phonotactic seems to have expanded the morph set of *un-* to {ʌn, ʌm, ʌŋ, ʌɱ} in certain speakers, who now say, e.g. *u*[m]*bearable*, *u*[ŋ]*conditional*, *u*[n ~ ɱ]*friendly*. Likewise, the nasal assimilation condition in (4) as well as the coronal nasal condition in (6) may prod certain individuals to add [coronal]-final {ˈsɜɹkən} to their *circum-* morph set. Misspellings are suggestive of such expansions, e.g. <circunstances> has 243,000 hits in Google Search.

In the meantime, Archangeli and Pulleyblank (2022) are probably right that *un-* and *non-* largely remain single-member morph sets, and they make another prediction in this regard. These negative prefixes may show a degree of labiodentalization before labiodentals due to non-controlled co-articulation, but if *un-* and *non-* lack [labiodental]-final morphs, they are expected to show less [n ~ ɱ] variation than the negative prefix *in-*, which includes the morph {ɪɱ}. By comparison, as discussed above, many generativists hold a separate phonetics or postlexical module solely responsible for labiodental nasals in English (e.g., Mohanan 1993: 115, n. 36; Padgett 1994: 490). On this view, labiodentalization should affect the negative prefixes *in-*, *un-* and *non-* rather similarly (cf. *invariable*, *unverified, nonviolent*).[13] These differing predictions have yet to be tested, but the literature on morph- and word-specific phonetics (Pierrehumbert 2002: 101 et seq) bodes well for Emergent Phonology.

3 [labial, strident] vs. [labiodental]

3.1 Gbe

East-Kwa Gbe dialects are well-known for distinguishing labiodental fricatives /f, v/ from bilabial ones /ɸ, β/, e.g. (8). Labiodental fricatives in Gbe are generally treated as [labial, strident] rather than as [labiodental] (Capo 1991a: 39–41, 119; Utman & Blumstein 1994; Halle 1995: 6; etc.).

(8) Labiodental vs. bilabial fricatives in Gengbe (Lotven & Obeng 2018: 38; Lotven 2020: 3)

fɑ̀	'to cool'	fɑ̃̀	'to cry'	vóvó	'freedom'	vɔ̃́	'to be scared'
(à)ɸá	'shout'	(è)ɸɑ̃̀	'belch'	(à)βà	'war'	(è)βɑ̃́	'spear'

This treatment is primarily due to precedence (Trubetzkoy 1939; Jakobson et al. 1952: 23; Halle 1959: 140; SPE / Chomsky & Halle 1968: 329), but Utman and Blumstein (1994) show that

[13] Secondary stress may be more variable on *in-* than on *un-* and *non-*, which may impact labiodentalization if this phonetic or postlexical process is stress-sensitive. Moreover, some prosodic phonologists have suggested that *in-* is unlike *un-* and *non-* because the latter two are uniquely positioned outside the prosodic word (ω), but Bermúdez-Otero (2018: 127, fn. 30) argues that *in-* is also ω-external in order to explain the presence of aspiration in e.g. $(\grave{i}m)_{\omega}([p^{h}]\check{o}l\acute{i}te)_{\omega}$; cf. $(\grave{i}m[p]\check{o}rt\acute{u}ne)_{\omega}$.

it is plausible to use [strident] to distinguish labiodental and bilabial fricatives in Ewegbe—the two sets are distinguished by turbulence noise amplitude consistent with the definition of [strident]. However, Maddieson (2005) warns in his own study of Ewegbe that the contrast is more likely based on articulation than on acoustics:

> [A]ny fricative noise between bilabial and labio-dental fricatives is subtle, [whereas] the complex of cues available from formant transitions (particularly a lower F1 adjoining bilabials) and the visual distinctiveness of the lip configurations make this difference not so difficult for listeners to recognize after all. (Maddieson 2005: 214)

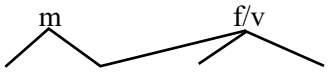
Thus from an Emergentist perspective, learners are more likely to posit [labiodental] than [strident] when they partition labiodental fricatives in Gbe.

Capo (1991a) shows that [labial] and [strident] are independently needed in the relevant Gbe dialects for phonemic contrasts (e.g., /t, d/ vs. /ts, dz/) as well as for phonological processes (e.g., assibilation).[14] This is strictly an argument from parsimony and economy (Clements 2001, 2003, 2009), which has an uncertain value in Emergent Phonology; cf. Mackie and Mielke (2011). In practice, there is no phonological phenomenon in the relevant Gbe dialects wherein sibilants pattern with labiodental fricatives to the exclusion of bilabial fricatives, which might suggest that sibilants and labiodentals uniquely share [strident]. Learners are therefore more likely to classify and label labiodentals and sibilant differently, as [labiodental] and [sibilant], respectively.

Only fricatives are reported as labiodental in Gbe dialects, but Gengbe speaker-linguist Ozouf Amedegnato informs me that a labiodental nasal can arise in assimilation to a following labiodental fricative, e.g. [m̩̀.vá] ‘I came’ (cf. [m̩.bé] ‘I said’; Lotven 2020: 13). Generative phonology can relegate this phenomenon to the phonetics as gestural overlap (cf. Padgett 1994: 490), but an autosegmental-phonological analysis is also possible. For such assimilations in other languages it is typically assumed that the feature [labial] is shared between the nasal and the labiodental fricative, as shown in (9). Crucially, the nasal consonant itself cannot be [strident], so what makes it labiodental?

[14] E.g.: “In Kpándo, /t d/ are realised as [tˢ dᶻ] before /i ĩ y/” (Capo 1991a: 135). Incidentally, Bach and Harms’s (1972) main exemplar of ‘crazy rule’ was coronal stop assibilation in Japanese: [coronal, stop] → [strident] / __ [high] (p. 13). It seemed to them especially difficult “to explain the affrication of dentals before high back vowels” (p. 15). Kim (2001) has since explained convincingly that the release of a stop into a high vocoid incurs a brief period of turbulence which may be misinterpreted and grammaticalized as the insertion of [strident] (cf. Blevins 2004). This phonologization is especially common before high front vocoids—notably before the glides /j, ɥ/ (Hall & Hamann 2006)—but regular assibilation of /t, d/ to [t͡s, d͡z] also occurs before high back vocoids such as /w/ in the Bantu language Lomongo (Kim 2001: 90) and /u, uː/ in Japanese (ibid.). Interestingly, high front vocoids as well as high back vowels trigger assibilation (and palatalization) in Hwe Gbe as well, according to Capo (1991b: 132): “/t d s z/ are realized as [ʧ ʤ ʃ ʒ] respectively before /i ĩ y/”; “/t d/ are realized as [ʧ ʤ] and /s z/ are optionally realized as [ʃ ʒ] before /u ũ/ In Hwe” (ib., p. 133).

(9)



[nasal] [labial] [strident] [fricative][15]

Goldsmith (1990) suggests an autosegmental solution in his discussion of similar place assimilations in English (e.g., *a*[ɱ]*phora*), Spanish (*á*[ɱ]*fora*) and Catalan (*à*[ɱ]*fora*): the phonological component has no "feature to distinguish the labio-dental position from the bilabial. ... But once the labial position is determined (labio-dental vs. bilabial), that determination is spread over both the nasal and the following consonant" (p. 295; see also Clements 2006: 435). In other words, the [nasal] is realized as labiodental [ɱ] because there is a path between [labial] and [strident] (Archangeli & Pulleyblank 1994: 50).[16]

This solution is ingenious but it is not available in Emergent Phonology. Archangeli and Pulleyblank (2022; 2023) deny autosegmental representations as overly abstract and seemingly unnecessary, so they treat morph sets like {m̰̀, m̰̀}$_{1SG}$ as independent cognitive entities, albeit subject to morphological concatenation. Nor is this autosegmental solution necessary in Emergent Phonology, which is free to treat [m̰̀.vá] 'I came' directly and transparently as [labiodental] assimilation, presumably as in (4) above (Archangeli & Pulleyblank 2022: 96).

3.2 Tenyidie

The Tibeto-Burman language Tenyidie (formerly Angami) present a rather baffling sound pattern: labiodentalization before schwa. This allophonic pattern affects the labial nasal in the Kohima dialect (3.2.1) and labials and labialized consonants more generally in the Khwüno dialect (3.2.2).

3.2.1 Kohima dialect

Giridhar (1980: 6–9) writes that Tenyidie has six vowels [i, u, e, o, ə, a] and six rising diphthongs [i̯e, ə̯i, i̯o, e̯o, u̯o, o̯u]. One of these—schwa—has a perplexing effect on /m/ according to Giridhar: "/m/ has two allophones: [ɱ] the labio-dental nasal occurs before /ə/ and [m], the bilabial nasal occurs elsewhere" (p. 13).

The same observation was made independently by Weidert (1977, 1981), e.g. "the unique labiodental nasal [mv-] occurs only with /ə/" (1981: 15). Matisoff (1980), too, reported this allophony after working with "Mr. Vikuosa Nienu, a brilliant Angami" (p. 4). Note that Weidert and Matisoff's [mv] corresponds to [ɱ] in other sources (e.g., Matisoff 1980: p. 7, fn. 13).[17]

> the nasal labiodental /mv/ seems to appear only before the vowel /ə/ (*thèmvə̌* 'star,' *thèmvə́* 'goat,' *mvə́* 'gather,' etc.). In this environment it clearly contrasts with /v/ (*və̄* 'beat, hit'),

[15] [+continuant, −sonorant] in a binary feature system.

[16] Goldsmith and Clements assume that the labial nasal receives a labiodental interpretation in in English, Spanish, and Catalan because it is on a path with [fricative] (or [continuant]), not [strident]. This cannot be the case in Gengbe or Ewegbe, where the feature combination [labial, fricative] (without [strident]) is interpreted as bilabial; cf. 2.1 above.

[17] Marrison (1967) also used [mv].

> but not with /m/, which apparently never occurs before /ə/. Synchronically, therefore, we could call [mv] an allophone of /m/: /m/ → [mv] / __ə. (Matisoff 1980: 7)

"The bilabial nasal [m] and the labio-dental nasal [ɱ] occur in the initial and medial positions," Ravindran (1974: 52) noted earlier, which led him to conclude that these are distinct phonemes. However, the near-minimal pairs he provides show that the two nasals are actually in complementary distribution before different vowels:

(10) Bilabial vs. labiodental nasals in Kohima Tenyidie (Ravindran 1974: 52)

[mí]	'fire'	[ɱə̂]	'refuse'
[mèkrá]	'white ant'	[ɱə̌kɻə́]	'she goat'
[tʰèmiè]	'man'	[tʰhèɱə̌]	'star'
[rə̀mò]	'hawk'	[rə̀ɱə̀]	'bed-bug'

The argument that /m/ and /ɱ/ are distinct phonemes in Kohima Tenyidie was made even earlier by Burling (1960), as discussed by Hajek (2009b):

> Perusal of the wordlist confirms that /ɱ/ only appears before /ə/, and Burling's (1960) justification for phonemic status for /ɱ/ appears to be one apparent case of contrast with bilabial /m/, i.e. /ɱə/ 'to gather' v. /məi/ 'tail'. If so, it appears this contrastive pair is problematic for some later sources on Angami, such as Matisoff (1980), given the only partial overlap of the post-nasal vowels. (Hajek 2009b: 109)

Ravindran (1974) also gives a word for 'tail' with a bilabial nasal: [puòməí] (p. 35). The vowel after [m] here is one of "six diphthongs all of which are rising," according to Giridhar (1980: 8), who gives a special warning about this particular diphthong:

> The diphthong /ə̯i/ consists of a glide from the central vowel [ə] to the front vowel [i] with the latter part of the unit being the peak of sonority. ... The onglide before [i] which is from a further back and lower position than [i] is so brief that many a speaker has lost it altogether converting it in the process into the pure vowel [i]. (Giridhar 1980: 8–9)

This complicating information on the diphthong [(ə̯)i] undermines Burling's (1960) lone near-minimal pair and it lends support (as an exception that proves the rule) to claims by Weidert, Matisoff and Giridhar (among others) that [ɱ] is strictly allophonic before [ə] in Tenyidie.

Hajek (2009b) concludes that Tenyidie forces us to resurrect the SPE use of [–distributed] for labiodentalization in a decidedly random rule:

(11) SPE-style rule for nasal labiodentalization in Tenyidie (Hajek 2009b: 113)

$$\begin{matrix} \text{m} \\ [+\text{distributed}] \end{matrix} \quad \rightarrow \quad \begin{matrix} \text{ɱ} \\ [-\text{distributed}] \end{matrix} \; / \; \_\_\_ \; \text{ə}$$

> The rule is one of place shift, involving a change in specification of the consonant feature [distributed], but which is not directly conditioned by the apparent trigger, which makes no use of what is an exclusively consonantal feature (see, e.g. ISP [Introduction to

> Segmental Phonology; broken URL]). It cannot, therefore, be labelled assimilation. This is very different from the more usual process of nasal labiodentalization that is very much part of a larger process of nasal place assimilation to following consonants, e.g. *English* /lɪnk/ → [lɪŋk] 'link.' (Hajek 2009b: 113)

As alluded to above, an Emergent analysis makes no presumption that phonological conditions are markedness-reducing or even phonetically grounded (cf. Archangeli & Pulleyblank 1994). It only matters that conditions are learnable with general cognitive principles. In this case, learners can posit *mə ≫ *ɱ in their phonological grammar based on their experience that m is generally favoured over ɱ, except before ə. In categorizing sound chunks and acquiring conditions on sound patterns, learners are free to posit "new" labels such as [bilabial] and [labiodental], as needed; again, cf. Borowsky's (1990) *[nasal, labiodental].

3.2.2 Khwüno dialect

Pre-schwa labiodentalization is a more general phenomenon in the dialect of Tenyidie spoken in Khwüno (Khonoma). "Labial and labialized consonants have allophones," Blankenship et al. (1993: 75) report, "that result from a labiodentalization process which is recognized in the orthography":

(12) Allophonic distribution of consonants in Khwüno Tenyidie (Blankenship et al. 1993: 76)

Phoneme or cluster	*Realization before [ə]*	*Realization elsewhere*
/p/	[(p)f]	[p]
/b/	([bv])[18]	[b]
/m̥ʰ/	[m̥̊ʱ]	[m̥ʰ]
/m/	[ɱ]	[m]
/kʰw/	[kʰf]	[kʰw]
/kw/	[kv]	[kw]
/gw/	[gv]	[gw]

Again, this is a 'crazy rule,' as Hajek (2009b) remarks: "From a synchronic perspective it is not clear what the motivation for such a shift would be—as is evident in any feature-based rule" (p. 113). This concern does not extend to Emergent Phonology, under which learners are free to label—however they like—not only the labiodental sounds before schwa, but also the class of sounds disallowed before schwa, viz. bilabial and labialized consonants (Blankenship et al. 1993: 75).

Emergent phonotactic conditions can favour pre-schwa labiodentals and/or prohibit pre-schwa bilabial and labialized consonants similarly to morpheme structure constraints (MSCs) in generative phonology (Booij 2011), but as discussed earlier, Emergent phonotactics are strictly

[18] Blankenship et al. (1993) lacked evidence for [bvə]: "An additional allophone, [bv], appears in the literature on Kohima Angami (e.g. [bvə] 'swollen', in Ravindran 1974:30), but it does not occur in Khonoma Angami" (p. 75). For what it's worth, I heard two instances of [bv] in Savio Meyase's recordings of Khwüno Tenyidie recently archived at the University of North Texas: https://digital.library.unt.edu/explore/collections/ATLC/

concerned with surface-apparent morphs. Emergent Phonology rejects phonemes as overly abstract, so it also rejects Blankenship et al.'s (1993) claim that, for example, [gvəɬ] 'to bear fruit' derives from /gwəɬ/; cf. [gweɬ] 'to be thin' from /gweɬ/ (p. 87). Rather, {gvəɬ} and {gweɬ} are treated as different morphs which belong to different morph sets.

The surface orientation of Emergent Phonology prevents it from entertaining certain analyses. For example, suppose we concede the traditional interpretation of labiodentals as [labial, strident] (Trubetzkoy 1939 et seq.). The allophony in (12) can then be interpreted as in (13), on two assumptions. First, /kʰw, kw, gw/ must be clusters, as Blankenship et al. (1993: 76) intimate, wherein /w/ is [labial], like /p, b, m̥ʰ, m/.[19] Second, the nasals /m̥ʰ, m/ also become [strident], i.e. [m̥ʸʰ, mv].[20] The latter assumption is uniquely possible in a generativist account because surface phonological representations are assumed to be different, not only from underlying representations, but also from their phonetic realizations (e.g., Keyser & Stevens 2006; Kingston 2007; de Lacy 2009).

(13) Allophonic labiodentalization of labial consonants in Khwüno Tenyidie

[labial]	→	[strident]	/ ___ ə[21]
/p, b, m̥ʰ, m, kʰw, kw, gw/		[(p)f, bv, m̥ʸ, mv, kʰf, kf, gv]	

Note that this SPE-style rule is even "crazier" than Hajek's (2009b) in (11) because its focus is [labial], which has a defining articulatory gesture, the change is [strident], which is defined acoustically and/or auditorily, and the pre-schwa environment is completely random from a synchronic perspective. As such, the rule in (13) makes no sense in a phonetics-informed approach like Grounded Phonology (Archangeli & Pulleyblank 1994) or in markedness-informed approach to segmental phonology, notably Optimality Theory (Pulleyblank 1997; Archangeli 1999). As discussed above, Emergent Phonology does entertain 'crazy' phonotactics, but only if they are learnable under general cognition, and a [strident] analysis makes little sense from this perspective:

[19] For comparison, Davis and Hammond (1995) show convincingly that /kw, gw/ represent clusters in English (*quit*, *Gwen*). English /w/ also seems [labial], judging from assimilation effects (e.g., *sandwich* [ˈsæn(d)ˌwɪʧ] becoming [ˈsæmˌwɪʧ]) and dissimilation effects (e.g., #{k, g, t, d, θ, s, ʃ}wV... vs. *#{p, b, f, v}wV...).

[20] It is interesting that the Tenyidie indicate labiodental nasals in writing as <hmv, mv>. They don't *need* to indicate the labiodental nasals in orthography, given the consensus that they are nothing more than allophonic realizations of /m̥ʰ, m/ (Weidert 1977; 1981: 15; Giridhar 1980: 13; Matisoff 1980: 7; Hajek 2009b: 111). And yet they write <mvü> rather than <mü> (where <ü> is /ə/). This could be interpreted as evidence that phonetic [mə] is phonological [mvə], as in (13), or else as evidence that the labiodental nasal is phonemic after all in Tenyidie—contra Weidert, Giridhhar, Matisoff, Hajek, etc. On the other hand, it could also be interpreted as evidence for the Emergentist claim that only surface-apparent morphs are real to speakers, who may therefore represent morphs like {mə} in writing as best they can, viz. <mvü>.

[21] Sources describe Tenyidie schwa as a typical mid central unrounded vowel, but its phonological features are unknown. Schwa is often described negatively and/or as featureless in other languages, at least in a privative feature system, e.g., not [round], not [high], not [low], not [front], not [RTR].

why wouldn't learners posit [labiodental] instead of [strident] in (12)/(13), not least because outputs like [m̊ŋə] and [ŋə] are [labiodental], but not [strident]?

The first generativist answer to this question was given in the introduction, after Huybregts (2020): the set of distinctive features, which has remained fixed since pre-Neolithic times, includes [strident], but not [labiodental]. Phonologies therefore shoehorn labiodental sounds into existing features such as [strident]. The second answer, detailed especially in section 2.1, is that a generative-innatist-modular framework assumes distinct phonological and phonetic components in the human faculty of language, which allows the abstract notion in (13) that the [labial] in /mə/ becomes [strident], i.e. [mv], which is then realized as fully nasal [ŋ] in Tenyidie phonetics.

Recall Keyser and Stevens's (2006) claim that "unlike feature-defining gestures, enhancement gestures are never subject to overlap severe enough to mask their acoustic consequences" (p. 58). This allows an enhancement gesture to serve as a proxy for a featural specification whose defining property is obliterated in the phonetics (e.g., Stevens & Keyser 1989, 2010; Keyser & Stevens 2001, 2006; Stevens 2002; Flynn 2011). So for generativists it remains defensible to use the traditional specification [labial, strident] for the surface-phonological nasal [mv], on the understanding that this feature combination is implemented with a labiodental gesture in the phonetics, and that this enhancement gesture can act as a proxy for [strident] in certain phonetic contexts, notably in nasals.

As it turns out, Burling's (1960) phonetic description of the labiodental nasal offers some support for its representation as [mv] in Tenyidie phonology, as per (13). Perhaps because he considered the labiodental nasal to be a phoneme (as mentioned earlier), he carefully described it as having two allophones: [ŋ] word-initially, and [mŋ] word-medially (see also Hajek 2009b: 109). Burling described the non-initial allophone as follows: "it has a slight bilabial nasal onset, followed by a labio-dental nasal, giving it a phonetic quality parallel to pf" (Burling 1960: 53). This phonetic description dovetails with the analysis in (13): the [labial] in /mə/ becomes [strident], i.e. [mv], which is realized as fully nasal in Tenyidie phonetics—as [mŋ] medially and as [ŋ] initially.

In sum, pre-schwa labiodentalization in Tenyidie usefully serves to highlight the deep divide between how emergentists and traditional generativists understand sound patterns. The next two sections consider two other more tentative cases of languages with pre-vocalic [ŋ].

4 [labial, round] vs. [labiodental]

Clements et al. (2015) suggest that no language makes a phonological distinction between labiodental nasal /ŋ/ and bilabial nasal /m/. They note that Southern Teke is a "possible exception" (p. 197) but are quick to add that its labiodental nasal "involves considerable lip protrusion (Christiane Paulian, p.c.) and might be regarded as rounded /m^{w}/ at the phonological level" (ibid.).[22] Paulian's report on the labiodental nasal in Southern Teke was recently confirmed by Li (2024):

> "a strong protrusion of both lips" … was exactly what I observed on the manner of articulation of the speakers when they tried to contrast this phoneme with /m/. However,

[22] Wells (2012) suggests instead that [ŋ] is the phonetic realization of the phoneme /mv/ in Southern Teke.

> this contrast seems to be only observed with elder speakers and is being neutralised among younger generations. (p. 15)

Li (2024: 15) remarks that the sound in question is written <mw> by speakers: *mwáana* 'child', *mwíi* 'eyes', *mwe* 'alive', etc. These words also illustrate that the labiodental nasal only appears before /a, i, e/—"[t]his phoneme is never attested before /u/ and /o/" (ibid.). Strikingly, the labiodental nasal shares this phonotactic restriction with the rounded sonorant /w/ (ibid.; Paulian 1975: 56). Incidentally, Paulian (1975) warns that lip rounding is stronger before /a/ than before /i/ and /e/:

> L'articulation de cette nasale est toujours accompagnée, chez nos informateurs, d'une forte avancée des lèvres, mais l'arrondissement qui devrait en résulter entre en conflit avec le caractère étiré de /i/ et de /e/ et ne se manifeste pleinement que devant /a/, voyelle pour laquelle la position des lèvres n'est pas pertinente. (p. 57; see also Li 2024: 15)

This [round] analysis of Southern Teke relieves generativists of positing [labiodental], and it can be adopted in an Emergent account, too. From the latter perspective, however, learners may acquire labiodental nasals as such, i.e. label them [labiodental] along with {f, pf, bv, ...}, and additionally label as [round] those labiodental nasals which present as such (notably before [a]).

Finally, E. Pulleyblank (2003b) suggested that Gbe dialects "oppose [–round] bilabials to [+round] labiodentals" (p. 731). This understanding of Gbe fricatives has been criticized by Maddieson (2005: 161, 173; see also LaCharité 1993: 97–98), but it dovetails with the understanding of Southern Teke [ɱ] "as rounded /mʷ/ at the phonological level" (Clements et al. 2015: 197). E. Pulleyblank (2003) adds:

> Even where there is no minimal contrast in the feature composition of phonemes, a differential contrast between [+round] labiodentals and [–round] bilabials can emerge as significant in phonological rules. … [E.g.,] contemporary Cantonese has pow, pʰow, mow to the exclusion of *puː, *pʰuw, *muː, but fuː, wuː, to the exclusion of *fow, *wow. That is, labiodental [f] is treated as [+round] along with the labiovelar [w], while the bilabial stops are treated as [–round]. (p. 732)

Under Emergent Phonology, it is indeed likely that Cantonese learners will categorize the sound chunks {f, w, kʷ, kʰʷ} under a single label[23] which excludes [bilabial] {m, p, pʰ}, based on the complementary distribution of these sets before the sound chunks {uː}, {uw}, and {ow}—also {aːw} and {iː} (Cheung 1986: 118). But learners may also categorize the sound chunks {f, m, p, pʰ} under a single label, say [labial], which excludes {w, kʷ, kʰʷ}, based on the complementary distribution of these sets before {ej}, {ɐw} and {oŋ} (Cheung 1986: 118).

[23] Cheung (1986: 119) suggests the SPE specification [–distributed] rather than [+round]. The precise label does not matter under Emergent Phonology, so long as it is learnable.

5 [labiodental] in idiolectal English

As discussed in section 2.2, Borowsky (1990: 93) proposed *[nasal, labiodental] as a markedness condition in her analysis of English prefixes (*in-*, *con-*). This condition is learnable and usable in an Emergent grammar, but Borowsky's framing in terms of markedness is unwelcome. In fact, Emergent Phonology makes the strong claim that a different learning trajectory or context may well lead a learner to posit the condition *[nasal, bilabial] instead. A case in point is Elon Musk. Whereas his oral labial stops are typically bilabial, his labial nasal is often if not always labiodental, as several people have reported on social media,[24] including phonologists.[25] In the absence of a systematic investigation, it is unclear whether Musk favours a labiodental nasal in general, or whether he favours it in certain environments, say before vowels and labiodental fricatives.

The phenomenon is reminiscent of idiolectal variation in the realization of English "r" discussed by Archangeli and Pulleyblank (2015: 2–3; 2022: 25–26). In Mielke et al.'s (2016) ultrasound study of American English, sixteen speakers used only bunched "r" whereas just two speakers used only retroflex "r." There were also nine speakers who used both types of "r" but with strict conditioning environments for each type. Interestingly, the conditioning environments were different for each speaker, probably because the two types of "r" are not distinguished in English. Nor can the two types of "r" be distinguished auditorily or visually, thus their phonological patterns are necessarily covert (cf. Pulleyblank 2003a).

It is also difficult to distinguish bilabial and labiodental nasals auditorily, but these sounds offer distinct visual cues, unlike bunched and retroflex "r." These visual cues have certainly helped people to notice Elon Musk's preference for labiodental nasals over bilabial ones (e.g., fns. 24, 25). On the other hand, the existence of such a pattern (again, say [ɱ] before vowels and before [f, v]) may well go unnoticed in speakers who are not oversized public figures. Moreover, even those who watch Musk's mouth closely may not understand what they see.

For example, Musk's [ɱ] figured prominently if infamously at a Trump rally earlier this year. After dancing on stage, Musk slowly released a labiodental articulation as he abruptly moved his hand away from his heart to an arm-extended position above his head, with his palm facing down. His oral and hand gestures were generally perceived as an f-word and a N@zi salute, respectively. Both gestures have been explained away as Musk uttering, "My heart goes out to you," resulting in incredulous commentary, e.g.:

> Elon's upper teeth, concealed by this upper (superior) lip (as is usual), are touching his lower lip for the labiodental articulation. And he's probably articulating a speech sound that doesn't jibe with any part of "My heart goes out to you." ... The unvoiced labiodental fricative is the sound of F. If Elon were actually saying what he said he was saying, we'd see his lips together in a bilabial M. (Paul Mordecai Rosenberg)[26]

[24] E.g., https://bsky.app/profile/adamlisagor.com/post/3lipem53dwk2g

[25] E.g., https://x.com/shjsat/status/1747964255888978051

[26] *The Litchfield Monitor*, March 19, 2025: https://litchfieldmonitor.com/region-20-super-and-musks-heart/

This blog post illustrates that labiodental fricatives are common knowledge for English speakers, but idiolectal [m ~ ɱ] variation is not. Nor should it be:

> What is crucial is that the learners identify the same partitions among the sounds of their language. Realising the partitioned segments in slightly different ways would only be problematic if the realisations were different enough to produce confusion. Simply having slightly different articulatory mechanisms, as in these cases, does not raise the concern of mutually unintelligible grammars: the grammars agree in their partitioning of segments and adopt articulatory mechanisms for producing a perceptually similar effect. (Archangeli & Pulleyblank 2022: 26)

In a generative-innatist-modular framework, Musk's [ɱ] can be explained away from phonology proper in a separate phonetics module, say. By contrast, Emergent Phonology embraces idiolectal variation as grammatical, as described in the next, final section.

6 Conclusion

This paper examined the generative-innatist-modular claim that there is a phonological component which is furnished with a set of distinctive features by Universal Grammar, and as luck from natural selection would have it, [labiodental] is not part of "the furniture of the world," as Bromberger and Halle (2000: 36) put it. In practice, this means that phonologies must shoehorn labiodentals into a standard set of distinctive features. Thus, labiodentals may be understood as [labial, fricative] in Ndrumbea (section 2.1) and in English (section 2.2); as [labial, strident] in Gbe dialects (section 3.1) and in Tenyidie (section 3.2), and as [round] in Southern Teke and Cantonese (section 4).

In each case an analysis with a distinctive feature [labiodental] is simpler in an Emergent Phonology approach. Emergent analyses readily accommodate prevocalic labiodental nasals, as found in Ndrumbea, Tenyidie, Southern Teke, and apparently in idiolectal English. Some of these cases may be explained away as marginal phonetic phenomena in a generativist-innatist-modular approach. By contrast, all such phenomena—including idiolectal variation in the realization of "m" and especially "r" in English—are valued in Emergent Phonology and make an important point: "humans devise language patterns even when there is no overt evidence to do so, which supports evidence in the language acquisition literature for facile and rapid pattern identification" (Archangeli & Pulleyblank 2015: 3). Archangeli and Pulleyblank (2023) conclude that "a core property of a human learner is being a rampant generaliser—looking for patterns, even where there might not be any, seems to be a hallmark property of human cognition" (p. 63). This human proclivity can result in some 'crazy rules' in phonology, as we have seen.

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