Phonological abstractness in English Diphthong Raising*

Elliott Moreton

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Abstract

Mature phonological patterns are often conditioned by factors other than surface phonetics, such as underlying form, prosody, morphology, lexical stratum, or syntactic category. Since many patterns originate via phonologization of a phonetic precursor, the question arises of how and when such abstract factors acquire their conditioning effects. This chapter sites American Raising within the worldwide typology of English Diphthong Raising and proposes some ways to extend Raising research geographically and linguistically to distinguish between three competing hypotheses: *Late Abstractness* (a freshly-phonologized pattern lacks abstract conditioning), *Early Abstractness* (abstract factors condition the pattern from the earliest stages of phonologization), and *Abstract Phonetics* (abstract conditioning is already present in phonetic precursors and may be phonologized along with them). Comparative study of established and nascent Raising varieties could make Raising a "model organism" for general theories of phonologization.

1 Introduction

Phonological patterns often involve factors other than the surface phonetic form of the utterance, *abstract factors* such as underlying representation (i.e., opacity, Kiparsky 1971, 1973), prosodic affiliation (Kahn, 1976), morphological structure (Casali, 1996; Beckman, 1998), paradigm membership (Benua, 1997), syntactic category (Smith, 2001, 2011), or lexical stratum (Itô and Mester,

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1995). Since many, or even most, phonological patterns originate historically in phonologization of pre-existing phonetic covariation (Hyman, 1976; Ohala, 1993; Hume and Johnson, 2001; Barnes, 2002; Blevins, 2004, 2008), the question arises of how and when they acquire their sensitivity to the effects of abstract factors. Research on American Raising has played an important role in addressing this question. That research has focused on *lexical* abstractness, specifically, how Raising comes to be conditioned by the (abstract) underlying voicing of flapped /t/ rather than its (concrete) surface voicing (e.g., Fruehwald 2013, 2016; Berkson et al. 2017; Davis et al. 2019; Farris-Trimble and Tessier 2019; Davis et al., this volume).

The theme of this paper is that that the program of research into lexical conditioning of American Raising can be generalized to encompass a wider spectrum of abstract factors and a wider field of dialects. American Raising and Canadian Raising are members of a larger family of similar patterns in English worldwide, English Diphthong Raising (Moreton and Thomas, 2007). Underlying voicing is one of many abstract factors that can condition Raising, including prosody, the type and position of morpheme boundaries, and the free/bound status of stems. The paper lays out three competing hypotheses as to how phonological patterns acquire abstract conditioning, and sketches several specific ways in which between-dialect variation in English Diphthong Raising might be used to distinguish between them empirically.

Section 2 situates American Raising in the global typology of English Diphthong Raising. Section 3 reviews the phonetic precursors to English Diphthong raising and their role in shaping that typology. Section 4 uses a Mississippi dialect to illustrate how prosodic and morphological factors can condition Raising. Section 5 reviews three competing hypotheses about how phonological patterns acquire abstract conditioning, and Section 6 suggests specific ways to use between-dialect variation in Raising to distinguish those hypotheses empirically. Section 7 concludes the paper with suggestions for future research.

2 English Diphthong Raising

American Raising is one version of English Diphthong Raising (Moreton and Thomas, 2007), a phonological syndrome in which the height of certain vocoids (diphthongs or monophthongs) depends on the voicing of the following consonant. Examples involving the PRICE and PRIZE classes

are shown in Table 1. Two remarkable facts are apparent at once. The first is that, while the phonetic realizations of the PRICE and PRIZE vocoids vary widely from one dialect to another, the higher of the two is always found in the pre-voiceless environment (T is always to the left of D in Table 1). The other is that the pattern reappears at many times and in many places around the English-speaking world. Cardoso (2015, p. 1), writes that "[i]n nearly every case of new-dialect formation in varieties of English, phonologically-conditioned variation of the PRICE and MOUTH vowels ... has developed ....", and Trudgill (1986) states that it is found "in *nearly every* form of non-creolised, mixed, colonial English outside Australasia and South Africa" (p. 160, emphasis in original).

Transcription (highest to lowest)				
[ʌɪ]/[ɐɪ]	[aɪ]	[ae]/[aɛ]	[a^{ɛ}]/[aː]	Reports of PRICE-PRIZE difference
T	*D*			*Canada*: Ontario (Joos, 1942; Chambers, 1973), Labrador and Newfoundland (Clarke, 2010), Cape Breton (Kiefte and Kay-Raining Bird, 2010), Manitoba (Onosson, 2010), B.C. (Rosenfelder, 2007). *North-central U.S.* (Dailey-O'Cain, 1997; Thomas, 2000) *U.S. East Coast*: Martha's Vineyard MA (Labov, 1963; Blake and Josey, 2003), Philadelphia (Fruehwald, 2016), E. VA (Shewmake, 1925), SC and GA Low Country (Kurath and McDavid, 1961). *Honduras* (Graham, 2010). *English Fens* (Britain, 1997), *Hawai'i* (Vance, 1987, 208), *Cape Town* (Finn, 2008).
T		*D*		*Bahamian Creole, 'working-class'* (Kraus, 2015)
T		*D*		*SE U.S.* (Greet, 1931; Kurath and McDavid, 1961). *Tristan da Cunha* (Schreier and Trudgill, 2006)
T			*D*	*Eastern Va., NE N.C.* (Kurath and McDavid, 1961). *Liverpool* (Cardoso, 2015).
	T	*D*		*SE U.S. white speakers* (Edgerton, 1935; Hall, 1942; Sledd, 1966; Pederson et al., 1992). *Bahamian Creole, 'higher-class'* (Kraus, 2015)
	T		*D*	*AAE, widespread in U.S.* (Thomas and Bailey, 1998; Thomas, 2001; Anderson, 2002; Knight and Herd, 2016). *SE U.S. white speakers* (Evans, 1935; Sledd, 1966; Bailey et al., 1991; Bernstein, 1993; Hazen, 2000; Knight and Herd, 2016). *Afro-Bahamian* (Childs et al., 2003; Reaser, 2010). *Devonshire, England* (Orton et al., 1978; Anderson, 1987). *Hull, England* (Trudgill, 1999, 72)
		T	*D*	*AAE in Texas* (Bailey and Thomas, 1998)
T, *D*				*Hertfordshire, Worcestershire, Norfolk* (Orton et al., 1978)
	T, *D*			*AAE in North Carolina* (Farrison, 1936, 130–135); *Mexican-Americans in Texas* (Thomas, 1995)
		T, *D*		*Anglo speakers in Texas* (Bailey et al., 1991)
			T, *D*	*Cherokee and Anglo speakers in Western North Carolina and Eastern Tennessee* (Hall, 1942; Anderson, 1999)

Table 1: English Diphthong Raising in PRICE vs. PRIZE words, based on impressionistic transcriptions. The variants found before voiceless and voiced codas are marked with *T* and *D* respectively. Backness variation has been removed from the original transcriptions to show the height variation more clearly. Non-Raising dialects are included at bottom to illustrate the equally-wide phonetic range of non-alternating PRICE/PRIZE variants.

Several of the reports have been investigated in enough detail to show that they most likely represent independent innovations, including historical cases in the English Fens (Britain, 1997; Britain and Trudgill, 2008), Liverpool (Cardoso, 2015), Cleveland, Ohio (Moreton and Thomas 2007, Thomas and Mielke, this volume), Philadelphia (Fruehwald, 2013, 2016), and Kansas City, Missouri (Strelluf 2018, this volume), and present-day cases in Fort Wayne, Indiana (Berkson et al. 2017, Davis et al., this volume) and New Orleans (MOUTH/LOUD classes only, Carmichael 2020).

Independent phonologizations of the same precursor can thus be observed at historical ages ranging from 350 years in the English Fens to zero in the Midwestern U.S.

3 The phonetics of Raising

The phonetic basis of Raising is obscured by the impressionistic transcriptions on which Table 1 is based, which can be phonetically misleading. Canadian Raising, for example, is conventionally transcribed as pre-voiceless "[ʌɪ ʌʊ]" vs. pre-voiced "[aɪ aʊ]", making it appear that voicing primarily affects the height of the nuclei, and that the pre-voiceless tokens are less diphthongal than the pre-voiced ones. In fact, instrumental measurements show that the offglide is as strongly affected as the nucleus, that the raised offglide is often fronted in /aɪ/ and backed in /aʊ/, and that the pre-voiceless variant is at least as diphthongal as the pre-voiced one, especially in early historical stages (Thomas 1991; Hagiwara 2006, Figure 3; Rosenfelder 2007; Onosson 2010, Table 4.2; Wittrock 2020, Table 10; Thomas and Mielke, this volume; Strelluf, this volume).

In dialects where English Diphthong Raising has developed within the era of sound recording, it has been observed to originate in the offglide, and only later spread to the nucleus (Moreton and Thomas 2007; Cardoso 2015, Chapter 10; Fruehwald 2016). Raising is more common in diphthongs with greater nucleus-offglide antagonism: More dialects have phonological Raising in /aɪ/ than in /aʊ/; more have it in /aʊ/ than in /ɔɪ/, /eɪ/ or /oʊ/; and none have it in /i/, /u/, or the lax monophthongs (to my present knowledge).[1] The historical precedence of the offglide, the association between Raising and nucleus-offglide antagonism, and the resemblance of the pre-voiceless and pre-voiced variants to the offglide and nucleus, appear to be linked to two phonetic effects found also in dialects without phonological English Diphthong Raising.

The first phonetic effect is *pre-voiceless peripheralization*, in which the vocalic event immediately preceding a voiceless consonant is displaced towards the margins of the acoustic vowel space (illustrated in Figure 1).[2] For monophthongs, this takes the form of exaggerated opening, causing

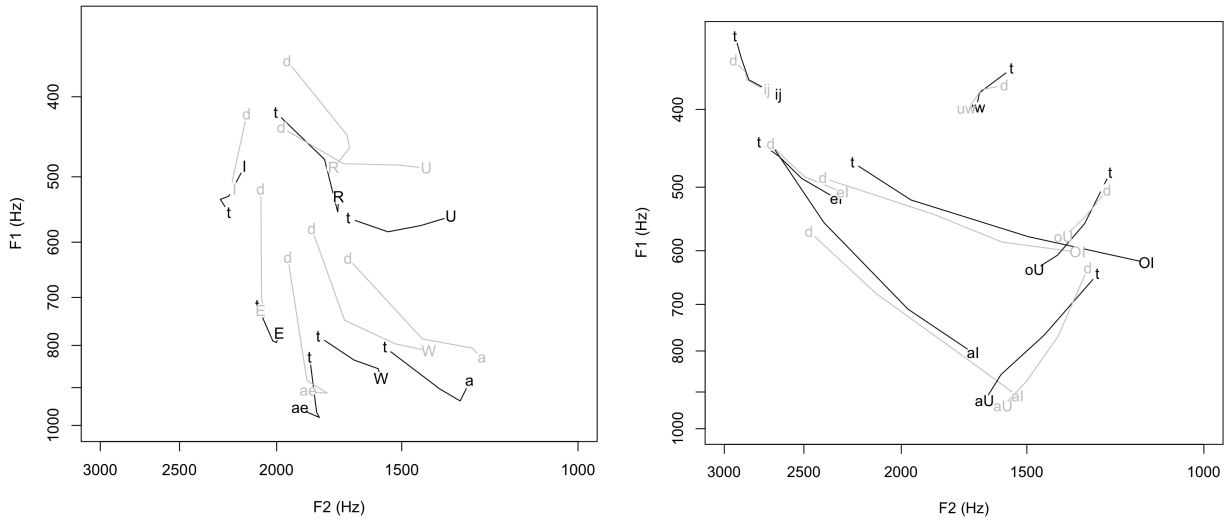
[1] Raising of /aɪ aʊ ɔɪ/ is reported in Winnipeg (Hagiwara, 2006), and Raising of /aɪ aʊ eɪ oʊ/ is reported in Cape Flats English of Cape Town, South Africa (Finn, 2008, 207–209).

[2] Candidate words were chosen to form minimal or near-minimal sets, e.g., *cloud-clout*, such that each vowel was represented by multiple such sets. All words ended in /t/ or /d/, except that /s/ and /z/ were used instead with /ɔɪ/ due to lack of suitable stop-final words. The speaker always released final /t/. Audio files recorded by this speaker ("Dvortygirl") were located via the crowdsourced online dictionary Wiktionary (`en.wiktionary.org`), downloaded in Ogg Vorbis format from Wikimedia Commons and converted to .wav format using the Audacity software (Audacity Team, 2018). This procedure yielded 149 words. Each was inspected visually in Praat (Praat.6.1.15), where an interval

the well-known phenomenon of pre-voiceless lowering (Wolf 1978; Revoile et al. 1982; Summers 1987; Crowther and Mann 1992; Nittrouer et al. 2005; Tauberer 2010, Chapter 5; Choi et al. 2016). For upgliding diphthongs, what is exaggerated is the closing of the offglide, so that it becomes higher before voiceless consonants not just in /aɪ/, but in /aʊ/, /ɔɪ/, and /eɪ/ as well (Moreton 2004, Exp. 1; Hagiwara 2006; Tauberer 2010, Chapter 5).[3] (Offglide peripheralization of /aʊ/ does not appear in the sample from the speaker in Figure 1.) Peripheralization affects F_2 as well, making front-gliding offglides fronter and back-gliding ones backer. These correlates of coda voicing are also cues to it: Raising F_1, or lowering F_2, increases the rate at which participants judge a coda to be voiced (Moreton, 2004, Expp. 2, 3).

was marked which began at or shortly after the onset of voicing, and continued until the last formant-trackable point preceding the closure. The formant tracks were extracted and post-processed to remove spurious "formants" with bandwidths greater than 750 Hz. Individual tracking errors were hand-corrected. For each diphthong and each coda, the formant tracks for the representative words were aligned at two points, the F_1 maximum preceding the midpoint and the next F_2 extremum (maximum for front-gliding diphthongs, minimum for back-gliding). For each monophthong, the two points were the F_1 maximum preceding the midpoint, and the closure. The formant tracks were then linearly interpolated to four equally-spaced points and averaged together to yield each of the curves plotted in the figure.

[3]The predicted effects of pre-voiceless peripheralization depend on the diphthongal or monophthongal nature of the vocoids, which can differ across dialects (Jacewicz and Fox, 2013). This is particularly relevant to the high tense vowels. If /i/ and /u/ are upgliding diphthongs /ij/ and /uw/, then exaggeration of the closing gesture predicts raising and fronting of /ij/, and raising and backing of /uw/, as in other upgliding diphthongs. If they are monophthongs, then exaggeration of the vocalic opening gesture predicts lowering and fronting of /i/, and lowering and backing of /u/, as in other monophthongs. Gussenhoven (2007) measured monophthongal /i/ and /u/ and found that that the pre-voiceless tokens had higher F_1 at the midpoint, as predicted for monophthongs (note, though, that that paper interprets the result as evidence *against* pre-voiceless peripheralization, on the grounds that exaggerating a high-vowel gesture ought to make it higher). In Tauberer (2010, Chapter 5), /i/, when analyzed as a monophthong and measured at the F_1 maximum, was found to be fronted and slightly lowered in the pre-voiceless environment. Finally, an articulatory study of a single English speaker by Löfqvist and Gracco (1994) found that /i/ and /u/ were higher before voiceless than voiced consonants, but also, unexpectedly, that the same held for /a/ as well.



Monophthongs

(pre-midpoint F_1 maximum to closure)

Diphthongs

(F_1 maximum to F_2 extremum)

Figure 1: Pre-voiceless peripheralization: Effect of coda [t] vs. [d] on F_1 and F_2 trajectories, pronounced by a female speaker of American English in San Jose, California (b. 1976). Plotting symbol "W" represents [ʌ]. Source: Wikimedia Commons, user *Dvortygirl*, accessed June 2020.

The second phonetic effect is *pre-voiceless nuclear shortening*, a special case of "pre-fortis clipping" (Wells, 1990). English vocoids are shorter before a voiceless consonant than before a voiced one (House and Fairbanks 1953; Chen 1970; Luce and Charles-Luce 1985; Crystal and House 1988; see extensive review and novel data in Tauberer 2010). In the case of diphthongs, this shortening comes primarily at the expense of the nucleus (Lehiste and Peterson, 1961; Gay, 1968; Jacewicz et al., 2003). In [aɪ], nuclear shortening is often accompanied by offglide lengthening (Thomas, 2000; Onosson, 2010; Pycha and Dehan, 2016). Nuclear shortening in [aɪ] and [eɪ] is a perceptual cue to coda voicelessness (Thomas 2000, Exp. 2; Moreton 2004, Expp. 2, 3).

These two effects combine to strengthen diphthong offglides, and weaken nuclei, before a voiceless consonant. Since the nucleus and offglide impose conflicting demands on the articulators, the result is *asymmetric assimilation*, i.e., weakened nuclei assimilate to strengthened offglides in the pre-voiceless environment, while weakened offglides assimilate to strengthened nuclei in the pre-voiced one. As Hagiwara (2006, 136) says of /aɪ aʊ/ in Winnipeg, "[t]he entire diphthong appears to have advanced along the path of the transition in the raising context." The historical progression

of the divergence has been described as "unzipping from the glide backward toward the nucleus" (Thomas and Mielke, this volume).

Two main historical scenarios have been proposed for this process. They are reviewed in detail in Cardoso 2015, Section 2.4. In one of them, two dialects, each with its own non-alternating diphthongs, come into contact, and the next generation of learners assigns the two dialects' diphthongs to two different phonological contexts on the basis of phonetic compatibility with the context (Britain, 1997; Britain and Trudgill, 2008). In the other, speakers of a single dialect spontaneously phonologize the within-diphthong phonetic variation. For proposals as to how that might happen historically, see Moreton and Thomas (2007); Gussenhoven (2007); Bermúdez-Otero (2014); Cardoso (2015); Bermúdez-Otero (2017). In both scenarios, the same phonetic effects ensure that the higher variant appears in the pre-voiceless environment.

This common phonetic basis accounts for the main sound-related typological and historical facts of English Diphthong Raising, explaining why the pre-voiced vocoid is the higher one; why the frequency of Raising decreases from /aɪ/ to /aʊ/ to /oɪ eɪ oʊ/, and is not found in monophthongs; and why Raising historically starts in the offglide and spreads to the nucleus. We turn now to the effects of abstract factors.

4 Non-lexical abstract conditioning of Raising

Previous research on abstract conditioning of English Diphthong Raising has focused on lexical abstractness in the form of the influence of the underlying voicelessness of flapped /t/ (Davis et al., this volume). Prosodic and morphological conditioning are illustrated here with a small-scale study (4 archival and 1 live speaker, the author) of an under-studied dialect with fully phonologized Raising, using a novel fully-crossed design (prosody × morphological boundary type × morphological boundary location × free/bound). The dialect is that of many 20th-Century educated white speakers from Jackson and Oxford, Mississippi (Table 2). Phonetic studies of this variety include Shands (1893); Knight and Herd (2016). For full details, see Moreton (2016), of which this section is a partial summary. The dialect will be referred to in this paper as "the focal Mississippi dialect".

A common practice in phonological studies of Raising is to transcribe each datum using ordinary English orthography, but use IPA for the critical diphthong (e.g., *fl[aɪ]ght*). This is confusing

when comparing Raising across dialects, since one dialect's raised allophone is another's unraised allophone (Table 1). A dialect-independent annotated orthography is therefore used instead: V̲ᵎ for the raised variant, V̲ for the unraised one (e.g., *rV̲ᵎce* vs. *rV̲se*). Since the same word can be stressed differently in different dialects, main and secondary stresses are also marked (e.g., *rhV̲́zòme*). The /t/ allophones are notated as well because of their importance in diagnosing syllabification (Kahn, 1976): t̬ = flapped /t/, t^h = aspirated /t/ (e.g., *wrV̲ᵎt̬́er*). Readers who themselves have Raising may find these transcription conventions useful in comparing their own productions with those in the dialect described here.

Code	Birth year	Gender	Residence	Race	Class	Occupation	Data
LAGS-546	1894	M	Oxford	white	middle	lawyer	1974 LAGS interview
LAGS-592	1902	F	Jackson	white	middle	unknown	1972 LAGS interview
AM	1934	M	Oxford	white	middle	lawyer	1990 interview
RLM	1937	F	Oxford	white	middle	linguist	1990 interview
EM	1968	M	Oxford	white	middle	linguist	2016 judgements

Table 2: Characteristics of speakers of the focal Mississippi dialect (from Moreton 2016).

English Diphthong Raising in this variety is "mature", i.e., fully phonologized, according to several diagnostics. The allophones are phonetically very distinct, [aɪ] in the Raising environment vs. monophthongal [aː] elsewhere (Figure 2), and are phonetically stable across three generations, except that Speaker LAGS-546 sometimes has a slight offglide where the others have a monophthong ([aː] ∼ [aᵋ]). Speakers have definite judgements, i.e., the difference is enough for them to be conscious of. The process is productive; it applies to loan words (e.g. *Hòkkáido* vs. *Neustadt an der Áisch*), nonce words, acronyms, etc. Lexical exceptions create a marginal contrast; e.g., *tV̲ᵎ́ger*, *TV̲ᵎ́gris* (exceptional) vs. *GV̲éiger*, *NV̲éiger*, *StV̲éiger*, *mV̲́grant*, *V̲́GERT* (regular). Finally, there is marginal contrast before flap; e.g., *wrV̲ᵎt̬́er* vs. *rV̲́der*.

To map out how prosodic and morphological factors affect Raising in this dialect, a word list was generated by crossing four prosodic environments (*ȧɪC̥*, *ȧɪC̥V̆*, *áɪC̥V̀*, *àɪC̥V́*) — *V̇* means "V́ or V̀" — with three morpheme-boundary locations (monomorphemic: aɪC̥(*V*), tautomorphemic:

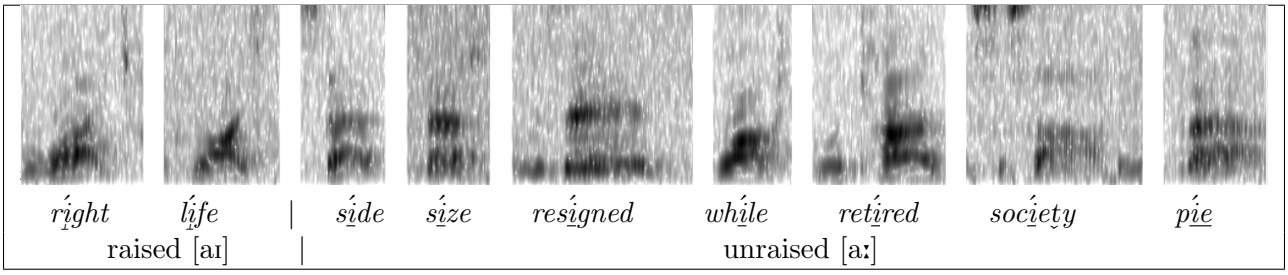


Figure 2: Speaker RLM, b. 1937, 2.4s × 5000 Hz

aɪ$\underset{\circ}{C}$-V, heteromorphemic: aɪ-$\underset{\circ}{C}V$)[4] and with free vs. bound status (at least one free morpheme vs. no free morphemes). The last factor, compound vs. stress-neutral affix vs. stress-affecting affix (Chambers, 1973; Siegel, 1974; Kiparsky, 1979; McCarthy, 1982; Vance, 1987) turned out not to matter and will not be discussed here.

Cells were populated from several sources, including previous publications on English Diphthong Raising (especially Chambers 1973; Vance 1987; Idsardi 2006), machine-readable dictionaries (Webster's *Second New Internation Dictionary* and the on-line *Oxford English Dictionary*), lexical databases (CELEX, Baayen et al. 1995; CMU Pronouncing Dictionary, Weide 1998), and the author's conjectures confirmed by Web search. Words were chosen to minimize prosodic and morphological ambiguity; e.g., *psychology* was excluded because it was unclear which morpheme the *o* belongs to synchronically; *micrometer*, because of the unclear free/bound status of *micro*; and *taiko* because it is unclear whether the final vowel is stressless. The speaker base was thus quite small, but the range of morphological and phonological conditions unprecedentedly wide and systematic. Representative examples with my own pronunciations (Speaker EM) are shown in Table 3. A fuller list can be found in Moreton (2016). Speaker productions agreed in all design cells where data from more than one speaker was available.

[4]The UR would theoretically be /aː/ (the elsewhere allophone), but I write /aɪ/ to facilitate comparison across dialects. "Allophone" is a misnomer since there is a marginal contrast, but will be used here for convenience.

Morphology	Prosody	Free stem? Yes	No
*Mono*morphemic: [aɪ], $\underset{\circ}{C}$, and following nucleus (if any) all in one morpheme	*áɪ$\underset{\circ}{C}$*	*l̲ífe*, *Chr̲íst*, *ind̲íct* (1, 3)	*metábol̲ìte*, *sátisf̲ìce* (1)
	áɪ$\underset{\circ}{C}$ V̆	*cr̲ísis*, *l̲ícense*, *cýpress*, *T̲ítan* (1)	*hýpocàust*, *psýchrophòyte* (1)
	áɪ$\underset{\circ}{C}$ V̀	*íc̲òn*, *Báik̲àl*, *Lýs̲òl*, *Pís̲cès*	(no examples found)
	àɪ$\underset{\circ}{C}$ V́	*T̲àipéi*, *t̲yphóon*, *S̲àipán*, *Ìk̲éa*, *Tch̲àikóvsky*	*hìp̲ótenuse*, *cr̲ìtérion*, *ìt̲ínerant*
*Tauto*morphemic: [aɪ] and $\underset{\circ}{C}$ are in one morpheme	*áɪ$\underset{\circ}{C}$-V̆*	*w̲íper*, *àrchetýpal*, *íc̲y*, *wr̲íter*, *br̲íght̲est*, *Wainwr̲íght̲ian*, *kn̲íght̲ish* (1, 3)	*Èut̲ýchian*, *sp̲ícous*, *l̲ýcanthròpe* (1)
	áɪ$\underset{\circ}{C}$-V̀	*àcon̲ít^{h}ìne*, *àmmon̲ít^{h}òid* (2)	*l̲ípàse*, *n̲ítràte* (2)
	àɪ$\underset{\circ}{C}$-V́	*c̲ìt^{h}ée*, *pàras̲ìt^{h}ólogy*, *str̲ìpátion*, *Dw̲ìght^{h}ésque*, *sp̲ìcétte*, *L̲ìght^{h}éria*, *N̲ìght^{h}árium*, *b̲ìkeítis*, (3)	*ph̲ýt^{h}ólogy*, *c̲ýt^{h}ólogy*, *l̲ìt^{h}átion*, *r̲ìsórial*, *m̲ìcátion*, *m̲ìt^{h}ósis*, *l̲ycánthropy*
*Hetero*morphemic: [aɪ] and $\underset{\circ}{C}$ are in different morphemes.	*áɪ-$\underset{\circ}{C}$*	*dr̲ýth*, *Í-th*	(no examples found)
	áɪ-$\underset{\circ}{C}$ V̆	*s̲ighful*, *tr̲ícolòn*	*b̲ífurcàte*, *tr̲ísomy*
	áɪ-$\underset{\circ}{C}$ V̀	*é̲yesòre*, *b̲ýpàss*, *tr̲ít^{h}òne*, *b̲íplàne*	*b̲íc̲èps*, *d̲íplèx*
	àɪ-$\underset{\circ}{C}$ V́	*h̲ìgh-cóncept*, *b̲ìséxual*, *d̲ìchlór̲ìde*	*b̲ìcúspid*, *Tr̲ìcératops*,

Table 3: Raising as a function of the prosodic and morphological factors. Parenthesized numbers refer to criteria: /aɪ/ precedes voiceless C in the *same morpheme*, and (1) the voiceless C does not precede a *stressed* nucleus, or (2) the voiceless C precedes a *less-stressed* nucleus in the *next morpheme*, or (3) the voiceless C ends a *free base*.

It is evident from Table 3 that multiple abstract factors are involved. /aɪ/ is raised if and only if it is immediately followed in the *same morpheme* by an *underlyingly* voiceless consonant $\underset{\circ}{C}$ of which at least one of the following is true: (1) $\underset{\circ}{C}$ does not precede a *stressed* nucleus, or (2) $\underset{\circ}{C}$ precedes a *less-stressed* nucleus in the *next morpheme*, or (3) $\underset{\circ}{C}$ ends a *free base*. This pattern seems so complex that it would be surprising if it didn't vary across dialects. However, most of

the relevant case types have not yet been studied in any other dialect. What evidence there is is discussed below in Section 6.

5 How does abstract conditioning originate?

This section describes three competing hypotheses as to how phonological patterns (i.e., rules or constraint rankings) come to be conditioned by abstract factors. All three assume that the pattern in question is innovated by phonologizing a phonetic precursor. I have given the hypotheses names that are intended to be mnemonic in the context of this article. The Late Abstractness Hypothesis holds that a newly-phonologized pattern is conditioned only by phonetic features; the Early Abstractness Hypothesis, that any abstract conditioning is inherited from a phonological predecessor; and the Abstract Phonetics Hypothesis, that any abstract conditioning is inherited from an abstractly-conditioned phonetic precursor.

5.1 The Late Abstractness Hypothesis

The *Late Abstractness Hypothesis* states that a freshly-phonologized pattern is conditioned by phonetic features (e.g., [±continuant]) alone, and that the abstractness of a phonological pattern increases with its age (Janda and Joseph, 2003; Bermúdez-Otero, 2007; Hyman, 2013; Bermúdez-Otero, 2015). This hypothesis, which Anderson (1981) traces back to Baudouin de Courtenay (1895/1972), is based on the distinction between phonetics as a concrete physical system, subject to physical constraints, and phonology as an abstract mental system, subject to cognitive constraints. Covariation between physical quantities may inspire a grammatical innovation expressed in terms of the phonetic features linked to those quantities. Once phonologized, it is liberated from physical constraints:

> When a rule is phonologized, however, it is important to recognize that its status has changed: even though it may have originated in the exigencies of articulatory dynamics, for example, when it is incorporated under the control of the cognitive system which is at the heart of Language, these factors no longer limit or prescribe its content. The motivations for subsequent evolution of such a process are quite different, and internal to the system of language as discussed above. (Anderson, 1981, 514)

Phonologization is thus like a low-resolution digital camera taking a high-contrast picture of a complex natural scene, and the new phonological pattern is initially a faithful rendition of its continuous phonetic precursor into discrete phonetic terms. Over historical time, the phonological pattern, untethered to the phonetic precursor that inspired it, randomly walks away from its initial form and so becomes, on average, ever more abstract.

Empirical support for this view comes from numerous historical cases in which phonological patterns are observed to lose transparent phonetic conditioning over time. For example, Velar Fronting in Icelandic formerly occurred before phonetically front vowels only, but vowels which have since then changed their phonetic backness are treated by Velar Fronting as if they still had their historical backness (Anderson, 1981). As time passes, what were once exceptionless, phonetically-conditioned phonological patterns become progressively more restricted and more abstract until they are morphologized or lexicalized (Janda and Joseph, 2003; Bermúdez-Otero, 2007; Hyman, 2013). Change in the other direction is rare (Joseph and Janda, 1988; Garrett and Blevins, 2009).

The Late Abstractness Hypothesis is a consequence of the hypothesis that synchronic phonology is "substance-free", i.e., that phonological learning is indifferent to the articulatory and perceptual difficulty of a phonological pattern (Hale and Reiss, 2000; Blaho, 2008; Reiss, 2017). Late Abstractness is therefore also supported by evidence which supports the substance-free hypothesis, such as the high typological frequency of phonetically-irregular phonological patterns (Mielke, 2004), and the elusiveness of phonetically-based learning biases in lab experiments (Moreton and Pater, 2012a,b; Glewwe, 2019).

5.2 The Early Abstractness Hypothesis

In contrast, the *Early Abstractness Hypothesis* maintains that abstract conditioning can be present from the very moment of phonologization, because phonological change *precedes* phonetic change and is in fact a precondition for it:

> In order for two contextual variants of a speech sound to diverge in their phonetics over time, they must, all else being equal, be treated as being qualitatively different categories by speakers from the moment they begin to diverge. That is, a categorical split of /ay/ into two new allophones or phonemes is not the reanalysis of a longer-term

> phonetic change. Rather, the longer-term phonetic change is possible only because /ay/ split into two new allophones or phonemes either previous to or concurrent with the onset of the phonetic change. The split allowed for their phonetic targets to be learned separately and to change independently. (Fruehwald 2016, p. 404; see also Fruehwald 2013, Section 6.2)

Early Abstractness relies on a theory of the interface between phonological surface representations and phonetics in which the phonology assigns symbolic category labels which are linked elastically to physical production targets, so that the target can change historically even when the category label does not (Fruehwald, 2013, 161–163). As long as the output of the phonology assigns the same label to historical [aɪ] in all contexts, all productions of that diphthong have the same production target. If, for whatever reason, the phonology changes so that historical [aɪ] receives different labels in different contexts, the production targets associated with the labels can begin to diverge over historical time under the influence of the precursor. Until that initial phonological change has occurred, the phonology cannot notice the precursor, because it has nothing to notice it with.

The phonetic precursor is thus not an axe blade cleaving a phonological category in two, but a crowbar inserted into the hairline crack made by a pre-existing covert phonological distinction. Since the precursor's role is only to widen the crack, not to make it, the new (or rather, newly audible) phonological pattern will retain whatever abstract conditioning its covert predecessor had until further historical change effaces that conditioning.[5]

The Early Abstractness Hypothesis is supported by the finding that English Diphthong Raising in Philadelphia has always been sensitive to the underlying voicing of flapped /t/, right from the start, and never passed through a phase of conditioning by the surface voicing (Fruehwald, 2013, 2016). The phonology, in this interpretation, made a pre-existing distinction that assigned two different category labels to pre-voiced and pre-voiceless /aɪ/, allowing the two phonetic targets to diverge under the influence of the precursor. The flapping rule applied later in the derivation and did not change the category label.

[5]Josef Fruehwald (p.c. 2020) points out that phonologization of a phonetic precursor is not the only force that could cause the two phonetic realizations to diverge. They might also dissimilate from each other in order to enhance the contrast between them (Garrett and Johnson, 2013, Section 5.1), or simply drift apart by accumulation of small random changes.

Further support for Early Abstractness comes from cases of "underphonologization", in which two formally similar phonetic precursors have the same physical magnitude, but one is phonologized more frequently than the other (Moreton, 2008, 2010). In Philadelphia English, phonetic pre-nasal raising of /aʊ/ has persisted for decades without being phonologized, even as the physically smaller phonetic pre-voiceless raising of /aɪ/ underwent phonologization (Fruehwald, 2014). For the Early Abstractness Hypothesis, that simply means that no phonological change has occurred to produce the two distinct category labels that would be necessary for the pre-nasal raising precursor to begin enlarging the difference between /aʊ/ pre-nasally and /aʊ/ elsewhere (Fruehwald, 2017).

5.3 The Abstract Phonetics Hypothesis

To these we can add a novel third possibility, the *Abstract Phonetics Hypothesis*, which says that abstract conditioning is already present in phonetic precursors *before* phonologization, and may be phonologized along with them. Although many models of language do not recognize a direct "morphology-phonetics interface", several phenomena have been observed which may reflect exactly that. For example, in Korean, the variability of the time lag between articulatory events increases when they are separated by a morpheme boundary (Cho, 2001) The vowel of an English monosyllable is shorter when the word is monomorphemic (e.g., *band*) than when the vowel precedes a morpheme boundary (e.g., *banned*; Frazier 2006; Sugahara and Turk 2009; Seyfarth et al. 2018), and the vowel of a productive prefix (e.g., *dis-* in *discolor*) is longer and more peripheral than that of a pseudo-prefix (e.g., *dis-* in *discover*; Smith et al. 2012). English /l/ is acoustically darker and articulatorily more velar before a morpheme boundary than within a morpheme (Sproat and Fujimura, 1993; Hayes, 2000; Lee-Kim et al., 2013).

Phonetics can also be affected by prosodic structure (Keating, 2006). Examples include domain-initial gestural strengthening (Cho and Keating, 2001; Keating et al., 2004), domain-final lengthening (Cho et al., 2014), and onset-coda asymmetries in the coordination of gestures in consonant clusters (Byrd, 1996; Byrd and Choi, 2010) or within single segments (Sproat and Fujimura, 1993). Finally, underlying features that are changed by the phonology can nonetheless leak through in subtle ways to influence the pronunciation of surface representations; e.g., the Mandarin second tone [35] derived from an underlying third tone /214/ is slightly but reliably lower than a faithfully-realized underlying second tone /35/ (Peng, 1996), and the vowel in *puh-PAḌ-ing* is slightly longer

than that in *puh-PAṬ-ing* (Braver, 2014).

If a phonetic precursor is in part abstractly conditioned, then a completely faithful phonologization of that precursor would yield a phonological pattern with that same conditioning. The Abstract Phonetics Hypothesis asserts that this can happen. The Late Abstractness Hypothesis denies that possibility, because Late Abstractness requires a historical lag between phonologization and the appearance of abstract conditioning. Late Abstractness must therefore either deny that phonetic precursors can be abstractly conditioned, or deny that their abstract conditioning can be copied into the phonology during phonologization.

6 Using interdialectal variation in English Diphthong Raising to contrast the hypotheses

This section considers some ways in which English Diphthong Raising might be used to test these three hypotheses, by exploiting some of the phenomena described in Section 4. The strategy is comparative: When two dialects, X and Y, have different conditions on Raising, the three hypotheses make divergent predictions as to how else the dialects should differ.

Abstract Phonetics predicts that differences in abstract conditioning of Raising should match differences in the conditioning of the phonetic precursor. The precursor for English Diphthong Raising affects all of the monophthongs and diphthongs in the dialect (Section 3, above), but is seldom phonologized except for [aɪ] and [aʊ]. Hence, Abstract Phonetics predicts that differences in phonological /aɪ/- or /aʊ/-Raising should match differences in phonetic /eɪ/- or /oʊ/-raising.

Early Abstractness predicts that differences in conditioning of Raising should correspond to a pre-existing phonological difference between Dialects X and Y. Testing this prediction requires an auxiliary hypothesis as to what that phonological difference is for the specific pair (X, Y), e.g., that they differ in syllabification of intervocalic consonants. For a different dialect pair (X', Y'), the relevant pre-existing phonological difference could be something else entirely, such as which morphological cycle triggers application of a particular phonological rule (Halle and Mohanan, 1985).

Late Abstractness does not predict either of the correlations predicted by Abstract Phonetics and Early Abstractness. Every time such a correlation is found, Late Abstractness must deem it

to be a coincidence. The more frequently that happens in a large sample of dialect pairs, the less plausible Late Abstractness becomes. Late Abstractness also makes a prediction about individual dialects (not pairs), namely, that freshly-phonologized Raising should have no abstract conditioning at all. While Abstract Phonetics and Early Abstractness do not *require* new Raising to be abstractly conditioned, they would have difficulty explaining a consistent lack of abstract conditioning across a large sample of dialects.

In each of the following subsections, these general predictions are applied to particular cases. Specific word lists are proposed in order to show that the effects would be visible in common vocabulary. Specific dialect pairs are identified where possible to show that dialects really can differ in the necessary ways. The data needed to test the predictions has not been collected; the point is rather to show that studies of Raising could be set up to collect it.

6.1 Prosody: *icon* cases

Monomorphemic words with the stress pattern *áɪC̥V̀* (e.g., *ícòn*) are unraised in the focal Mississippi dialect, but they are reported to be raised in Ontario (Chambers, 1973, 126–127) and implied to be so in the Inland North (Vance, 1987, 200). Examples are shown in Table 4.

No Raising before stressed syllable	*i̲còn*	*Lý̲sòl*	Focal Miss. (Moreton, 2016)
Raising between main- and secondary-stressed syllable	*i̍còn*	(no data)	Ontario (Chambers, 1973, 125–127)

Table 4: *ícòn*-like cases

Early Abstractness posits a pre-existing phonological difference between the two dialects that caused the same phonetic precursor to produce different effects in the two dialects when phonologized. Early Abstractness does not tell us what the pre-existing phonological difference is, but an obvious candidate is the prosodification of *V́CV̀*. Suppose that before phonologization, the grammar, for whatever reason, comes to assign one category label to historical /aɪ/ before voiceless codas, and another elsewhere. The phonetic precursor then acts to differentiate the (initially identical) phonetic targets for the two categories, leading to the phonological pattern "raise before

voiceless codas". In a dialect where the medial C is syllabified as a coda (or as ambisyllabic), the new pattern would automatically produce Ontario-style raising in *ícòn*. In one where the medial C is syllabified exclusively as an onset, the automatic result for *ícòn* would be the focal Mississippi pattern.

The Early Abstractness Hypothesis therefore predicts that as Raising goes, so go other phonological patterns which depend on the prosodification of *áɪ*$\underset{\circ}{C}$*V̀*: Dialects in which the C acts as a coda for Raising should also treat the C as a coda for other coda-dependent patterns like Flapping (Kahn, 1976), Nasalization (Durvasula and Huang, 2017), and æ-Tensing (Ferguson, 1975). Examples are shown in Table 5.

Observed	Inferred	Early Abstractness predictions for		
Raising outcome	syllabification	Flapping	Nasalization	æ-Tensing
ɪ́còn	C acts like an onset	*prót^{h}èin*	*cánìne*	*cáthòde*
í̱còn	C acts like a coda	*próṭèin*	*cã́nìne*	*cÁthòde*

Table 5: Phonetic analogues of Raising in *ícòn*-like words predicted by Early Abstractness.

The relevant words tend to be unlikely to arise in a sociolinguistic interview, but are hardly obscure: *ɪ́còn, Píscès, Nícène, Báikàl, Nýquìl, Lýsòl, glýcòl, Stréisànd* vs. *íbèx, rhízòme, Hýdròx, mígràine, mígràte, Tývèk* for Raising; *prótèin, látèx, vértèx, láttè, mutátè, prótòn, rétàil, rótàte* for Flapping; *cánìne, clímàx, fínànce, fínìte, mónàrch, Sínài* for Nasalization; *gámète, ánnèx, ánòde, Sámòs, cáthòde, Cáthàr, ássèt* for æ-Tensing. The words must really have a secondary-stressed second syllable in the given dialect. In some dialects, the second syllable may be stressless instead; e.g., the first pronounciation given in the current on-line *American Heritage Dictionary* for *ícon*. The prediction may not be testable in such dialects.

Since Late Abstractness maintains that prosodic conditioning can only be added to the pattern after a historical lag, newly-phonologized Raising should see only the surface voicing, yielding *í̱còn* regardless of how the medial consonant is syllabified (and hence regardless of how Flapping, Nasalization, and æ-Tensing behave). All four rules may gain abstract conditioning over historical time, but they need not do so at the same rate, and they are not bound to all four acquire the same conditioning.

The Abstract Phonetics Hypothesis says that abstract conditioning of a phonological pattern is inherited from abstract conditioning of its phonetic precursor. When the /aɪ/ pattern has been phonologized, the precursor itself is still there, still peripheralizing pre-voiceless offglides in other diphthongs at the expense of the nucleus as described in Section 3, and hence still observable. Between-dialect differences in the phonologized pattern are therefore predicted to be mirrored in the unphonologized residue of the precursor. Hence, *ícòn*-like words with /eɪ/ and /oʊ/ should follow, phonetically, the same pattern that *ícòn* itself follows phonologically in the focal Mississippi and Ontario dialects (Table 6).

The relevant words, though unlikely to come up in conversation, are by no means too bizarre to elicit, e.g., *ápèx, látèx, bótòx, lócàte, prófȉle, ÓPÈC, phótòn, prótòn, rótàte, tópàz* vs. *rádȍn, rádȁr, Mádȍff, Bógȁrt, bóv̀ine, Cóbàin, cóbȁlt, ózòne, Prózàc, róbòt, Ózȁrk*. Here again, caution is required, as some dialects may have an unstressed second syllable in some or all of these words.

		focal Miss.			Ontario		
		voiceless		voiced	voiceless		voiced
/aɪ/	phonologized	*i̱còn*	=	*rhi̱zòme*	*i̱còn*	≠	*rhi̱zòme*
/oʊ/	unphonologized	*pró̱file*	$\overset{?}{=}$	*ó̱zòne*	*pró̱file*	$\overset{?}{\neq}$	*ó̱zòne*

Table 6: Correlations between *icon*- and *rhizome*-like words and *profile*- and *ozone*-like words predicted by Abstract Phonetics

6.2 Morphology: *invitee* cases

The Late Abstractness Hypothesis predicts that sensitivity to morphological structure appears at an even later stage than abstract phonological conditioning (Anderson 1981; Janda and Joseph 2003; Bermúdez-Otero 2007; Hyman 2013). A proposed theoretical basis is that a newly-phonologized rule comes last in the grammar, and takes time to work its way up the ordering into earlier morphology-phonology cycles (King, 1973; Zec, 1993; Kiparsky, 1995; Bermúdez-Otero and Trousdale, 2012; Bermúdez-Otero, 2015). The Abstract Phonetics Hypothesis, in contrast, predicts that a rule can be sensitive to morphological structure from the very moment of phonologization, if the phonetic precursor was itself morphologically conditioned. The Early Abstractness Hypothesis also allows

for morphological conditioning from the start, but predicts that this conditioning should be related to that of a phonological predecessor rather than that of the phonetic precursor. The divergent predictions are illustrated in the following example.

In the Ontario and Inland North dialects, Raising happens only when /aɪ/ and the triggering consonant are in the same syllable (Paradis, 1980; Chambers, 1989; Moreton and Thomas, 2007; Idsardi, 2006; Pater, 2014) or foot (Kiparsky 1979, 440; McCarthy 1982, 586; Jensen 2000, 212f.; Bermúdez-Otero 2003). But in the focal Mississippi dialect, Raising also occurs before a syllable- and foot-initial voiceless consonant if that consonant ends a free base, as in *invi͡t^{h}ée*, but not if the consonant ends a bound base, as in *mi͡t^{h}ósis* (Table 7).[6] The pattern is highly productive, occurring before a wide range of main-stressed formatives (*-ée*, *-ésque*, *-átion*, *-ólogy*, *-ógraphy*, *-ítis*, *-ósis*, *-éria*, *-álity*, etc.) and with bases from many lexical strata including not only Germanic, but Greek, Latin, and French as well (e.g., *ty͡pólogy*, *invi͡t^{h}ée*, *indi͡ct^{h}ée*).

Free base: Raising	*invi͡t^{h}ée*	*stri͡pátion*	*Fi͡ght^{h}ólogy*	*Dwi͡ght^{h}ésque*
Bound base: No Raising	*mi͡t^{h}ósis*	*li͡t^{h}átion*	*phi͡t^{h}ólogy*	*li͡cánthropy*

Table 7: Effect of free/bound status of base, focal Mississippi dialect.

Overapplication of Raising can also be seen when an affixed word is restressed for contrastive segmental focus, as shown in Table 8. The formerly flapped voiceless consonant becomes aspirated, indicating resyllabification, but Raising still occurs. An abstract morphological factor, the free vs. bound status of the stem, thus overpowers a less-abstract phonological factor, the syllabification of the stem-final consonant.[7]

[6] *Ci͡t^{h}átion* is so pronounced in the focal Mississippi dialect, and *ty͡pólogy* and *pi͡pétte* vary with *ti͡pólogy* and *pi͡pétte* in my idiolect, but those are exceptions, *invi͡t^{h}ée*, *stri͡pátion*, and the like being the productive pattern. *Citation* is not historically derived from *cite* (*Oxford English Dictionary*, at *citation*).

[7] Proposals about how the grammar might accomplish that can be found in Moreton (2016, 36–39) and Bermúdez-Otero (2019). The problem is not trivial. A simple off-the-shelf solution in which the pronunciation of the unaffixed base is preserved in the affixed form via cyclicity, Output-Output Faithfulness, etc., is not available, because only stem-final consonants continue to trigger Raising after resyllabification. Stem-medial consonants cease to trigger Raising when resyllabified, e.g., *Ti͡tan* ∼ *ti͡t^{h}ánic*, or *vi͡tal* ∼ *vi͡t^{h}álity*.

Plain:	The menu is chosen by the	*invi̱ter*,	not the	*invi̱ted*
Focused:	The menu is chosen by the	*invi̱th́er*,	not the	*invi̱th́ed*

Table 8: Contrastive segmental focus changes syllable affiliation but does not affect Raising, focal Mississippi dialect

The Late Abstractness Hypothesis predicts freshly-phonologized Raising in this dialect to have *invi̱th́ee*, because Raising should not yet have access to the morphological information that distinguishes it from *mi̱th́osis*; more iterations of historical change are required. The Early Abstractness and Abstract Phonetics Hypotheses, though, allow for the possibility that a new Raising dialect has *invi̱th́ee*. Abstract Phonetics predicts further that new Raising dialects which have phonological Raising in *invi̱th́ee* also have phonetic raising in, e.g., *esca̱pée*. If a dialect instead has *invi̱th́ee*, without phonological Raising, it should also have *escàpée*, without phonetic raising (see Table 9).

		focal Miss.			(other dialect)		
		voiceless		voiced	voiceless		voiced
/aɪ/	phonologized Raising	*fi̱ghth́ology*	$\neq$	*phy̱th́ology*	*fi̱ghth́ology*	$=$	*phy̱th́ology*
/oʊ/	unphonologized precursor	*flo̱ath́ation*	$\overset{?}{\neq}$	*ro̱th́ation*	*flo̱ath́ation*	$\overset{?}{=}$	*ro̱th́ation*

Table 9: Correlations between *invitee-* and *mitosis*-like words and *devotee-* and *otitis*-like words predicted by Abstract Phonetics.

The relevant examples would have to be elicited. Free-stem examples like *Fightology* can be coined at will, e.g., *indictee, pipette, Spicette, Bikeology, Lighteria, Christesque, flightitis*, etc., and are so easily parsed by naïve readers that they are used as business names. Bound stems tend to be specialized Greek or Latin vocabulary items like *litation, mication, phytology, cytology, psychiatry, risorial*, which may be harder to parse, but parsing unfamiliar Greco-Latin words is a common skill even at the middle-school level (Crosson and McKeown, 2016).

6.3 Morphology: i*th* and *sighful* cases

In some mature English Diphthong Raising dialects, Raising is triggered by a voiceless coda that is a subsyllabic affix (Idsardi, 2006). There are not many of these, but they are productive (ordinal -*th* as in i*th,* y*th,* ϕ*th,* χ*th*, etc; deadjectival -*th* as in *dryth, highth*). The focal Mississippi dialect is different: Raising fails when the voiceless coda is in a different morpheme from the vocoid (Table 10). Raising is also blocked in that dialect when the voiceless coda is in a different morpheme from the vocoid (Table 11). Raising is also blocked in that dialect when the voiceless coda is part of a longer morpheme with a stressless vowel (Table 11).[8]

	Ordinal -*th*	Deadjectival -*th*	
Voiceless coda but no Raising	í̲*th*	*drí̲th*	Focal Miss. (Moreton, 2016)
Raising before voiceless coda	í̲*th*	(no data)	Ontario (Idsardi, 2006)

Table 10: í̲*th*-like cases.

Voiceless coda but no Raising	*sí̲ghful*	*drí̲ster*	*trí̲colòn*	*bí̲furcàte*	Focal Miss. (Moreton, 2016)
Raising before voiceless coda	*sí̲ghful*	*drí̲ster*	*trí̲colòn*	*bí̲furcàte*	(predicted by Late Abstractness)

Table 11: *sí̲ghful*-like cases

The Late Abstractness Hypothesis thus predicts that freshly-phonologized Raising should apply to *drýth*, í-*th*, *sighful*, because the Raising pattern has not yet had time to acquire morphological conditioning. The Early Abstractness and Abstract Phonetics Hypothesies predict that some new Raising dialects may have the unraised variant in those examples, and Abstract Phonetics predicts further that such dialects will also have phonetically unraised /eɪ/ and /oʊ/ in *sprýth* and *lówth*, j́-*th* and ó-*th*. *pláyful* and *snówful*. The relevant words are unlikely to occur spontaneously and will have to be elicited. For example, high-school algebra students who have learned to read "x^n" as "x to the nth" could be asked to complete the sequence $x^a, x^b, x^c \ldots$.

[8]The example *éyeful* 'a quantity sufficient to fill an eye' is sometimes cited for Canadian and Inland North varieties, but denominal -*ful* in that word is not stressless (Bermúdez-Otero 2003, 9; Idsardi 2006, 123; Bermúdez-Otero 2019, §8).

7 Conclusions and future directions

Research on English Diphthong Raising is likely to burgeon in the coming years, motivated by a variety of research aims (see other papers in this volume). In anticipation of a flood of data from separate studies of individual dialects, this paper has suggested some ways that such studies might be set up to facilitate the later cross-dialectal comparisons that could test competing theories of phonologization, including using dialect-independent annotated orthography, adding morphological and prosodic abstractness to lexical abstractness, eliciting words from the cells of a matrix of crossed prosodic and morphological factors (the list could be standardized across studies), collecting analogous words that represent the unphonologized residue of the apparent phonetic precursor, and including English Diphthong Raising dialects world-wide. Considering how readily the pattern seems to arise, one might also gather baseline data for non-Raising dialects, anticipating that some of them will later develop Raising. No methodological innovations are required, only adding words to the elicitation list — which, as Davis et al. (2019) point out in their final paragraph, will be necessary in any case, since the words needed for the existing research program are unlikely to arise spontaneously in sociolinguistic interviews and must be elicited. The only theoretical innovation is the Abstract Phonetics Hypothesis, which is actually easier to test than the Late and Early Abstractness Hypotheses.

In English Diphthong Raising, Nature has produced an adventitious experiment in which one phonetic precursor is independently phonologized in multiple dialects and allowed to develop for times ranging from zero to 350 years. The number of replications, the range of observable times, and the geographical and social accessibility to observation by many academic linguists at low cost, would be difficult to match at present in any other way. The Raising pattern itself is complex enough to be theoretically interesting, but simple enough to be representative of conditioned alternations in languages generally. These attributes could make English Diphthong Raising a "model organism" for phonologization, an intensively-studied individual case that provides a useful benchmark for general theories.

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