

Prosody-morphology interaction in English Diphthong Raising in a Mississippi dialect  
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## Abstract\*

Alternations in vocoid height conditioned by consonant voicing recur in geographically dispersed dialects around the English-speaking world, representing multiple recent or ongoing phonologizations of the same phonetic precursor. Little is known about how the outcome of phonologization varies in the effects of morphological and prosodic structure. This paper describes Diphthong Raising in a Mississippi dialect, systematically combining a range of morphological and prosodic contexts, and compares Diphthong Raising across three generations of dialect speakers and three other dialects. Diphthong Raising is found to interact with stress, morphological structure, and free vs. bound status of stems, and in different ways across dialects.

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## 1. Introduction: English Diphthong Raising

Around the English-speaking world, synchronic phonological alternations are found in which the height of a vocoid differs depending on whether it precedes a voiced or voiceless coda obstruent. The best-known case is Canadian Raising, in which [aɪ] and [aʊ] are raised to [ʌɪ] and [ʌʊ] before a voiceless coda consonant; e.g. *tight* [tʌɪt] vs. *tide* [taɪd]; *lout* [lʌʊt] vs. *loud* [laʊd] (Joos 1942, Chambers 1973, Paradis 1980). However, patterns meeting this criterion — “English Diphthong Raising” — recur in multiple geographically and historically separated varieties of English, as shown in Table 1. The scattered geographic distribution, the rarity of English Diphthong Raising in the British Isles, the phonetic diversity of the vocoids from one dialect to another, and the relative recency of Diphthong Raising in some dialects indicate that at least some of the instances are independent innovations (Labov 1963; Chambers 1989; Britain 1997; Moreton & Thomas 2007; Fruehwald 2016).

All patterns meeting the criterion share a number of properties in addition to the criterion itself: The higher and lower vocoids are always found before voiceless and voiced obstruents, respectively; never the other way around. Before sonorant codas, and in open syllables, the lower vocoid is found, never the higher. The affected vocoids always include at least one of historical /ai/ and /au/. What creates this consistency across independent innovations, and maintains it in the face of historical change, seems to be that Diphthong Raising arises from the phonologization (Hyman 1976) of a consistent phonetic precursor — a phonetic pre-voiceless peripheralization process that involves all English vocoids, and that affects diphthongs more the bigger the articulatory difference between their nucleus and offglide (Thomas 2000, Moreton 2004, Moreton & Thomas 2007). Diphthong Raising thus provides a clear, well-documented, and historically on-going illustration of how the interaction between a phonetic precursor and cognitive mechanisms of generalization can skew phonological typology by steering language change.

$\Delta$	ai	aɛ	a <sup>ɛ</sup> , a:	Dialects
–	+			Canada (Joos 1942, Chambers 1973, Paradis 1980) North-central U.S. (Dailey-O'Cain 1997, Thomas 2000) East coast of U.S. (Labov 1963, 2001; Blake & Josey 2003; Fruehwald 2016) Eastern Virginia (Shewmake 1925) Low Country of South Carolina and Georgia (Kurath & McDavid 1961) South Atlantic islands (Trudgill 1986) Hawai'i (Vance 1987:208) English Fens (Britain 1997)
–		+		Southeastern U.S. (Greet 1931, Kurath & McDavid 1961)
–			+	Eastern Virginia, northeastern North Carolina (Kurath & McDavid 1961)
	–	+		Southeastern U.S. white (Edgerton 1935, J. S. Hall 1942, Sledd 1966, Pederson et al. 1986–1992)
	–		+	African-American English, many varieties (Thomas & Bailey 1998, Thomas 2001, B. Anderson 2002; Knight & Herd 2015) Southeastern U.S. white speakers (Evans 1935, Sledd 1966, Bailey et al 1991, Bernstein 1993; Hazen 2000; Knight & Herd 2015) Devonshire (Orton et al. 1978; P. Anderson 1987) Humberside (Trudgill 1999:72)
		–	+	Texas African-American English (Bailey & Thomas 1998)

Table 1. Height alternation in historical /ai/ conditioned by voiceless (–) versus voiced (+) coda obstruents. (Other environments, such as nasal and zero codas, were not reported by all sources.)  
Enlarged from Moreton & Thomas (2007: Table 1).

A few dialects have been studied in more detail, with the result that two other main factors have been found to affect Diphthong Raising: the prosodic environment of the segmental trigger and the morphological structure of the word (Shewmake 1925, Chambers 1973, Paradis 1980, Vance 1987, Fruehwald 2016). These properties are much more abstract than the phonetics of the

diphthongs or of the segmental trigger, and far less is known about how their effects vary between speakers or change over historical time.

This paper describes an underknown instance of Diphthong Raising in the English of 20th-Century educated European-American speakers from Mississippi. It investigates the prosodic and morphological conditioning of the process and compares them with those reported from dialects in Virginia (Shewmake 1925, 1943, 1945), Ontario (Chambers 1973, 1989, Paradis 1980), and the U.S. Inland North (Vance 1987, Dailey O'Cain 1996). The present study goes beyond the Virginia, Ontario, and Inland North studies in systematically and orthogonally varying prosody and morphology across a wider range of contexts, revealing interactions between stress environment, morphological environment, and free vs. bound status.

Section 2 of this paper gives basic information about the dialect and the speakers whose data is used in this study. Section 3 uses the author's judgements of words in each observable cell of the prosody-morphology matrix to describe the productive Diphthong Raising alternation in this dialect. Section 4 compares the conclusions of Section 3 with recorded productions of two speakers in the previous generation and of two speakers in the generation before that, confirming the stability of the pattern over time. Section 5 presents a formal analysis in the framework of Harmonic Grammar (Legendre, Miyata, & Smolensky 1990), and discusses problems posed by overapplication of Diphthong Raising to affixed free roots like *Hittitology*. Section 6 discusses lexical exceptions and apparent exceptions in the four dialects. Section 7 compares the regular Diphthong Raising pattern in focal Mississippi dialect with the focal Virginia, Ontario, and Inland North dialects. Section 8 lays out what is known about the historical development of Diphthong Raising in the focal Mississippi dialect. The main findings and their significance are discussed in Section 9.

## 2. Dialect and speakers

The focal dialect for this study is that of educated white speakers in Mississippi born in the 20<sup>th</sup> Century. I will distinguish it from other Mississippi dialects by calling the “the focal Mississippi dialect”, since it is the focus of this study. The other three dialects will be likewise referred to as the “focal Ontario” (Chambers 1973 et seqq.), “focal Virginia” (Shewmake 1925 et seqq.), and “focal Inland North” (Vance 1987, Dailey-O'Cain 1996) dialects.

Data comes from five speakers. Speaker RLM was born in Jackson, Mississippi, in 1937 and raised in a middle-class monolingual English-speaking white family in that city. Her father, who had some college, was an engineer for a gas company. Her mother had completed college and was a housewife. Speaker AM, spouse of RLM, was born in New Orleans in 1934 and raised in a working-class monolingual English-speaking white family in different places on the Gulf Coast. Neither of his parents attended college. He served in the U.S. Navy from 1952 to 1956, stationed in Norfolk, Virginia. Both RLM and AM attended white-only public schools. Both matriculated at Millsaps College in Jackson, then completed undergraduate and graduate or professional degrees at the University of Mississippi, in Oxford. They lived in Oxford, where AM practiced law, continually thereafter except for one year in New Haven, Connecticut, one year in Cambridge, England, and four years in Washington, D.C. Speaker EM, son of RLM and AM (and author of this article) was born in 1968 near Washington, D.C., and was raised from the

age of 1 in Oxford in their middle-class monolingual English-speaking white family. EM attended integrated public schools.

Judgement data is entirely from EM, drawn partly from an unpublished 1999 manuscript (E. Moreton, 1999). Recordings of RLM and AM come from a two-hour oral-history interview recorded in January 1990 by EM, in which he interviewed them about the integration of the University of Mississippi in 1962. The recording was made on audio tape, which was digitized in 2015.

Two archival speakers from the *Linguistic Atlas of the Gulf States* (Pedersen, McDaniel, Bailey, & Bassett 1986) were chosen based on geographical and social similarity to RLM and AM. Both were a bit over one generation older, and both were white. Speaker LAGS-592 was born in the town of Madison, near Jackson, and at the age of three moved to that city, where she later taught school. She was 70 years old when interviewed in 1972. Her own schooling went through college, and would have been in white-only schools. The recording was made on audio tape and later digitized in MP3 format. Speaker LAGS-546 was born in Burgess, Mississippi, which is about 12 km from Oxford, and was 80 years old when interviewed in 1974. He attended Oxford High School and the University of Mississippi (both white-only at that time), practiced law in Oxford, and served as a circuit court judge in Oxford and as a State Supreme Court judge in Jackson. He was a familiar neighbor of RLM, AM, and EM until shortly before the interview, when the M family moved to a different part of Oxford. The recording was made on audio tape and later digitized in MP3 format.

AM and EM's speech is consistently rhotic. RLM's dialect is variably non-rhotic in unstressed final syllables; e.g. *prior*, *grammar* sometimes end in [ɹ̥], sometimes in [ə]. LAGS-592 consistently has [ə] in place of syllabic [ɹ̥] and also in place of syllable-final [ɹ]; e.g. *fire* is [faə], but *andiron*, where the [ɹ] is not syllable-final, is [ændə.ɹn].

For all of these speakers, the unraised /ai/ is a low monophthong, back of [æ] but considerably less back than [ɑ]. It is near, but slightly less back than, the [a] of Boston *car*. Here it will be written [ɑ], following R. L. Moreton (pers. comm., 1999). The raised allophone is [aɪ]. For typographical simplicity, and to facilitate comparison across Diphthong Raising dialects, examples will be written in English orthography, with primary and non-primary stress marked on the vowels, and raised (^) or unraised ( ) /ai/ marked at the end: *bàlaláika*<sup>^</sup>, *Hokkáidò*<sub>^</sub>, *éyesight*<sub>^</sub>. Variable judgements are indicated with a slash: *hýpánthium*<sup>^</sup>/<sub>^</sub>. Different dialects are, where necessary, disambiguated with abbreviations: *tíger*<sup>^</sup><sub>MS\_VA</sub> means that *tíger* is raised in the focal Mississippi dialect, but unraised in the focal Virginia dialect (it is pronounced [taɪgə] in both dialects). Flapped /t/ or /d/ is underlined: *líghter*<sup>^</sup>.

### 3. Speaker judgements

Speakers of the focal Mississippi dialect, like those of other Diphthong Raising dialects, have definite and stable judgements about whether the raised or unraised vocoid occurs in a given word (Vance 1987:197, 203–204; Idsardi 2006). This section of the paper describes the judgements of a single speaker (the author, Speaker EM). Although doubts have been raised about the productivity of Diphthong Raising in Ontario (Mielke et al. 2003:132), Diphthong Raising in the focal Mississippi dialect is fully productive for this speaker. Names, loan words,

and other new lexical items with surface [aɪ] in the source language are lexicalized with the context-appropriate alternant. Thus *Shánghài*\_, *Hokkáidò*\_, *dáikòn*\_, *káitèn*\_, *Kai*\_, *Kléiber*\_, (*Karl*) *May*\_, (*Frankfurt am*) *Main*\_, *Báikàl*\_ all have [ɑ], while *Aisch*^, *Méissen*^, *Réissner*^, *Reith*^, *Leith*^, *bàlalaíka*^, *Reince*^ (*Prieibus*) have [aɪ]. The pattern has lexical exceptions and apparent exceptions, which are discussed in Section 6.

Two main factors were investigated: the local morphological structure and the stress environment. Following previous work on Diphthong Raising (Chambers 1973, Kiparsky 1979, McCarthy 1982, Vance 1987), we distinguish two classes of affix, “stress-neutral” and “non-stress-neutral”. The classification used here follows Siegel (1974), where they are called “Class I”, or “stress-determining”, and “Class II”, or “non-stress-determining”. An affix is classified as stress-neutral if it does not perturb the stress of the base word except possibly by usurping main stress; e.g. *anti-* as in *ántipàrticle*\_ (cf. *pàrticle*) or *-er* as in *móonlighter*^ (cf. *móonlight*^). An affix is classified as non-stress-neutral otherwise; e.g. *bí-* as in *bítheism*\_ (cf. *théism*) or *-ee* as in *ìnvitée*^ (cf. *ìnvíte*^). I write “+” for a non-stress-neutral boundary, “#” for a stress-neutral or compound boundary, and “|” for any kind of boundary. Example words were chosen to minimize ambiguity as to the existence and location of the morpheme boundary. *Éistedfòdd*^, for example, is monomorphemic to the non-Welsh-speaking author, *vítamin*^ is synchronically monomorphemic despite its etymology (*vit-* + *amine*), and *bíplàne*\_ is dimorphemic, but *psýchólogy*\_ is ambiguous, because I have unstable intuitions about which morpheme the *o* belongs to. Three kinds of stress environment were used in this study. They are listed in (1).

(1) Stress environments used in this study

- a. VCv — stressed /ai/, voiceless consonant, unstressed nucleus; e.g. *síphon*^
- b. V<sup>1</sup>CV<sup>2</sup> — stressed /ai/, voiceless consonant, stressed nucleus that is less stressed than /ai/; e.g. *Báikàl*\_
- c. V<sup>2</sup>CV<sup>1</sup> — stressed /ai/, voiceless consonant, stressed nucleus that is more stressed than /ai/; e.g. *Tàipéi*\_

Example words were chosen to minimize ambiguity in the critical stress environment. If the second nucleus was intended to be stressless, that stresslessness had to be demonstrable by either (a) a reduced nucleus, i.e. [ə], [ɪ], or a syllabic consonant (*míca*^, *crísis*^, *rífle*^, *chítón*^) or (b) a preceding flap (*Àphrodíte*^). If the second nucleus was intended to be non-primary-stressed, its syllable had either to be closed or to have a tense nucleus other than [i], [u], and [oʊ].<sup>1</sup>

In preparing the lists, I found that I could not reliably distinguish levels of stress of /ai/ itself at any finer granularity than “main” vs. “other”. For example, the first syllables of *tycóon*\_ and *Saipán*\_ sometimes seemed to have a lower level of stress than that of *Tàipéi*\_, but the judgement was not stable from one self-consultation to the next. For that reason, the stress of /ai/ is scored only syntagmatically, as greater than or less than that of the following nucleus. That judgement was stable; e.g. the first syllable of *tycóon*\_ always seemed less stressed than the

<sup>1</sup> These three tense vowels can occur word-finally with or without stress (Chomsky & Halle 1968; Hammond 1997), creating ambiguity in the prosodic environment that is reflected in both flapping and Diphthong Raising: *Plato* (*Tito*, *vibrato*, etc.) can be either [ˈpleɪ.təʊ] or [ˈpleɪrəʊ]; likewise, *taiko* can be either [ˈtɑ.kəʊ] or [ˈtɑɪkəʊ].



second. In non-/ai/ nuclei, I use ´ to mark primary stress, and ` to mark non-primary stress, without distinguishing between secondary and less-than-secondary stress.

The three stress categories (VCv, V<sup>1</sup>CV<sup>2</sup>, and V<sup>2</sup>CV<sup>1</sup>) were factorially combined with the three levels of morpheme-boundary strength (compound, stress-neutral, and non-stress-neutral) to create the basic design. Cells were populated from several sources, mainly previous publications on other Diphthong Raising dialects (especially Chambers 1973, Vance 1987, Idsardi 2006), the list of headwords from Webster's *Second New International Dictionary* (1934) in the Unix /usr/share/dict/words file, the CELEX lexical database (Baayen & Piepenbrock 1995), the CMU Pronouncing Dictionary, Version 0.7a (Wiede 1996), the current on-line edition of the *Oxford English Dictionary*, and my own active vocabulary. Many of the words thus found were unfamiliar to me (e.g. *díkage*^, *Picrámnia*^, *hýpánthium*^/\_). I also used productive derivation to conjecture words, then searched the World Wide Web via Duck Duck Go or Google to find the ones that actually existed (e.g. *Fightology*^, *Nightarium*^, *Wrightesque*^). The pronunciation in every case is my own.

To anticipate, the descriptive generalization that emerges is stated in (2). The remainder of Section 3 justifies the generalization on the basis of the data.

- (2) /ai/ is raised if and only if it is immediately followed by an underlyingly voiceless consonant (Section 3.1) which
- (a) belongs to the same morpheme (Section 3.2) and of which
  - (b) at least one of the following is true (Section 3.3):
    - (i) it does not precede a stressed nucleus, or
    - (ii) it precedes a less-stressed nucleus in the next morpheme, or
    - (iii) it ends a free morpheme

### 3.1. The segmental trigger must be underlyingly voiceless

In final stressed syllables of monomorphemic words, [α] and [aɪ] are in complementary distribution, with [aɪ] before voiceless sounds and [α] elsewhere. Only /ai/ alternates; /au/ does not. Examples are shown in (3) and (4).

- (3) Underived word-final syllables: [aɪ] before voiceless segments: *gripe*^, *Skype*^, *slype*^, *cripes*^, *light*^, *right*^, *site*^, *igné*^, *tyke*^, *spike*^, *shrike*^, *knife*^, *wife*^, *rife*^, *Reith*^, *price*^, *vise*^, *rice*^, *Christ*^, *heist*^

- (4) Underived word-final syllables: [α] elsewhere: *I*\_, *eye*\_, *shy*\_, *thigh*\_, *sigh*\_, *why*\_, *Níkolai*\_, *bribe*\_, *tribe*\_, *slide*\_, *tide*\_, *Ides*\_, *Steig*\_, *hive*\_, *shrive*\_, *thrive*\_, *tithe*\_, *writhe*\_, *lithe*\_, *prize*\_, *guise*\_, *Nige* (dim. of *Nigel*)\_, *oblige*\_, *rhyme*\_, *lime*\_, *Syme*\_, *Grimes*\_, *nine*\_, *Rhine*\_, *line*\_, *sign*\_, *blind*\_, *mind*\_, *file* [fal]\_, *mile* [mal]\_, *style* [stal]\_, *aisle* [al]\_, *child* [tʃald]\_, *Miles* [malz]\_, *Giles* [dʒalz]\_, *fire* [faɪ]\_, *wire* [waɪ]\_, *mire* [maɪ]\_, *byre* [baɪ]\_, *ours* [aɪz]\_ (*sic*), *iron* [a.ɪn]. (Note that *file*, *wire*, *iron*, etc. are monosyllables, not disyllables or sequisyllables.)

When a word-final /t/ is flapped, the /ai/ allophone is the one appropriate for /t/; e.g. in *bite*^ *a cactus*, or *night*^ *after night*^, the raised allophone [aɪ] is found. As in the focal Ontario, Inland

North, and Virginia dialects, the allophone continues to follow the voicing of the final consonant as it undergoes morphophonological alternation: e.g. *knives\_*, *wives\_*, *lives\_* (the noun); *devíce^*, *advíce^*, *incísive^*, *strífe^*, and *díce^*; *devíse\_*, *advíse\_*, *incíse\_*, *stríve\_*, and *die\_* (n.).

### 3.2. The segmental trigger must be tautomorphemic with the /ai/

The distinction between the three kinds of morpheme boundary turns out not to make a difference in the focal Mississippi dialect. The examples in Table 2 show that when the segmental trigger is separated from the /ai/ by any of these three boundary types, the unraised /ai/ is found in all three stress environments. The unraised allophone is likewise found before the two subsyllabic suffixes *-th*, in the deadjectival noun *dryth^* (a real word, listed in the *OED* and Webster's *Second New International Dictionary*), and in Idsardi (2006)'s ordinal examples like *i-th\_*, *y-th\_*, *χ-th\_*, *π-th\_* (which are raised in Idsardi's dialect). The two *-ths* are syllabified as codas. I am unsure of the syllable affiliation in the V|Cv non-stress-neutral examples like *bítheísm\_* and *bífurcate\_*. In all other cells of Table 2, the C is syllabified as an onset.

Context	Compound	Stress-neutral affix	Non-stress-neutral affix
V C	—	[α]: dryth_, i-th_, y-th_, χ-th_, π-th_	—
V Cv	[α]: high-performance_, flý_ collèction; éye_ protèctor_	[α]: bìconvéx_, síghful_, éyesome_, tricenténnial_, bìcondítional_, disyllábic; trichromátic_, àntisterílity_	[α]: tricolòn_, bífida_, bífurcàte_, trísomy_, bítheism_
V <sup>1</sup>  CV <sup>2</sup>	[α]: éyesòre_, éyetèeth_, éyefùll_ ( <i>noun</i> ), býpass_, spýcàm_, flýpàper_, hígh schòol_, Hígh Pòint_, frý còok_, drý-pròcess_, Rýe Hòuse; trí-Stàte_, drý-clèan_, éyestràin_, flýspéck_, skýscràper_, spýpròof_, píe-plàte_	[α]: tritòne_, dípòle_, tricòlor_, íPhòne_, bífòcals_, bícýcle [ 'bɑ ,sɪkl], dísyllable; bícèps; bíplàne_, Trístàr_	—
V <sup>2</sup>  CV <sup>1</sup>	[α]: high-cóncèpt_, bì-cúrious_, hígh-fí_, spý-sóldier_ ( <i>dvandva, like singer-songwriter</i> ); hígh-prófile_	[α]: bipártisan_, biséxual_, bitémporal_, dihédral_, àntitánk_, mùltifàmily_, àntisócial_, sèmi-fictional_, àntipàrticle_, dipósitive; bìcúspid; dichlóride_, àntitrúst_, sèmitrópical_, Ántichríst_, ànticlímax_, Díprótòdon	—

Table 2. The unraised allophone is found before a heteromorphemic voiceless consonant.

### 3.3. Further stress and prosodic conditions on the segmental trigger

Not every tautomorphemic voiceless consonant triggers Diphthong Raising. In order for Raising to happen, the consonant has to satisfy at least one of Conditions (2b-i–iii).

Condition (2b-i) is that THE SEGMENTAL TRIGGER DOES NOT PRECEDE A STRESSED NUCLEUS. Word-

final voiceless consonants do not precede a stressed nucleus, and we saw in Section 3.1 that they trigger Raising in examples like *life*<sup>^</sup>, *Christ*<sup>^</sup>, *sight*<sup>^</sup>, etc. When a voiceless consonant falls between /ai/ and a tautomorphemic nucleus, the raised allophone is found if and only if the second nucleus is unstressed. For instance, the raised allophone is found in the VCv words *crisis*<sup>^</sup> and *míca*<sup>^</sup>, but not in the V<sup>1</sup>CV<sup>2</sup> words *ícòn*<sub>\_</sub> and *Báikàl*<sub>\_</sub>, nor in the V<sup>2</sup>CV<sup>1</sup> words *critérión*<sub>\_</sub> and *Tàipéi*<sub>\_</sub>. The medial C is ambisyllabic in the VCv context, as shown by the occurrence of [r]. Both [ɑ] and [aɪ] are found before [r] in this environment, depending on whether the flap is spelled <d> or <t> (e.g. *Ídle*<sub>\_</sub> vs. *Éitel*<sup>^</sup>). In the V<sup>1</sup>CV<sup>2</sup> and V<sup>2</sup>CV<sup>1</sup> contexts, the C is exclusively an onset and no flap occurs. Examples are shown in Table 3.

Context	Examples
VC	[aɪ]: <i>gripe</i> <sup>^</sup> , <i>Skype</i> <sup>^</sup> , <i>slype</i> <sup>^</sup> , <i>cripes</i> <sup>^</sup> , <i>light</i> <sup>^</sup> , <i>right</i> <sup>^</sup> , <i>site</i> <sup>^</sup> , <i>igníte</i> <sup>^</sup> , <i>tyke</i> <sup>^</sup> , <i>spike</i> <sup>^</sup> , <i>shrike</i> <sup>^</sup> , <i>knife</i> <sup>^</sup> , <i>wife</i> <sup>^</sup> , <i>rife</i> <sup>^</sup> , <i>Reith</i> <sup>^</sup> , <i>price</i> <sup>^</sup> , <i>visé</i> <sup>^</sup> , <i>rice</i> <sup>^</sup> , <i>Christ</i> <sup>^</sup> , <i>heist</i> <sup>^</sup>
VCv	[aɪ]: <i>síphon</i> <sup>^</sup> , <i>lícence</i> <sup>^</sup> , <i>crisis</i> <sup>^</sup> , <i>rífle</i> <sup>^</sup> , <i>bíson</i> <sup>^</sup> , <i>míca</i> <sup>^</sup> , <i>cýcle</i> <sup>^</sup> , <i>discíple</i> <sup>^</sup> , <i>Títan</i> <sup>^</sup> , <i>Éiffel</i> <sup>^</sup> , <i>Mícah</i> <sup>^</sup> ; <i>ícón</i> <sup>^</sup> , <i>Rípon</i> <sup>^</sup> , <i>pýthon</i> <sup>^</sup> , <i>stípend</i> ( <i>when pronounced with unstressed final syllable</i> ), <i>hýpocàust</i> <sup>^</sup> , <i>hýperspàce</i> <sup>^</sup> ; <i>títle</i> <sup>^</sup> , <i>níte</i> <sup>^</sup> , <i>Àphrodíte</i> <sup>^</sup> , <i>Títus</i> <sup>^</sup> ; <i>cýpress</i> <sup>^</sup> , <i>Cýprus</i> <sup>^</sup> , <i>méister</i> <sup>^</sup> , <i>Éisteddfòdd</i> <sup>^</sup> , <i>Lýcra</i> <sup>^</sup> , <i>pícra</i> <sup>^</sup> , <i>Díjkstra</i> <sup>^</sup> ( <i>Contrasting</i> [ɑ]: <i>brídle</i> , <i>spíder</i> , <i>cíder</i> )
V <sup>1</sup> CV <sup>2</sup>	[ɑ]: <i>lýsine</i> <sub>_</sub> , <i>Cambýsès</i> <sub>_</sub> , <i>Lýsòl</i> <sub>_</sub> , <i>Níkòn</i> <sub>_</sub> , <i>Ícàhn</i> <sub>_</sub> , <i>Mýsòre</i> <sub>_</sub> , <i>Báikàl</i> <sub>_</sub> , <i>ÍCÒR</i> <sub>_</sub> ; <i>ícòn</i> <sub>_</sub> , <i>Rípon</i> <sub>_</sub> , <i>pýthòn</i> <sub>_</sub> , <i>stípend</i> <sub>_</sub> ( <i>when pronounced with stressed final syllable</i> ); <i>Nýquíl</i> <sub>_</sub> , <i>Mýcròft</i> <sub>_</sub> , <i>Nýquist</i> <sub>_</sub> , <i>Pýkrète</i> <sub>_</sub> [ɑ]/[aɪ]: <i>cýcàd</i> <sub>_</sub> <sup>^</sup> , [aɪ]/[ɑ]: <i>Pòlynícès</i> <sub>_</sub> <sup>^</sup> , <i>mícròn</i> <sub>_</sub> <sup>^</sup>
V <sup>2</sup> CV <sup>1</sup>	[ɑ]: <i>Tàipéi</i> <sub>_</sub> , <i>Nicáea</i> <sub>_</sub> , <i>Hýpátia</i> <sub>_</sub> , <i>Lýsànder</i> <sub>_</sub> , <i>Prytánia</i> <sub>_</sub> , <i>Mýcéne</i> <sub>_</sub> [ ,mɑ' sɪni ], <i>Ticònderóga</i> <sub>_</sub> , <i>týcóon</i> <sub>_</sub> , <i>týphóon</i> <sub>_</sub> , <i>Sàipán</i> <sub>_</sub> , <i>critérión</i> <sub>_</sub> , <i>itinerary</i> <sub>_</sub> ; <i>hýpótenuse</i> <sub>_</sub> , <i>hýpónymy</i> <sub>_</sub> , <i>litótès</i> <sub>_</sub> ; <i>nýstágmus</i> <sub>_</sub> , <i>Pìcrámnia</i> <sub>_</sub>

Table 3. A tautomorphemic voiceless consonant triggers Raising unless it is followed by a stressed nucleus.

Some words have both a VCv and a V<sup>1</sup>CV<sup>2</sup> pronunciation; i.e. the post-/ai/ syllable can bear either no stress or secondary stress. In the former case /ai/ is raised, and in the latter it is not: *stipend* can be either ['staiɹnd] or ['stɑ.pɪnd]. *Python* the snake is ['paɪθən], *Python* the programming language is ['pɑ.θən], and *Monty Python* can be either. Other such examples include *icon* and *Ripon*. In these cases the stress level of the final syllable is clear from the reduced vs. full status of the nuclear vowel and from the aspiration of the intervocalic consonant. Once the prosody is fixed, Diphthong Raising applies normally; hence, these words are not exceptions to Diphthong Raising.<sup>2</sup> As in other Diphthong Raising dialects (Chambers 1973), when a stress-shifting affix moves stress within a morpheme, the /ai/ realization changes to match, e.g. *Tritón*<sup>^</sup>~*Tritónian*<sub>\_</sub>, *Títan*<sup>^</sup>~*Titánic*<sub>\_</sub>, *lícence*<sup>^</sup>~*licéntious*<sub>\_</sub>.

2 Vance (1987: Table 3) reports within- and between-speaker variation in *icon*, *python*, and *stipend* in the Inland North. Secondary stress is not indicated, so it is not clear whether the variation in /ai/ is due to variation in lexical stress.

A few  $V^1CV^2$  words have both /ai/ pronunciations without any apparent difference in stress: *cycàd* ^/, *Pòlyníces* ^/\_/, *mícròn* ^/\_/. The difference could be due to the availability of an alternative bimorphemic parse: *cyc-àd* (like *mon-ad*, *tri-ad*, *Ili-ad*, *Dunci-ad*, *jeremi-ad*), *Polyníc-ès* (like *Socrat-es*, *Pericl-es*, *Aristophan-es*), *mícr-òn* (like *electr-on*, *neutr-on*, *decathl-on*), which would move the word into the class discussed in the next section.

Condition (2b-ii) is that THE SEGMENTAL TRIGGER PRECEDES A LESS-STRESSED NUCLEUS IN THE NEXT MORPHEME. When a morphological boundary follows the segmental trigger, the raised allophone is regularly found in the VC|v and  $V^1C|V^2$  contexts. The examples in Table 4 are composed entirely of bound morphemes; free morphemes are discussed in the next section. The C in the  $V^1C|V^2$  context is an onset rather than ambisyllabic, as shown by the lack of flapping, but triggers Raising nonetheless.

Context	Compound	Stress-neutral affix	Non-stress-neutral affix
VC v	[ai]: lýcanthròpe^	[ai]: vítal^	[ai]: Èutýchian^, Hèracléitean^, Sbáikian^, spícous^
$V^1C V^2$	—	[ai]: lípàse^, cýtàse^, nítràte^	[ai]: phýtòid^, ficòid^
$V^2C V^1$	[ɑ]: lýcánthropy_	[ɑ]: vitálicity_ [ai]/[ɑ]: hýpánthium^/_	[ɑ]: litátion_ micátion_; phýtólogy_ cýtólogy_, mýcology_ psýchiátry_; risórial_ ripárial_

Table 4. A voiceless consonant at the end of a bound morpheme triggers Raising only if it is followed by a less-stressed nucleus.

Condition (2b-iii) is that IF THE SEGMENTAL TRIGGER OCCURS AT THE END OF A FREE MORPHEME, the raised allophone is regularly found regardless of the stress environment, as shown in Table 5. Words like *cítée* ^, *knífétte* ^, and *Rèichésque* ^ ( $V^2C|V^1$ ) have the same surface prosody as *Taìpéi* \_ ( $V^2CV^1$ ), but the  $V^2C+V^1$  words have the raised allophone, while the  $V^2CV^1$  words have the unraised one. *Bikeólogy* ^ and *Lightéria* ^, with the same surface prosody as *critérión* \_, have the raised allophone instead of the unraised one. In a few etymological<sup>3</sup>  $V^2C|V^1$  words — *cítátion* \_, *týpólogy* ^/\_/, and *pìpétte* ^/\_/ — the unraised allophone is found, as if they were  $V^2CV^1$  words. In all cases, whether regular or exceptional, aspiration and lack of glottalization show that the C of  $V^2C|V^1$  is syllabified as an onset. Nonetheless, an optional flap is found in some items like *Býteólogy* ^.

3 *Citation* is not historically derived from *cite* in English (*Oxford English Dictionary*, at *citation*).

Context	Compound	Stress-neutral affix	Non-stress-neutral affix
VC v	[aɪ]: wípe-away <sup>^</sup> , spíce assòrtment <sup>^</sup> ; flíght attendant <sup>^</sup> , ríght-of-way <sup>^</sup> , ríght-abóut <sup>^</sup>	[aɪ]: wíper <sup>^</sup> , díkage <sup>^</sup> , ícy <sup>^</sup> , rípen <sup>^</sup> , wífísh <sup>^</sup> , bíkeathòn <sup>^</sup> , líkeable <sup>^</sup> ; pláywríghtess <sup>^</sup> , wríter <sup>^</sup> , kníghtage <sup>^</sup> , recítal <sup>^</sup> , míghty <sup>^</sup> , níghtie <sup>^</sup> , líghted <sup>^</sup> ; Chrístathòn <sup>^</sup> , Chrístish <sup>^</sup> ([ɑ]: ríder <sub>_</sub> , glídage <sub>_</sub> , tídal <sub>_</sub> , wídísh <sub>_</sub> )	[aɪ]: àrchetýpal <sup>^</sup> , pàradísál <sup>^</sup> , Wèinrèichian; recítal <sup>^</sup> , Wàinwríghtian <sup>^</sup> , pýrítous <sup>^</sup> , àconítal <sup>^</sup> ; mítral <sup>^</sup> ; wrítative <sup>^</sup>
V <sup>1</sup> C V <sup>2</sup>	[aɪ]: knífe-èdge <sup>^</sup> , pípe-òrgan; whíteòut <sup>^</sup> , níght-òwl <sup>^</sup> , Bríghtèyes <sup>^</sup> , líght-àrmed <sup>^</sup>	—	[aɪ]: àmanítine <sup>^</sup> , àconítine <sup>^</sup> , àmmonítòid <sup>^</sup> , sàtèllítòid
V <sup>2</sup> C V <sup>1</sup>	[aɪ]: více-ádmíraltý <sup>^</sup> ; Bakùníníte-Óweníte <sup>^^</sup>	—	[aɪ]: cítée <sup>^</sup> , invitée <sup>^</sup> , índictée <sup>^</sup> , knífée <sup>^</sup> , knífétte <sup>^</sup> , wrítátion <sup>^</sup> , Spíkétte <sup>^</sup> , strípátion <sup>^</sup> , Spicétte <sup>^</sup> , Rèichésque <sup>^</sup> , Bíkéólogy <sup>^</sup> , Hittítology; Býtéria <sup>^</sup> , Líghtéria ( <i>both with unflapped t</i> ); Sprítéttes <sup>^</sup> , Wríghtésque <sup>^</sup> , Býteólogy <sup>^</sup> , Fíghtólogy, líghtáality ( <i>all with optionally flapped t</i> ); Bíkéógraphy <sup>^</sup> , býteógraphy; Chrístésque <sup>^</sup> , Chrístólogy [aɪ]/[ɑ]: pípétte <sup>^</sup> / <sub>_</sub> , týpólogy <sup>^</sup> / <sub>_</sub> [ɑ]: cítátion <sub>_</sub>

Table 5. A voiceless consonant at the end of a free morpheme triggers Raising regardless of morphological or prosodic environment.

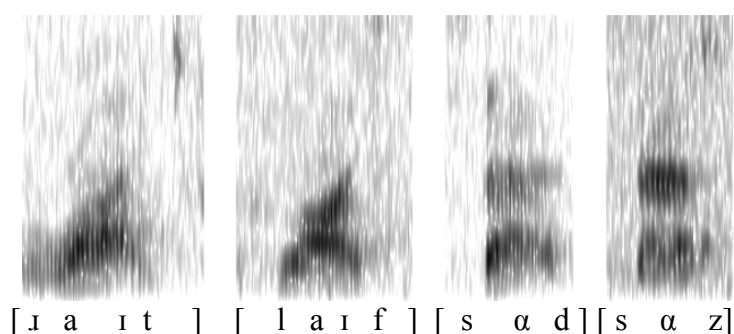
#### 4. Recorded pronunciations (RLM, AM, LAGS-592, LAGS-546)

To check the typicality of the author's judgements, and the stability of the pattern across time, the recordings of the four speakers were searched to find a set of words that exemplified relevant

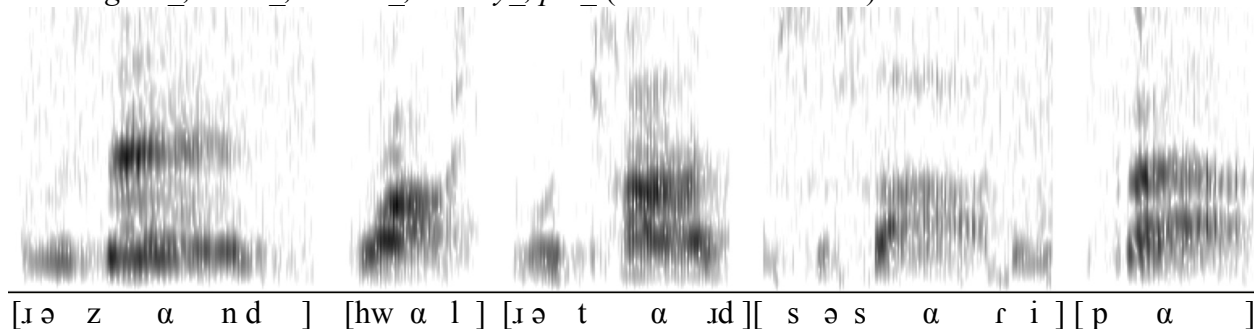
environments, and were as similar as possible across the speakers. For many of the relevant environments, no tokens could be found; e.g. no speaker produced VC+v words like *pàradisal*<sup>^</sup>. The tokens were extracted, listened to, and transcribed by EM. In the great majority of cases, each token could be unambiguously classified as [α] or [aɪ]. A few tokens had intermediate offglides, which are transcribed here as [æ]. Examples are shown in (6) and (7) in the form of spectrograms made with Praat (Boersma & Weenink 2016) using an 0.005-ms Gaussian window.

(6) Spectrograms illustrating the alternation in word-final stressed syllables. Speaker is RLM.

a. *Right*<sup>^</sup>, *life*<sup>^</sup>, *side*<sub>-</sub>, *size*<sub>-</sub> (2500 ms x 4000 Hz)



b. *Resigned*<sub>-</sub>, *while*<sub>-</sub>, *retired*<sub>-</sub>, *society*<sub>-</sub>, *pie*<sub>-</sub> (4000 ms x 4000 Hz).



(7) *Crisis*<sup>^</sup> and *Lycéum*<sub>-</sub> pronounced by RLM and by AM (3200 ms x 4000 Hz).

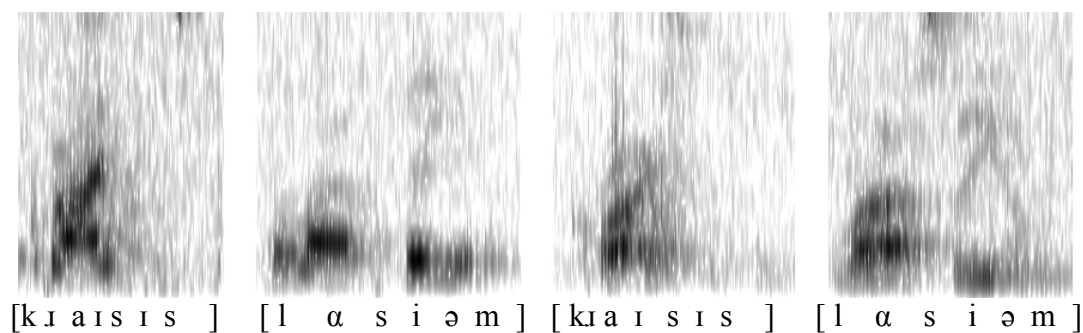


Table 6 shows the parallel examples from the four recorded speakers. Where comparable data

exists, the four recorded speakers agree with each other, and with the EM judgements, except in the following cases: In the non-raising environment, LAGS-546 sometimes produces a diphthong with a low onset and a non-high offglide, here transcribed as [æɛ] and illustrated in (8). This diphthong occurs in about half of the word-final cases, and is also found in some final voiced-obstruent cases as well. LAGS-546 also produces a monophthongal [ɑ] in one of five tokens of *right*. LAGS-592 has [æɛ] in one of the two tokens of *knife* in her data. Aside from those instances, all five speakers are in agreement.

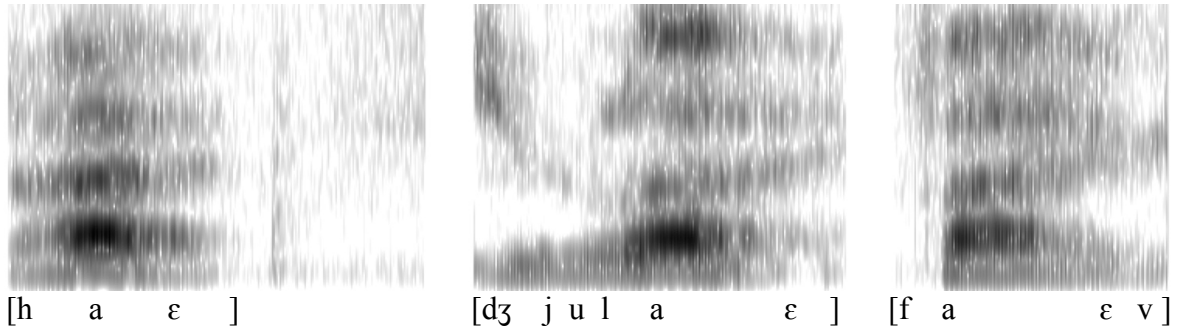
The data suffices to confirm that the the phonetic identity of the vocoids, and the set of segmental triggers, remained stable across seven decades. The opaque interaction with flapping is also confirmed, as is the effect of stress in the tautomorphic context. One datum, LAGS-592's unraised *tricycle*, corroborates EM's judgement that raising does not occur in the V<sup>1</sup>C#V<sup>2</sup> context. However, the contexts which put morphological structure in conflict with stress did not occur in any of these multi-hour samples, which shows that they are rare relative to the other contexts.



	RLM	AM	LAGS-592	LAGS-546
_#	pie     α try     α	pie     α	pie     α spry    α	high    α, æ July    æ
_[vowel]	society α prior   α	society α science α	íodine α fire    α [fæ]	scientist α
_[voiced obstruent]#	five    α side    α surprise α	side    α réalize α [ɹɪləz]	five    α side    α size    α	five    α, æ side    α, æ réalize α [ɹiələz]
_[nasal]#	time    α, ε nine    α	time    α nine    α	time    α nine    α	time    α nine    α
_[l](C)#	while   α (n.)	while   α (n.) files	while(n. α )       α mile	style    α miles   α
_[ɹ](C)#	iron    α [ɑɹn] fire    α [fɑɹ]	—	iron    α [ɑɹn] andiron α [ɑɹnz] s	iron    α [ɑɹn]
_[voiceless]#	stripe  aɪ right   aɪ twice   aɪ	right   aɪ	striped aɪ bite    aɪ slice   aɪ	gripe   aɪ right   aɪ, α Price   aɪ
Nasal + voiceless	nínètèen aɪ	—	nínètèen aɪ nìnetéen aɪ ninth    aɪ	nínètèen aɪ pint     aɪ
Morphophonemic alternation	life     aɪ lives    α	—	knife    aɪ, æ knives   α	life     aɪ lives    α
VCv	crísis  aɪ lícense aɪ	crísis  aɪ	—	cýpress aɪ
V <sup>1</sup> C#V <sup>2</sup>	—	—	trícycle α	—
V <sup>2</sup> CV <sup>1</sup>	Lýcéum α	Lýcéum α	—	—
/t/ in VCv	nigh <u>t</u> of   naɪrəv	indícted   ɪndaɪrɪd	lígh <u>t</u> ere   laɪrə-d d	wríter     ɹaɪrə mígh <u>t</u> y     maɪrɪ
Has flapping?	<i>yes</i>	<i>yes</i>	<i>yes</i>	<i>yes</i>
/au/ alternates too?	<i>no</i>	<i>no</i>	<i>no</i>	<i>no</i>

Table 6. Examples illustrating the regular application of Diphthong Raising across four speakers. All words are monosyllabic unless stress is indicated.

(8) Tokens of *high*, *July*, and *five* pronounced by LAGS-546, illustrating [aε].



### 5. Formal analysis of the regular pattern

The regular, productive pattern in this dialect is restated as (2'), and illustrated with examples in (14).

- (2') /ai/ is raised if and only if it is immediately followed by a voiceless consonant or cluster which
- (a) is tautomorphic with /ai/ and of which
  - (b) at least one of the following is true:
    - (i) it does not precede a stressed nucleus, or
    - (ii) it precedes a less-stressed nucleus in the next morpheme, or
    - (iii) it ends a free morpheme

	Base is free	All morphemes are bound
Tautomorphemic		
VC	<b>life</b> <sup>^</sup> , <b>Christ</b> <sup>^</sup> (2a, b-i)	<b>metábolite</b> <sup>^</sup> (2a, b-i)
VCv	<b>cípher</b> <sup>^</sup> , <b>lícence</b> <sup>^</sup> , <b>cýpress</b> <sup>^</sup> (2a, b-i)	<b>hýpocàust</b> <sup>^</sup> (2a, b-i)
V <sup>1</sup> CV <sup>2</sup>	ícòn_, Báikàl_, Nýquìl_ (2a)	—
V <sup>2</sup> CV <sup>1</sup>	týphóon_, Tàipéi_, nýstágmus_, licéntious_ (2a)	itínèrày_, crítèrion_ (2a)
VC v	<b>wíper</b> <sup>^</sup> , <b>àrchetýpal</b> <sup>^</sup> , <b>míttral</b> <sup>^</sup> (2a, b- <i>Èutýchian</i> <sup>^</sup> , <b>spícous</b> <sup>^</sup> (2a, b-i) <i>i</i> )	
V <sup>1</sup> C V <sup>2</sup>	<b>àconítine</b> <sup>^</sup> , <b>àmanítine</b> <sup>^</sup> (2a, b-ii)	<b>lípàse</b> <sup>^</sup> , <b>nítràte</b> <sup>^</sup> (2a, b-ii)
V <sup>2</sup> C V <sup>1</sup>	<b>Hittitology</b> <sup>^</sup> , <b>strìpátion</b> <sup>^</sup> , <b>Christésque</b> <sup>^</sup> (2a, b-iii)	cýtólogy_, litátion_, risórial_ (2a)
Heteromorphemic		
V C	dryth_, <i>i</i> -th_	—
V Cv	síghful_, trícòlòn_	bífurcàte_, trísomy_
V <sup>1</sup>  CV <sup>2</sup>	trítone_, bíplàne_	bícèps_, díplèx_
V <sup>2</sup>  CV <sup>1</sup>	bisèxual_, dìchlóride__	bicúspid_, Dìprótodòn_

Table 7. Effects of morphology and stress on /ai/ preceding a singleton voiceless consonant (EM judgements). Bold = raised, roman = unraised.

Following Paradis (1980), we begin by assuming that the critical prosodic condition for Diphthong Raising is that the voiceless consonant be a syllabic coda to the /ai/, either exclusively or ambisyllabically. (This assumption is supported by intuitions and objective diagnostics such as aspiration, except in the cases to be discussed in the next section.) There are several proposals as to the constraints that choose the appropriate allophone once the prosody is given (Myers 1997, Moreton 1999, Bermúdez-Otero 2003, Hayes 2004, Pater 2014); here we discuss instead the problem of getting the right syllabification. We assume the constraints in (9):

(9)

(a) NoCODA: “No syllable has a coda.” Assign one violation mark for every syllable which has a coda. (After Prince & Smolensky 1993/2004.).

(b) COINCIDE (C, stressed syllable): “Every consonant must belong to a stressed syllable.” Assign one violation mark for every surface consonant which is not syllabified into a stressed syllable. (After Zoll 1996, 1998, 2004.) Abbreviated as C/stress.

(c) COINCIDE (C, main-stressed syllable): “Every consonant must belong to a main-stressed syllable.” Assign one violation mark for every surface consonant which is not syllabified into a main-stressed syllable. (After Zoll 1996, 1998, 2004.) Abbreviated as C/main.

(d) ALIGN (morpheme, R, syllable, R): “The right edge of every morpheme should be aligned

with the right edge of some syllable.” Assign one violation mark for every surface segment which is immediately followed by a heteromorphemic segment in the same syllable. (After McCarthy & Prince 1993, McCarthy 2003.) Abbreviated as ALIGN-R.

NOCODA makes rightward syllabification of an intervocalic consonant into the default. Diphthong Raising occurs when the other constraints, singly or in combination, overpower NOCODA and put a voiceless consonant into the coda (i.e. making the consonant either an exclusive coda, or ambisyllabic). The constraints act additively, as we will see; hence, this analysis is couched in the framework of Harmonic Grammar (Legendre, Miyata, & Smolensky 1990; for a recent review, see Pater to appear). The basic cases — tautomorphemic VCv, V<sup>1</sup>CV<sup>2</sup>, V<sup>2</sup>CV<sup>1</sup>, and their heteromorphemic counterparts VC|v, V<sup>1</sup>C|V<sup>2</sup>, and bound-stem V<sup>2</sup>C|V<sup>1</sup> — will be dealt with briefly before we turn to the complications presented by free-stem words like *Fightology*<sup>^</sup>.

The role of the two COINCIDE constraints is to explain how come the medial C is syllabified as a coda when the stress of the preceding nucleus (the /ai/) is greater than that of the following nucleus. In both tautomorphemic VCv cases like *síphon*<sup>^</sup> and heteromorphemic VC|v cases like *spíc|ous*<sup>^</sup>, the medial C syllabifies as a coda to the stressed syllable in order to avoid belonging exclusively to the unstressed one. Hence  $w(C/\text{stress})$ , the weight of the C/stress constraint, exceeds  $w(\text{NOCODA})$ . In tautomorphemic V<sup>1</sup>CV<sup>2</sup> *ícòn*<sub>-</sub>, the main-stressed initial syllable does not attract the medial consonant into coda position, because C/stress can be satisfied by syllabifying the C as an onset to the final (secondary-stressed) syllable. But in heteromorphemic V<sup>1</sup>C|V<sup>2</sup> *líp|àse*<sup>^</sup>, the medial C is syllabified as a coda. Thus C/main is too weak to overcome NOCODA by itself, but can do so when assisted by ALIGN-R:  $w(\text{NOCODA}) > w(C/\text{main})$ , but  $w(C/\text{main}) + w(\text{ALIGN-R}) > w(\text{NOCODA})$ . However, ALIGN-R by itself is not sufficient to overcome NOCODA, since the medial C is an onset, not a coda, in heteromorphemic V<sup>2</sup>C|V<sup>1</sup> *cýt|ólogy*<sub>-</sub>; thus,  $w(\text{NOCODA}) > w(\text{ALIGN-R})$ . A set of weights satisfying these criteria is shown in the summary tableau in (10).

(10)

		C/stress	NoCODA	ALIGN-R	C/main	H
		7	6	5	3	
a. <i>síphon</i> <sup>^</sup>	→ VC.v		-1			-6
	V.Cv	-1			-1	-10
b. <i>spíc ous</i> <sup>^</sup>	→ VC .v		-1			-6
	V.C v	-1		-1	-1	-15
c. <i>ícòn</i> <sub>-</sub>	V <sup>1</sup> C.V <sup>2</sup>		-1			-6
	→ V <sup>1</sup> .CV <sup>2</sup>				-1	-3
d. <i>líp áse</i> <sup>^</sup>	→ V <sup>1</sup> C .V <sup>2</sup>		-1			-6
	V <sup>1</sup> .C V <sup>2</sup>			-1	-1	-8
e. <i>týphóon</i> <sub>-</sub>	V <sup>2</sup> C.V <sup>1</sup>		-1		-1	-9
	→ V <sup>2</sup> .CV <sup>1</sup>					0
f. <i>cýt ólogy</i> <sub>-</sub>	V <sup>2</sup> C .V <sup>1</sup>		-1		-1	-9
	→ V <sup>2</sup> .C V <sup>1</sup>			-1		-5

In Examples (16a) and (16b), the generic stressed /ai/ is coincidentally the main-stressed syllable, but that is not crucial to the analysis, since the correct candidate's margin of victory exceeds the contribution of C/main. The same constraints and weights also account for the cases in which a morpheme boundary precedes the potential segmental trigger. In those cases, as shown in (11), ALIGN-R and NoCODA combine to make the medial consonant syllabify as an onset, against the opposition of the COINCIDE constraints.

(11)

		C/stress	NoCODA	ALIGN-R	C/main	H
		7	6	5	3	
a. <i>síphon</i> <sup>^</sup>	→ VC.v		-1			-6
	V.Cv	-1			-1	-10
b. <i>sigh ful</i> <sub>-</sub>	V Cv		-1	-1		-11
	→ V .Cv	-1			-1	-10

If the final sound of *dryth*<sub>-</sub> and *i-th*<sub>-</sub> is analyzed as an appendix to the prosodic word, outside the syllable, then the same analysis extends to the two subsyllabic *-th* affixes: In *dryth*<sub>-</sub>, ALIGN-R and NoCODA combine to force the *-th* suffix into the appendix, whereas in *life*<sup>^</sup>, NoCODA alone is not strong enough on its own to overcome the opposition of the COINCIDE constraints (or even of C/stress). This is shown in (12).

(12)

		C/stress	NoCODA	ALIGN-R	C/main	H
		7	6	5	3	
a.	<i>life</i> <sup>^</sup>	→ VC	-1			-6
		V.C	-1		-1	-10
b.	<i>dry th</i> <sub>-</sub>	V C	-1	-1		-11
		→ V .C	-1		-1	-10

This analysis does not distinguish between free and bound bases, and hence incorrectly predicts no difference between *Fightólogy*<sup>^</sup> and *cýtólogy*<sub>-</sub>. The weighted constraints correctly syllabify the two words alike, as shown in (13a, b); however, in *Fightólogy*<sup>^</sup>, the /ai/ allophone does not match the surface syllabification.

(13)

		C/stress	NoCODA	ALIGN-R	C/main	H
		7	6	5	3	
a.	<i>cýt ólogy</i> <sub>-</sub>	V <sup>2</sup> C .V <sup>1</sup>	-1		-1	-9
		→ V <sup>2</sup> .C V <sup>1</sup>		-1		-5
b.	<i>Fìght ólogy</i> <sup>^</sup>	V <sup>2</sup> C .V <sup>1</sup>	-1		-1	-9
		→ V <sup>2</sup> .C V <sup>1</sup>		-1		-5
c.	<i>Tìtán ic</i> <sub>-</sub>	V <sup>2</sup> C.V <sup>1</sup>	-1		-1	-9
		→ V <sup>2</sup> .CV <sup>1</sup>				0

This difference between *Fightólogy*<sup>^</sup> and *cýtólogy*<sub>-</sub> cannot be captured by any mechanism whose effect is to preserve intact the entire surface form of the free base in the affixed form, because only base-final /ai/C sequences are protected. The free base *Tìtan*<sup>^</sup> is raised like the free base *Fìght*<sup>^</sup>, but the suffixed form *Tìtánic*<sub>-</sub>, though prosodically parallel to *Fìghtólogy*<sup>^</sup>, is not raised (19 b, c). For example, an Output-Output Faithfulness constraint (Benua 1995, 1997) enforcing identical vowel height in a free base and its affixed form would correctly compel *Fìghtólogy*<sup>^</sup> to faithfully copy the raised /ai/ of *Fìght*<sup>^</sup>, while *cýtólogy*<sub>-</sub> would be exempt due to lack of a free base to be faithful to. However, the same constraint would copy the raised /ai/ of *Tìtan*<sup>^</sup> to yield \**Tìtánic*<sup>^</sup>.

The same difficulty would afflict an account based on cyclic rule application. The problem again is that *Fìghtólogy*<sup>^</sup> and *Tìtánic*<sub>-</sub> have the same underlying morphological structure, a free root plus a Level 1 suffix, and the same surface prosodic structure, V<sup>2</sup>CV<sup>1</sup>. Starting from non-raised underlying representations, the first cycle would assign stress and syllabification and raise the /ai/ in both roots, yielding [[*Fìght*<sup>^</sup>]*ology*] and [[*Tìtan*<sup>^</sup>]*ic*]. The second cycle would correctly alter the stress and syllabification, but by then it would be too late; the diphthong in both words

would already be raised, predicting *Fightology*<sup>^</sup> and \**Titánic*<sup>^</sup>. Even if we were to hypothesize an additional rule of Diphthong Lowering, whose function was to lower raised /ai/ in the elsewhere environment, the resulting model would again fail by treating both words alike, this time predicting \**Fightology*<sub>-</sub> and *Titánic*<sub>-</sub>. An example derivation, based on the discussion of *titanic* in connection with Philadelphia æ-Tensing by Kiparsky (1988:401), is shown in (14).<sup>1</sup>

(14)

	Input	<i>cytology</i> /sət-alədʒi/	<i>Fightology</i> /fət-alədʒi/	<i>Titanic</i> /tætæn-ɪk/
Cycle 1	Syllabification and stress	/  / V  /  [,sə'talədʒi]	/  [['fət]alədʒi]	/  /  [['tætæn]ɪk]
	Diphthong Raising	—	/  [['fæt]alədʒi]	/  /  [['tætæn]ɪk]
Cycle 2	Syllabification and stress	—	/  / V  /  [,fæt'alədʒi]	/  /  /  [,tæt'tæɪk]
	Diphthong Raising	—	—	—
	Output	/  / V  /  ,sə'talədʒi	/  / V  /  ,fæt'talədʒi	/  /  /  *,tæt'tæɪk

A combination of Output-Output faithfulness (Benua 1995, 1997) with Positional Faithfulness (Beckman 1997) offers a solution. There is independent evidence that features in final syllables are phonologically privileged, i.e. they resist synchronic changes that affect the same features elsewhere (Barnes 2002, Walker 2005, Kaplan 2015), and Walker (2005) has proposed Input-Output faithfulness to vowel height in final syllables in order to explain metaphony in Italian dialects. The theory of Output-Output faithfulness predicts the existence of an Output-Output version of the same constraint, relativized to Level 1 affixes (see Benua 1997, Chapter 5) and stated in (15). A large weight on OO<sub>1</sub>-IDENT ([high], final-σ) will cause the /ai/ allophone in *Fightology*<sup>^</sup> to copy the height of /ai/ in *Fight*<sup>^</sup>, in spite of the lack of a voiceless coda. It will have no effect on *cytology*<sub>-</sub>, because there is no output (no free base) to be faithful to. Finally, it will also have no effect on *Titánic*, because the relevant /ai/ is not in the final syllable of the base *Títan*.

(15) OO<sub>1</sub>-IDENT ([high], final-σ): “Preserve vowel height of the final syllable.” Give one violation mark to an affixed candidate for each segment which OO-corresponds to the vowel of the final syllable of the base, but differs from it in height.

1 It is possible that although the *-ology* of *cytology*<sub>-</sub> is a Level 1 suffix, attaching to bound roots and affecting word stress, the *-ology* of *Fightology*<sup>^</sup> and *Hittiteology*<sup>^</sup> has some other status *X* — a Level 2 suffix, an element of a compound, part of a lexical blend, etc. In order for this possibility to serve as the basis for an alternative analysis, we would have to ascribe the same dual nature to *-ation* (of *stripation*<sup>^</sup>), *-ality* (of *lightality*<sup>^</sup>), *-ee* (of *invitée*<sup>^</sup>), etc., but not to *-ic*. Suppose we did so. That would not solve the current problem, that Diphthong Raising applies too early to *Titánic*<sub>-</sub>. Whatever *X* may turn out to be, it can only change the analysis by delaying the application of Diphthong Raising to *Fightology*<sup>^</sup> (since, in the current analysis, Diphthong Raising applies to *Fightology*<sup>^</sup> on the very first cycle) — and doing so would either leave the output unchanged, or derive \**Fightology*<sub>-</sub>.

This analysis, while serviceable, does not explain why OO<sub>1</sub>-IDENT ([high], final-σ) would have such a high weight. A learner could infer the weights of the syllabification constraints in (10)–(13) — not necessarily those exact weights, but weights that would achieve the same effect — by observing the syllabification of common words, including words which have no /ai/ in them at all. In contrast, opportunities to learn the high weight of OO<sub>1</sub>-IDENT ([high], final-σ) are few and far between, being dependent mainly on the infrequent *invítee* and novelties like *Fíghtólogy*. Since initial syllables are cross-linguistically a “strong” position (Beckman 1998), there is just as much theoretical reason to posit OO<sub>1</sub>-IDENT ([high], initial-σ) as OO<sub>1</sub>-IDENT ([high], final-σ). Why should the former be too weak to do to *Títánic* what the latter is strong enough to do to *Hítítólogy*? One suspects that a more interesting explanation awaits discovery.

## 6. Exceptions and apparent exceptions

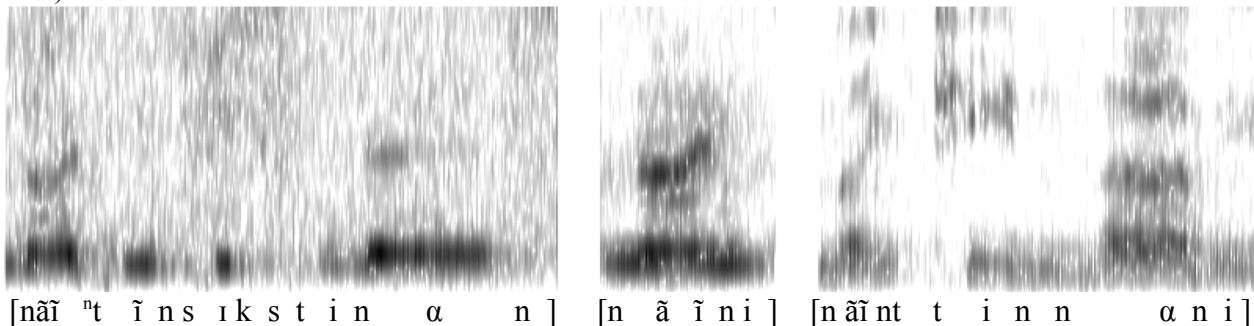
Raising in the focal Mississippi dialect, at least as spoken by EM, is regular and productive. There are many apparent exceptions which can be reanalyzed as regular application to an underlying representation other than the one suggested by orthography or etymology. There is also a small residue of outright exceptions.

### 6.1. Apparent exceptions

When an underlying nasal-plus-voiceless-stop cluster is syllabified as a coda, speakers may realize the nasal phonetically not as an independent consonant like in *pine*, but as nasalization on the vowel (Malécot 1960, Cohn 1993), and may interpret the cluster phonologically as a sequence of a nasalized vowel followed by a voiceless stop, as shown by naïve spellings (Treiman, Zukowski, & Richmond-Welty 1995). This explains the apparent exception that [aɪ] occurs in *pínt*<sup>^</sup>, *tèe-nínecy*<sup>^</sup> ([tinãɪtsi] 'very small'), *nínth*<sup>^</sup>, *nínètèn(th)*<sup>^</sup>/*nínètéen(th)*<sup>^</sup>, *Reínce*<sup>^</sup>, and in *Mainz*<sup>^</sup> and *Heinz*<sup>^</sup> if the orthographic <z> is pronounced with its German value of [ts]. Since the actual consonant following the vowel is voiceless, [aɪ] is in fact the regularly expected allophone: *pínt*<sup>^</sup> is [pãɪt] or [pãɪʔ]; *níneteen*<sup>^</sup> is [nãɪt.tɪn] or [nãɪʔ.tɪn] (RLM, LAGS-592, LAGS-546, EM; no data for AM). Examples are shown in (15): *Níneteen*<sup>^</sup> has the raised allophone, while *níné*<sub>-</sub> has the unraised one. However, in *nínety*, RLM and LAGS-592 have [aɪ], while EM has [α]. Neither pronunciation is unambiguously an exception to Diphthong Raising, as they are the expected outputs for the underlying representations /'nãɪti/ and /'nãɪni/, respectively. Variable raising in *pínt* has been reported in the Inland North by Dailey-O'Cain (1997). In Ontario, *pínt* is variously reported as raised (Idsardi 2006) or unraised (Chambers 2006), while *nínth* and *níneteen* were found to be raised by K. C. Hall (2005).



(15) *Nineteen*<sup>^</sup> *sixty-nine*<sub>-</sub> (RLM); *ninety*<sup>^</sup> (RLM); *nineteen*<sup>^</sup>-*ninety*<sub>-</sub> (EM). (3000 ms x 4000 Hz.)



As noted in the discussion of the V<sup>2</sup>C|V<sup>1</sup> structure above, familiar words, like *citation*<sub>-</sub> and *pipette*<sup>^</sup>/<sub>-</sub>, may have unraised /ai/ as if they were monomorphemic V<sup>2</sup>CV<sup>1</sup> words, whereas less-familiar words like *indictée*<sup>^</sup> or *Fightology*<sup>^</sup> have the raised /ai/ of their familiar free roots *indict*<sup>^</sup> and *fight*<sup>^</sup>. The same thing happens with the two subsyllabic suffixes *-th*. The regular pattern of no raising before a morpheme boundary is obeyed in the unfamiliar deadjectival noun *dryth*, and in ordinal examples like *i-th*, *y-th*, *χ-th*, *π-th*, but the familiar *ninth*<sup>^</sup> has a raised /ai/ as if it were monomorphemic like *pint*. Idsardi (2006) describes the same phenomenon in an Ontario dialect.

*Tidy*<sub>-</sub>/<sup>^</sup> can be either [tɑri] or [tɑri] (EM). As with *ninety*, the variation can be accounted for as fluctuation between two underlying representations, /tati/ and /tadi/. Vance (1987) reports variable pronunciations for *colitis*, *neuritis*, *cider*, *idle*, *spider*, all of which are open to the same analysis as *tidy*. Shewmake (1925:492) reports unraised *spider* in Eastern Virginia, confirmed by Tresidder (1947:95). In the focal Mississippi dialect, *spider* is also unraised (EM judgements; LAGS-592's three tokens of *spiderweb*).

## 6.2. Genuine exceptions

A small residue of genuine exceptions remains that cannot be derived by Diphthong Raising from any underlying representation. Specifically, /g/ has the same raising effect as a voiceless consonant in words which begin with /taɡ/ followed by a rhotic. Thus we have unexpected VCv *tiger*<sup>^</sup>, *tigress*<sup>^</sup>, *Tigris*<sup>^</sup> and V<sup>1</sup>C|V<sup>2</sup> *tigròid*<sup>^</sup>, but regular V<sup>2</sup>C|V<sup>1</sup> *tigrólýsis*<sub>-</sub>. The exceptional behavior is confined to the environment /#t\_ɡɹ/: *Géiger*<sub>-</sub>, *Néiger*<sub>-</sub>, *Éigles*<sub>-</sub>, *Kutrigur*<sub>-</sub>, *migrant*<sub>-</sub> are all unraised. Even *Stéiger*<sub>-</sub>, where /ai/ occurs in the same immediate environment as in *tiger*<sup>^</sup>, is unraised. *Táiga*<sub>-</sub>/<sup>^</sup> can be pronounced with either diphthong (EM).

In a handful of words that have a consistent VCv stress pattern, an unraised pronunciation is nonetheless possible in the focal Mississippi dialect: *diaper*<sup>^</sup>/<sub>-</sub> is ['daɪpə] or ['dapə], *Ísis*<sup>^</sup>/<sub>-</sub> is ['aɪsɪs] or ['ásɪs]; likewise *Dýson*<sup>^</sup>/<sub>-</sub>, *Týson*<sup>^</sup>/<sub>-</sub>, *Dréyfus*<sub>-</sub>/<sup>^</sup>. Each of the last three may be explained by free variation between a mono- and a dimorphemic parse, but not *diaper*<sup>^</sup>/<sub>-</sub> and *Ísis*<sup>^</sup>/<sub>-</sub>.

## 7. Comparison with other English Diphthong Raising dialects

### 7.1. Segmental triggers and affected vocoids

In the focal Mississippi dialect, the segments which condition Diphthong Raising are the underlyingly voiceless consonants, including flapped /t/. Only /ai/ is affected, alternating between [ɑ] and [aɪ]. Ample data is available about triggering vs. non-triggering segments in the other focal dialects. The focal Virginia dialect is described as having the same segmental triggers, although no examples are given for /r/ (Shewmake 1925, 1943, 1945). In that dialect, /au/ and /ai/ both alternate ([aɪ]~[Λɪ] and [aʊ]~[Λʊ]). Shewmake gives *niter*<sup>VA</sup> and *vital*<sup>VA</sup> alongside *cipher*<sup>VA</sup> and *viper*<sup>VA</sup> as instances of the raised diphthong in a voiceless environment, suggesting that /t/ in the VCv environment was not flapped in East Virginia at that time. Independent corroboration for this conclusion comes from an 1881 description of American English by James Mercer Garnett, who was born in 1840 in Virginia, and was on the University of Virginia faculty at the time of writing. He notes both the Diphthong Raising and the lack of Flapping:

The common narrowing and shortening of the diphthongal sounds *i*, *ei* (*ai*), and *ou* (*au*), as in *mite*, *night*, *sleight*, and *house*, *mouse*, *grouse*, is not noticed by Storm, nor, I believe, by Sweet, as perhaps it does not prevail in England, but being so common in this country, phonetists should make note of it.... [Footnote:] In Storm's symbols it would be, I suppose, *mait* and *māus*, not *mait*, *maus*; *writer* = *rāitə* and *rider* = *rai'də* show the distinction, also *house* = *hāus* and *hound* = *haund*. (Garnett 1881:489).

Shewmake's generalization therefore holds without qualification in the focal Virginia dialect: The raised diphthongs are only found before sounds that are voiceless.<sup>1</sup>

As described by Chambers (1973, 1989, 2006), Diphthong Raising in the focal Ontario dialect is likewise triggered by underlyingly voiceless consonants, including flapped /t/, and affects both /ai/ and /au/ ([aɪ]~[Λɪ] and [aʊ]~[Λʊ]). It is thus nearly identical in these respects to the focal Virginia dialect, except that the Ontario dialect has Flapping. In the focal Inland North dialects described by Vance (1987) and Dailey-O'Cain (1997), only /ai/ alternates regularly ([aɪ]~[Λɪ]). The set of segmental triggers consists of underlyingly voiced consonants (including flapped /t/) plus /ɹ/ and /ə/ (Vance 1987:200–201). This pre-rhotic raising is unambiguously a foot-based rather than a syllable-based process (see Section 9 below), since raising occurs before both VCv /ɹ/ (*iris*<sup>^</sup>, *irony*<sup>^</sup>) and unstressed syllabic /ə/ (*iron*<sup>^</sup>, *ire*<sup>^</sup>), and but not in V<sup>2</sup>CV<sup>1</sup> (*irónic*\_) or V<sup>2</sup>C|V<sup>1</sup> (*iráte*) contexts.

### 7.2. Effect of stress and morphology

Judgements of the full matrix of stress environments crossed with morphological environments, as in Section 3, is not available for the other focal dialects. Only a subset of cells can be compared, and non-primary stress is sometimes not available.

<sup>1</sup> Primer (1890) likewise transcribes Eastern Virginian (Fredericksburg) *kettle* as “[kitl] or [ketl]”, with a voiceless [t]. Twenty years after Shewmake, the Tidewater Virginia subgroup of the college students studied by Tresidder (1943) had very frequent voicing of /t/ in the Flapping environment.

The focal Mississippi pattern is indistinguishable from the focal Virginia one with respect to the effects of stress and morphology, but that may be due only to lack of relevant data. Shewmake's description runs as follows:

In typical Eastern Virginia speech, diphthongal i is given the dialectal sound represented by [ɔi]<sup>2</sup> under two conditions: (1) when the diphthong is immediately followed in the same syllable by the sound of a voiceless consonant; and (2) when the diphthong occurs at the end of a syllable which is immediately followed in the same word by an unaccented syllable beginning with the sound of a voiceless consonant and containing an obscurely pronounced vowel. Under all other conditions standard i is employed. (Shewmake 1925:491).

Stress is not transcribed, but if standard dictionary stress is assumed, the examples given (1925:491–2; 1945) are consistent with the description: VCv *cipher*<sup>^</sup>, *hyphen*<sup>^</sup>, *hypodermic*<sup>^</sup>, *license*<sup>^</sup>, *rifle*<sup>^</sup>, *stifle*<sup>^</sup>, *viper*<sup>^</sup>, *niter*<sup>^</sup>, and *nitrogen*<sup>^</sup> are raised, V<sup>1</sup>CV<sup>2</sup> *typhoid*<sub>^</sub> is not, nor are V<sup>2</sup>CV<sup>1</sup> *Hyperion*<sub>^</sub>, *nitrogenous*<sub>^</sub>, *licentious*<sub>^</sub>, *licentiate*<sub>^</sub>, *citation*<sub>^</sub>, and *vitality*<sub>^</sub>. The implication is that morphological structure is irrelevant, but supporting examples (like *Tàipéi* vs. *knífée*) are lacking.<sup>3</sup> *Citation*<sub>^</sub> is unraised, but it could be exceptional in focal Virginia as in focal Mississippi. Shewmake notes *nitràte*<sup>^</sup> as exceptionally raised, and suggests that “the presence of *r* before *a* leaves the voiceless *t* free to influence *i*” (1925:491, fn. 6); however, *nitràte*<sup>^</sup> is regular with respect to (4). Since all of Shewmake's actual examples behave exactly the same way in both dialects, it is possible that (4) applies to the focal Virginia dialect as well.

In the focal Ontario dialect, Chambers (1973) and Paradis (1980) agree that Raising occurs in the V<sup>1</sup>CV<sup>2</sup> context, unlike in the focal Mississippi dialect; i.e. word-internally, /ai/ is raised if and only if it is followed by a voiceless consonant that precedes a less-stressed nucleus. The evidence that Raising occurs in the V<sup>1</sup>CV<sup>2</sup> context consists of *icòn*<sup>^</sup>, *psýchò*<sup>^</sup>, *Psýchè*<sup>^</sup>, all described as having secondary stress on the final syllable, and *microbe*<sup>^</sup>, *nítrate*<sup>^</sup>, and *nítro(glycerine)*<sup>^</sup>, described as having tertiary stress on the final syllable (Chambers 1973:126–127). In focal Mississippi. *icòn*<sub>^</sub> is V<sup>1</sup>CV<sup>2</sup> and unraised; *nítrate*<sup>^</sup> and *mícròbe*<sup>^</sup> are raised; *psycho*<sup>^</sup>, *Psyche*<sup>^</sup>, and *nitro*<sup>^</sup> are raised, but their final-syllable stress is uncertain (see Section 3.2 above). Thus *icòn* is the only datum distinguishing the two dialects. Chambers (1989:79–80) attributes to stress the apparent blocking effect of morphology in the V<sup>1</sup>#CV<sup>2</sup> and V<sup>2</sup>#CV<sup>1</sup> contexts (*bifòcals*<sub>^</sub> and *bícúspid*<sub>^</sub>) versus no blocking in V+Cv, which implies that raising is not universal in V<sup>1</sup>CV<sup>2</sup> contexts, but examples to corroborate this are lacking.<sup>4</sup>

In the focal Inland North dialect, Vance found consistently raised /ai/ in the VCv environment (with a few exceptions like *bíson*<sub>^</sub> [baisn̩], p. 200), but conflicting judgements for many V<sup>2</sup>CV<sup>1</sup> and V<sup>1</sup>CV<sup>2</sup> words, e.g. *itinerary* was judged as raised by one speaker, unraised by another, and “uncertain” by the third (pp. 198ff.). The crucial *icòn* is noted as exceptionally unraised (p. 200),

2 The transcription is Shewmake's. He states (p. 491) that [ɔ] is the vowel in *but*, and [i] the vowel in *pin*.

3 As in Mississippi, the first nuclei in *biceps* (Shewmake 1925:492) and *eyesight* (Shewmake 1945:153) are unraised, but that proves nothing about sensitivity to morphology, since the unraised nuclei are adequately explained by their V<sup>1</sup>CV<sup>2</sup> stress.

4 McCarthy (1982:586) mentions a dialect in which Diphthong Raising is blocked in a VC#v context, e.g. *bicenténial*, *trisyllábic*, but it is not clear whether it is the same dialect described by Chambers (1973, 1989). Chambers (1989:79–80) does not mention these examples in discussing the V<sup>1</sup>#CV<sup>2</sup> and V<sup>2</sup>#CV<sup>1</sup> contexts.

implying that V<sup>1</sup>CV<sup>2</sup> words are normally raised in the Inland North, but examples of the normal pattern are lacking.<sup>5</sup> Vance (1987:199) argues that stress-neutral and non-stress-neutral morpheme boundaries have different effects in the focal Inland North dialect. He gives examples of unraised diphthongs in a V#Cv context: *bicentennial*\_, *trisyllabic*\_, *anti-Semitic*\_, and an example of a raised diphthong in a V+Cv context, *bicycle*^. The focal Mississippi dialect likewise has no raising in V#Cv, but has no raising in V+Cv either (e.g. *bitheism*\_).

All of this adds up to evidence that prosodic and morphological conditioning can differ between Diphthong Raising dialects, but leaves us with little knowledge of specifics, aside from the difference in the V<sup>1</sup>CV<sup>2</sup> environments.

### 7.3. Exceptions

Diphthong Raising in all four dialects is categorical enough that there are lexical exceptions and minimal or near-minimal pairs (Mielke et al. 2003,, Hayes 2004, Pater 2014). Notably, *tiger* is exceptionally raised in the focal Mississippi dialect (Section 5.2 above) and in the focal Inland North (Vance 1987, Table 5), but it is unraised in focal Ontario (Chambers 1999:119) and focal Virginia (Shewmake 1925:492). In Ontario, K. C. Hall (2005) has observed several similar clusters of exceptions involving specific phoneme sequences that are not morphemes.

*Diaper*^/\_ and *Ísis*^/\_ were noted above as isolated exceptions in the focal Mississippi dialect. Vance found exceptionally unraised *nice* in two of three Inland North speakers (1987, Table 3), but *nice* is regular in the focal Mississippi dialect.

There is also variation across dialects in the apparent exceptions, but those can be accounted for by assuming different segmental, prosodic, or morphological representations for individual words. For example, *spíder*^IN\_MS\_VA (Vance 1987:201, Shewmake 1925:492) could reflect a difference between the underlying representations /spaitə/ and /spaidə/, rather than a lexicalized exception to Diphthong Raising. *High school*, which is raised by some Ontario and Inland North speakers (Chambers 1973:116–117; Vance 1987:198), could be another case of a familiar bimorphemic word behaving as if it were monomorphemic (see Section 3.3 above).

Two dialects are unlikely to share an exception or variant by chance, but no clear historical picture emerges from the pattern of sharing in these four dialects.

## 8. Abrupt appearance of Diphthong Raising in the focal Mississippi dialect

The most direct testimony we have about the English of North Mississippi suggests that neither Diphthong Raising nor Flapping had yet taken hold there even in the late 19<sup>th</sup> Century, and that /ai/ had not developed into a monophthong in any context. In an 1893 University of Mississippi doctoral thesis, H. A. Shands undertakes to describe the speech of speakers both educated and uneducated, both black and white. Of /ai/, he writes (p. 10):

Long *i* (ai) is nearly always correctly pronounced, and seems to follow no rule in those changes that it does undergo. There is no group of related or similar words in which it suffers any regular change. In a few isolated examples there is incorrect pronunciation of

<sup>5</sup> Vance (1987) does not mark secondary stress, but does say that words are chosen to have the same stress patterns as those of Chambers (1973:124–127). I therefore mark secondary stress on Vance's words following Chambers.

this *i*, but nearly all of these are old words and owe their present forms to etymological spelling or assimilative change. Long *i* (*ai*) is changed to (*î*) in (*blîdgd*) for *obliged*, to (*ê*) in (*tʃêni*) for *china*, to (*au*) in (*mauti*) and (*maut*) for *mighty* and *might*. All of these pronunciations indicated by the phonetic spelling have been, at some time in the past, current in England.

Shands says nothing of Flapping, and transcribes *t* in CVC contexts as [t] (e.g. *kritter* is transcribed as [kritə], p. 47; *school-butter* as [skûl-bətə], p. 55, see also *mighty* in the above-quoted paragraph)<sup>1</sup>. Grandgent (1891), surveying written self-reports from readers of *Modern Language Notes*, reports that:

In many parts of the South the case is quite different. Before a voiceless consonant *ai* is *ëi*, *ai*, or *æi*, and *au* is *ëu* or *vu*; before a voiced consonant or at the end of a word, *ai* is *ae* or *aə*, *au* is *au* or (occasionally) *æu*. According to the answers I have received, this distinction is universal for both diphthongs in eastern Virginia and North Carolina; for *ai* it is common also in Kentucky, Tennessee, and South Carolina, and less general in Maryland and central and western Virginia; for *au* it occurs (I cannot tell how frequently) in Maryland, Kentucky, Tennessee, and central and western Virginia. (Grandgent 1891:460).

Since Grandgent's Southern respondents included representatives of Mississippi and Louisiana, the failure of those States to appear in the quoted list provides some corroboration for Shands's claim that /*ai*/ did *not* alternate in Mississippi among adult speakers in the early 1890s, i.e. speakers born before about 1870. Yet Speakers LAGS-592 and LAGS-546, born within ten years of Shands's writing, into the demographic group with which Shands was likely most familiar (educated white speakers from near Oxford or Jackson), had both Diphthong Raising and Flapping as adults, with the usual opaque interaction between the two processes. Once established, the pattern remained stable across the three generations represented by the speakers in this study. Thus, a short period of rapid change was followed by a long period of apparent stasis.<sup>2</sup>

1 The focal Mississippi and Virginia dialects are not unusual in lacking Flapping in the late nineteenth century. MacMahon (1998) notes its absence from several detailed phonetic descriptions of American English dialects dating from 1860 to 1895. The style sheet of *Dialect Notes*, Volume 1 (1896) transcribes [t] in words which today would be flapped, as do Emerson (1896:76f.) and Grandgent (1896). Yet less than twenty-five years later, Krapp (1919:9, 100), describing “standard English in America”, notes regular voicing of /*t*/ between a stressed and an unstressed syllable. Less than two decades later, Haugen (1937) mentions “the sound commonly known as ‘voiced T’”, and linguists writing in the 1940s and later assume that flapping is familiar to their readers (Bloch 1941, Joos 1942, Trager 1942, Oswald 1943). Lehmann (1953:271) comments that “this phenomenon is of considerable interest because it is one of the first sound changes that is being observed and documented by linguists in its successive stages.”

2 Other dialects seem to have gone directly from /*ai*/ to /*α*/ or /*a*/ regardless of consonant voicing, without ever passing through a stage of Diphthong Raising. Eber Carle Perrow (1912), describing southern Appalachian speech of the late 19<sup>th</sup> Century — Perrow, born in 1880, says on pp. 140 and 144 that he moved to Eastern Tennessee as a child and spent twenty years there — states categorically that speakers have only non-alternating /*ai*/ (pp. 139–140). But in the late 1930s, J. S. Hall (1942, p. 43) found that adult speakers in the mountains of eastern Tennessee and western North Carolina had only non-alternating [aː] or [aː̃] in all environments.

I am not able to say whether focal Mississippi Diphthong Raising is historically cognate with, or independent of, the other three dialects. Where the development of Diphthong Raising has been observed over time, it seems to take about three generations to move gradually from a subtle phonetic alternation to a large phonological one (Labov 1963, Moreton & Thomas 2007, Fruehwald 2015). Its sudden appearance in Mississippi may therefore mean that it was not phonologized locally from the common phonetic precursor, but imported already phonologized via contact with speakers in the other areas mentioned by Grandgent (1891).<sup>3</sup>

## 9. Summary and conclusions

Although the focal Mississippi dialect is based on the same phonetic precursor as the focal Virginia, Ontario, and Inland North dialects, it differs from them in several ways. One is the phonetic identity of the allophones of /ai/. That is not especially surprising, as Diphthong Raising dialects vary widely in this respect (see Table 1 above). Another is the set of segmental triggers, but there it is the Inland North dialect, with its pre-rhotic raising, that is the outlier. More interesting is the difference in prosodic conditioning in tautomorphemic contexts: V<sup>1</sup>CV<sup>2</sup> words like *icòn* are unraised in the focal Mississippi dialect, but raised in the focal Ontario and Inland North dialects.

Perhaps the most surprising finding is the interaction between prosody and morphology in the focal Mississippi dialect, analyzed above in Section 5. There are two main hypotheses about how stress affects Diphthong Raising in other Diphthong Raising dialects. One is that Diphthong Raising happens only if /ai/ and the segmental trigger are in the same syllable (Shewmake 1925, Paradis 1980, Chambers 1989, Moreton & Thomas 2007, Idsardi 2008). The other is that raising happens only if they are in the same foot (Kiparsky 1979, McCarthy 1982, Jensen 2000, Bermúdez-Otero 2003). Both of these hypotheses correctly predict Raising in VC and VCv cases like *life*<sup>MS</sup> and *license*<sup>MS</sup>, and no Raising in V<sup>1</sup>CV<sup>2</sup> and V<sup>2</sup>CV<sup>1</sup> cases like *icòn*<sub>MS</sub> and *critérión*<sub>MS</sub>. But in V<sup>2</sup>C|V<sup>1</sup> cases with a free base like *Hittitology*<sup>MS</sup>, *stripation*<sup>MS</sup>, and *invitée*<sup>MS</sup>, Raising occurs even though the segmental trigger is an onset to a stressed syllable and hence neither a coda nor foot-internal. In V|C examples like *dryth*<sub>MS</sub> and *i-th*<sub>MS</sub>, and in V|Cv examples like *sighful*<sub>MS</sub> and *bifurcate*<sub>MS</sub>, a voiceless coda or foot-internal segment fails to trigger Raising. Only in *cytology*<sub>MS</sub>, *litation*<sub>MS</sub>, and other V<sup>2</sup>C|V<sup>1</sup> words lacking a free base does prosodic affiliation trump morphological affiliation. Chambers (1989:79–80) has proposed that in the focal Ontario dialect, morphology affects Raising

3 At the time of its first appearance in Mississippi, it could have been an alternation between two diphthongs. In Southern dialects which had Diphthong Raising, monophthongization of the elsewhere diphthong (“Southern Glide Weakening”, Thomas 2005) seems to have set in among speakers born towards the end of the 19<sup>th</sup> Century. Both black and white Texans born in the 1890s had [ai] before voiceless consonants and nearly pure [a] before voiced ones (Bailey & Thomas 1998). William Read, of Louisiana State University, described voicing-conditioned Diphthong Raising in “the South”, but said nothing of monophthongization (1909:73–74). A quarter-century later, his LSU colleague C. M. Wise (1933, 1936) reported monophthongization of the unraised diphthong. Writing in 1931, Greet says of the Williamsburg, Virginia dialect that “[ai] tends towards [a] or [a] in *I, mind, find, my, while, and by it* but of course the sound seldom entirely loses its diphthongal character” (p. 166). William B. Edgerton (born 1914 in North Carolina) writes that “Southern long *i* is not, however, simply [a]. There is a scarcely perceptible glide towards [ɪ]” (1935:190). The fact that late-19th-Century attestations of Diphthong Raising in the South refer to two diphthongs thus does not mean that the focal Mississippi dialect could not have borrowed Diphthong Raising from another dialect.

indirectly, via its effect on surface prosodic structure, but that proposal does not explain the differences in the focal Mississippi dialect between pairs of prosodically identical contexts which differ in morphological structure and in Diphthong Raising, e.g. *icòn*<sup>MS</sup> and *lipàse*<sub>MS</sub> (V<sup>1</sup>CV<sup>2</sup> vs. bound V<sup>1</sup>C|V<sup>2</sup>), or *critérión*<sub>MS</sub> and *invitée*<sup>MS</sup> (V<sup>2</sup>CV<sup>1</sup> vs. free V<sup>2</sup>C|V<sup>1</sup>), or *litátion*<sub>MS</sub> and *stripátion*<sup>MS</sup> (bound V<sup>2</sup>C|V<sup>1</sup> vs. free V<sup>2</sup>C|V<sup>1</sup>).

What could cause multiple phonologizations of the same phonetic precursor to differ in the effects of relatively abstract factors like prosody and morphology? One possibility is that before phonologization, the dialects' grammars already differed in ways that automatically extended to the phonologized pattern. For example, the focal Mississippi and Ontario dialects may have already differed in their prosodification of tautomorphemic V<sup>1</sup>CV<sup>2</sup> strings, so that when speakers in both dialects phonologized the same phonetic precursor as raising before voiceless codas, the outcomes automatically differed in that environment. If that is what happened, then these grammatical differences should be detectable in data not involving Diphthong Raising; e.g. /t/ in the V<sup>1</sup>CV<sup>2</sup> environment should be aspirated in the focal Mississippi dialect, and flapped or glottalized in the focal Ontario dialect. Even if the grammatical difference is a “hidden ranking”, difficult or impossible to observe in ordinary linguistic data, it may still be detectable experimentally (Davidson 2001).

An alternative possibility is that the phonologized patterns are different because the phonetic precursors were different. Both prosodic and morphological structure can affect low-level phonetic phenomena such as vowel duration and hyper- vs. hypoarticulation, and can do so differently in different languages (Maddieson 1984, De Jong 2004, Frazier 2005, Keating et al. 2004, Sugahara & Turk 2009). The prosodic and morphological effects could thus have been phonologized faithfully from subtly different phonetic precursors. In that case, the differences should still be detectable in the unphonologized residue of the precursor. Phonetic pre-voiceless raising affects all tense English diphthongs to a degree proportional to the articulatory difference between the nucleus and offglide (Moreton 2004). This precursor is phonologized most often for /ai/, the diphthong with the greatest nucleus-offglide difference, less often for /au/, and rarely or never for /oi/ and /ei/. The unphonologized phonetic raising of /oi/ and /ei/ in the V<sup>1</sup>CV<sup>2</sup> environment is therefore predicted by this hypothesis to be greater for focal Ontario speakers than for focal Mississippi speakers.

Most of the contexts used in the present study have not been systematically investigated in other dialects or, indeed, other idiolects. Many of the most informative words, like *invitée*, *Fightology*, or *dryth*, have almost no chance of occurring spontaneously in a sociolinguistic interview, and are not represented in even the most detailed phonological-judgment studies. Morphological structure and non-primary stress can be hard to judge accurately. Consequently, we do not know yet how much even the focal dialects differ in the subtleties of the interactions between Diphthong Raising, prosody, and morphology. Since Diphthong Raising is frequently re-innovated, it can be observed at many different stages of the phonologization process, and the relevant data will not be hard to get from living speakers.

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