“CHRUMP’S ON CHWITTER”?
A FRESH LOOK AT POSTERIORIZATION IN ENGLISH*

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1. Introduction

In many varieties of English around the world, /t, d, s/ become [posterior] ([−anterior]) before /ɹ/, e.g., *try* [t͡ʃ̟ɹaɪ], *dry* [d͡ʒɹaɪ], *sri* [ʃɹiː] (Jones 1962:165–6, 1963:80; Read 1971:13; Hammond 1999:101–2; Lawrence 2000:82, 86, n. 2, 6; Cox & Palethorpe 2007:343; Hay et al. 2008:18; Duanmu 2009:30; Smith 2013:71; Cruttenden 2014:189–192; Hatcher 2017; Magloughlin 2018).[1] In this paper, we report that obstruent posteriorization can occur before /w/, too, e.g., *tweet* [t͡ʃ̟ʷiːt], *Dwayne* [d͡ʒweɪn], *swing* [ʃwɪŋ]. For example, Figure 1 shows that /d/ has become a posterior affricate in a production of the name *Dwayne*. (Compare the spectrogram in Figure 1 with the one in Figure 2, a pronunciation of the same word by the first author which lacks posteriorization and affrication.)

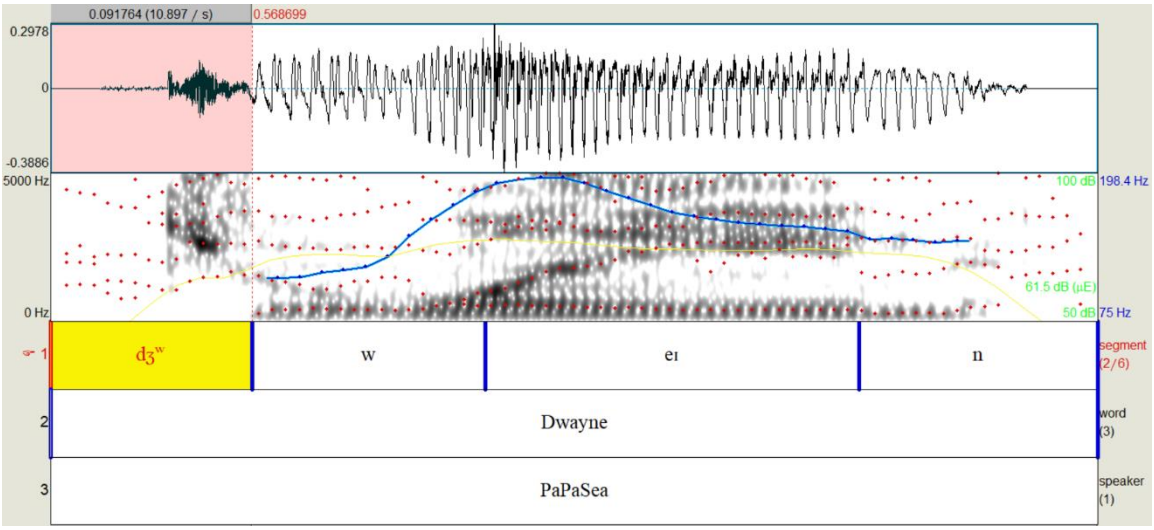

Figure 1. Waveform and spectrogram of YouTuber PaPaSea (New York) saying English *Dwayne* with posteriorization and affrication of /d/ before /w/ in word-initial position (PaPaSea 2021).

* We are grateful to Angeliki Athanasopoulou for useful discussion. Thanks also to attendees of the 2021 meeting of the Canadian Linguistic Association who provided valuable feedback.

[1] Featurewise, /z/ might be expected to participate in posteriorization, too, but no English words or syllables begin in /zɹ/. However, Shapiro (1995) observes that posteriorization applies across syllables on occasion and it can target /z/ in such words as *I*[ʒ]*rael* (p. 105, n. 5). In practice, posteriorization is not regular across syllables, e.g., *ou*[t]*run*, *be*[d]*room*, *Ba*[s]*ra* (cf. Hammond 1999:101).

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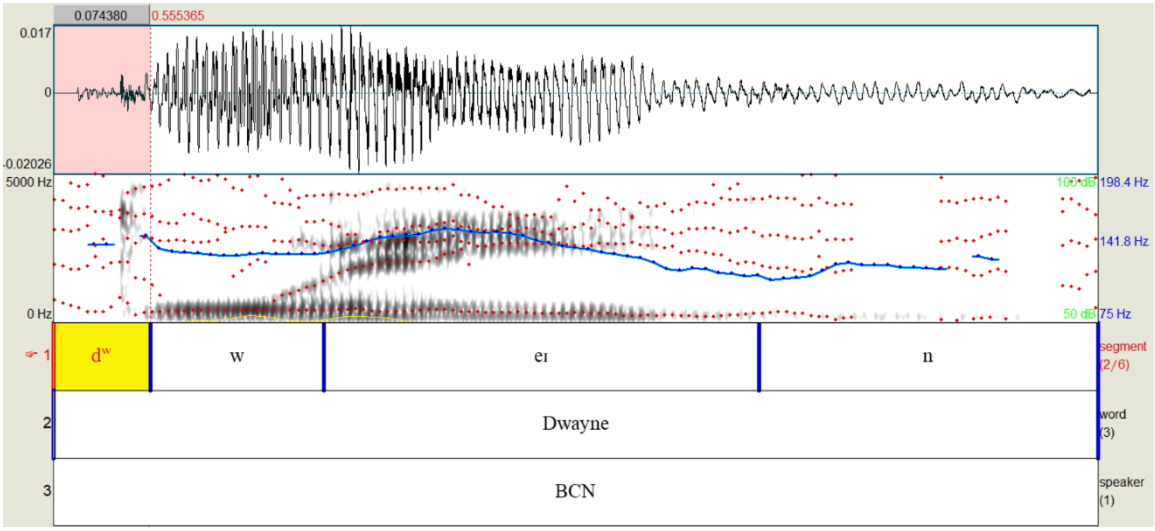

Figure 2. Waveform and spectrogram of first author BrettC Nelson (Louisiana) saying English *Dwayne* without posteriorization of /d/ before /w/ in word-initial position.

/t, d, s/ do not contrast with /t͡ʃ, d͡ʒ, ʃ/ before /ɹ/ at the beginnings of words or syllables in English. Speakers' implicit knowledge of this fact may well license variable obstruent posteriorization in words like *try*, *dry*, and *sri* (Gylfadottir 2015, Baker et al. 2011, Magloughlin 2018:5). Similarly, lexical contrasts seem marginal at best between words that begin in /t, d, s/ vs. /t͡ʃ, d͡ʒ, ʃ/ before /w/, e.g., *twenty* vs. *Chwezi*; *swab* vs. *Schwab*. Speakers' implicit knowledge of this fact, too, may foster a tolerance for variable obstruent posteriorization in words like *tweet*, *Dwayne*, and *swing*.

The simplest phonological account of obstruent posteriorization is that /t, d, s/ assimilate the tongue blade feature [posterior] from /ɹ/ (e.g., Lawrence 2000:82; Yildiz 2010:231; cf. Zsiga 2013:50–1).[2] However, this phonological explanation cannot extend to the novel context — /w/ is not [coronal], so it cannot be [posterior]. Instead, we propose that speakers who posteriorize /t, d, s/ before /w/ do so because obstruents are coarticulated with lip rounding in this context. Crucially, this coarticulation can be reanalyzed as a phonetic enhancement gesture that normally accompanies [posterior] in obstruents (Keyser & Stevens 2006, Stevens & Keyser 2010, Flynn 2011).

To make this case, we first provide some background on feature enhancement (section 2). We then describe how we discovered and documented obstruent posteriorization before /w/ (sections 3 and 4). Next we provide an analysis of obstruent

[2] On this account, obstruent posteriorization is not expected in varieties where the rhotic is not [posterior]. According to Lawrence (2000), this prediction is borne out: "Sequences of *t* and a rolled or uvular *r* do not affricate" (p. 85); cf. Kamińska (1995:129). In a recent investigation of "whether and which rhotics are realized as trills/taps, which are considered 'traditional Scottish'," Meer et al. (2021:4) found that "tap/trill realizations dominate in cluster contexts" (p. 4). However, the rhotic is a post-alveolar approximant rather than a tap or trill when /t, d/ show posteriorization and affrication in Scottish English (Chirrey 1995:124, 127–128; Scobbie 2006:340; Jauriberry 2021:4).

posteriorization (section 5). Finally, we acknowledge some limitations and open questions in our study (section 6).

2. Background: enhancement in phonetics and phonology

Enhancement is the notion that weak feature contrasts may be strengthened by supplemental subfeatural gestures (Stevens et al. 1986 et seq.).[3] A canonical example is the superimposition of lip protrusion on the defining tongue blade gesture for [posterior] in English /ʃ/, say. This enhances the perceptual saliency of that distinctive feature, as Stevens and Keyser (2010) explain:

> "This rounding tends to lower the natural frequency of the anterior portion of the vocal tract, so that the frequency of the lowest major spectrum prominence in the fricative spectrum is in the F3 range, well below the F4 or F5 range for the lowest spectrum prominence for the contrasting fricative consonant /s/." (p. 16)

Keyser & Stevens emphasize that this enhancement gesture is strictly phonetic:

> "its implementation appears to be graded. For example, the degree of rounding of /ʃ/ is more variable than in a featurally initiated rounding such as that in /u/. The phonological input is discrete and quantal in nature whereas the enhancement gestures tend to be nondiscrete and continuous." (Keyser & Stevens 2006:40)

Stevens and Keyser observe that enhancing gestures gain importance as the gestures which are more obviously associated with distinctive features reduce: "Enhancing acoustic cues usually preserve evidence for the distinctive feature, even though the defining acoustic cue is weakened or even obliterated" (2010:18). In fact, Perkell et al. (1998) report that upper lip protrusion *trades off* with tongue blade retraction from token to token in American English [ʃ]. Kingston (2007) interprets this "effort to keep resonator length constant ... as evidence that the speaker is trying to produce a particular acoustic or auditory effect" (p. 405). Manifestly, the effect in question is a strong spectrum prominence in the F3 range.

Though enhancement properly belongs to the phonetic component of grammar, it is recognized that "enhancement gestures can become phonologized" (Keyser & Stevens 2006:61). In fact, most phonologizations derive from enhancement gestures (Hyman 2013). A half dozen examples are presented in Flynn (2011), including this one: Miotti (2002:241) reports that in central Friulian, the fricatives /ʃ, ʒ/ are variably realized as "post-alveolar" [ʃ, ʒ] or as "labialized alveolar" [s̪ʷ, z̪ʷ]. (The former realization is conservative, the latter innovative.)

[3] The principle is closely related, if "independently developed" (Diehl 2008:974), to the auditory enhancement hypothesis (Diehl & Kluender 1989a,b; Diehl et al. 1990; Kingston & Diehl 1994).

(1) *Variable alveolarization and labialization in non-(sub)urban central Friulian*

/ʃ/ [ʃ ~ s̪ʷ]	/meʃeˈda/	‘to mix, stir’	cf. /s/ [s̪]	/ˈmase/	‘too much’
	/paˈiːʃ/	‘villages’		/paˈiːs/	‘village’
	/ˈvoːʃ/	‘voice’		/ˈvoːs/	‘voices’
/ʒ/ [ʒ ~ z̪ʷ]	/alˈbruʒe/	‘it burns’	cf. /z/ [z̪]	/ˈmuze/	‘face’
	/aˈʒeːt/	‘vinegar’		/ˈcaze/	‘house’
	/ˈʒave/	‘toad’		/zarˈdin/	‘garden’

That [round] should figure categorically precisely where [posterior] disappears indicates that central Friulian has phonologized the above-mentioned acoustically/auditorily-based trade-off relation between tongue-blade retraction (the feature-defining gesture) and lip protrusion (the enhancement gesture).

Another instance of phonological (not just phonetic) enhancement is the affrication of /t, d/ before /ɹ/ in English, which we described in the introduction. Note first, however, that the posteriorization of /t, d/ originates in gestural overlap, not enhancement. The change of /t, d/ to [posterior] represents a coarticulation which has been phonologized: /ɹ/ generally shows a bunched (tip-down) articulation after /t, d, s/, even among speakers who generally favour a retroflex articulation ([ɻ]) (Baker et al. 2011; Mielke et al. 2010, 2016). When coarticulated with /ɹ/, then, /t, d/ show “tongue tip/blade postures ... less like coronal stops and more like /tʃ/ and /dʒ/, which are articulatorily more similar to a bunched /ɹ/” (Magloughlin 2018:141; see also Walker et al. 2016).[4] Crucially, in her study of English speakers born after the 1950s in Raleigh, NC, Magloughlin (2018) found that

> “participants were not just coarticulating [tɹ] and [dɹ] sequences, but rather, had phonologized a coarticulatory effect, producing targets that were [tʃ]-like and [dʒ]-like (and distinct from prevocalic [t] and [d]), coproduced with [ɹ]: the aftermath of coarticulation.” (p. 143)

Of special interest is that the addition of [posterior] to /t, d/ entails the addition of [strident], because these phonological features cooccur obligatorily in English obstruents, e.g. */t̻, d̻, s̻, z̻/, */c, ɟ, ç, j/. According to Clements (2009), this is ultimately because the specification [stop, posterior] is enhanced by [strident] in English phonology:

> “[±strident] can be understood as a feature that enhances the acoustic properties of ... posterior sounds (such as palatoalveolars), in the sense of Stevens, Keyser & Kawasaki (1986). It enhances ... posterior obstruents by making their characteristic lower frequency noise component in the region of the third formant more audible. ... The addition of [+strident] to a posterior stop increases its auditory distance from a nonstrident anterior stop such as /t/. In this case, the increase is not along a uniform auditory dimension, but along a different one. This is because /tʃ/ differs from /t/ not only in terms of its lower burst and transition frequencies, which depend on the

[4] Gick (1999:50–1) observes that /ʃ/ is so similar articulatorily to bunched /ɹ/ that words like *wash* can undergo *r*-epenthesis (“warsh”).

> feature value [+posterior], but also in terms of the presence of high-pitched, high-amplitude turbulence noise following the burst, which depends on [+strident].” (p. 50)

In sum, the defining gesture of the phonological feature [posterior] (a.k.a. [–anterior]) is a tongue blade articulation behind the gum ridge. In English phonetics, this defining lingual gesture is accompanied by lip protrusion such that /ʃ, ʒ, t͡ʃ, d͡ʒ/ may be narrowly transcribed [ʃʷ, ʒʷ, t͡ʃʷ, d͡ʒʷ]. The phonetic teleology of this additional labial gesture is clear (Keyser & Stevens 2006, Stevens & Keyser 2010). In the remainder of this paper, we show that the enhancement relationship between lip protrusion and the defining tongue gesture for [posterior] is so compelling that some speakers regularly assume the presence of [posterior] in /tw, dw, sw/. This feature is also enhanced by [strident] in English phonology (Clements 2009), such that /t, d/ become affricates [t͡ʃ, d͡ʒ] before /w/ for such speakers.

3. Methods

As the entirety of this study took place in the heart of a worldwide pandemic, usual methods of sociolinguistic observation and interviews were not feasible. Instead, we used a passive methodology: noticing the presence or absence of the sound change in question in daily life, through the regular consumption of media. For initial observations and data collection, we focused primarily on /tw/ sequences, as the posteriorization of /t/ in this context was the initial observation of this study. Only after our initial observations did we notice that posteriorization was not exclusive to /tw/ sequences; it applied to all cases of anterior coronal obstruents in onset clusters before /w/.

During the first half of 2021, we compiled a list of 10 speakers of US American English who exhibited posteriorization of /t/ before /w/, noting, where possible, their places of birth, present locations, and any other locations of note. Additionally, we extracted audio examples of these posteriorized alveolars for further acoustic analysis and comparison. Later, the extracted examples were imported into Praat v.6.0.43 (Boersma & Weenink, 2018) for playback, analysis, and comparison to non-posteriorized productions of these sequences by other speakers. Furthermore, importing these audio files in to Praat also allowed us to draw the waveforms and spectrograms shown throughout this paper.

4. Observations

After gathering our initial observations, and follow-up investigations into the speakers’ backgrounds, we plotted their locations on a map of the United States (Figure 3).

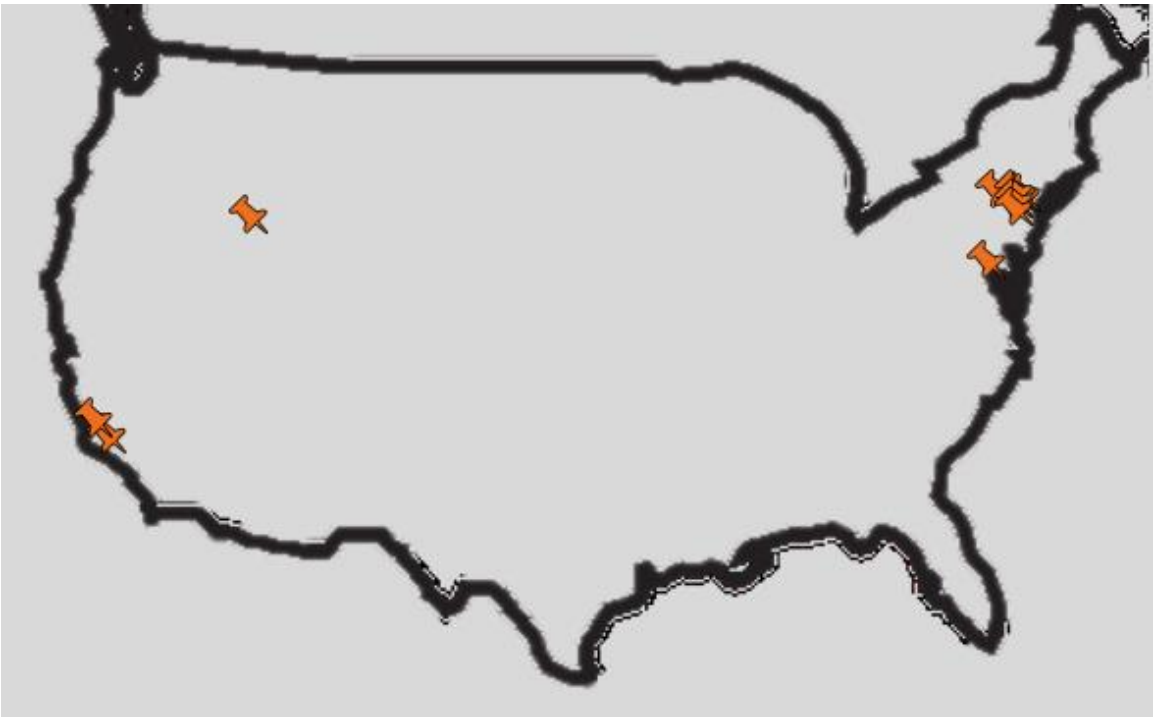

Figure 3. Map of contiguous United States of America with locations of speakers with posteriorized /t/ before /w/.

Based on this map, we see that speakers who exhibited the shifts of /t/ into [t͡ʃ], /d/ into [d͡ʒ], and /s/ into [ʃ] clustered in a single area: five of the ten speakers lived in the New York/New Jersey/Connecticut tri-state area. Other locations of speakers exhibiting the changes in question were Los Angeles, California (two speakers); Salt Lake City, Utah (one speaker); [5] and Washington, DC (one speaker).

As stated in section 3, our initial observations focused on /tw/ sequences, as seen in Figure 4 with the word *between* and in Figure 6 with the word *twitch*. Contrast these with the non-posteriorized pronunciations of *between* and *twitch* by the first author shown in Figures 5 and 7, respectively.

In viewing these waveforms and spectrograms, there are two key features to note: First we can see that whether /t/ is posteriorized or not, a significant amount of noise is present after/during the release. However, this cannot, on its face, be used as a diagnostic for posteriorization. We have to consider whether the noise in question represents aspiration noise, notably in the lower bands of the spectrogram, as is the norm for /t/ in the onset of a stressed syllable, or else frication noise, notably in the upper bands. Only the latter of these is indicative of posteriorization ([t͡ʃ]). Indeed, we find this difference in noise in the production of /tw/ by these two speakers. Additionally, note the differences in

[5] The speaker whose location is plotted as Salt Lake City completed a master's degree at American University in Washington, DC, and has lived there since then.

amplitude of the initial release bursts by these speakers. While the speakers in Figures 4 and 6 have no discernable initial burst, the productions of the first author in Figures 5 and 7 show a visible amplitude spike in their waveforms. This acoustic difference is again indicative of the articulatory differences being produced by these speakers. In short, discernible affrication accompanies posteriorization of /t/ before /w/.

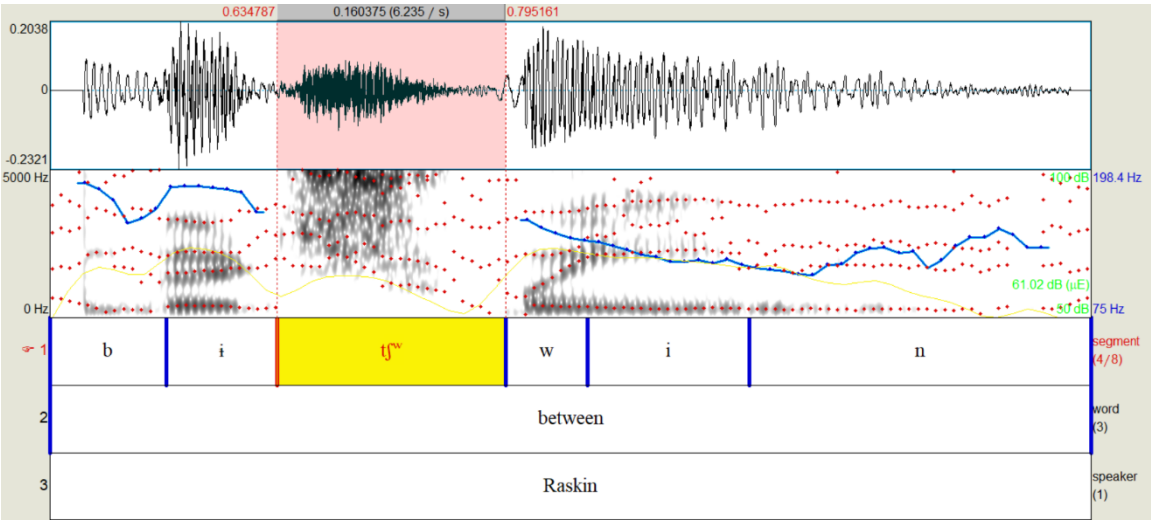

Figure 4. Waveform and spectrogram of U.S. Representative Jamie Raskin (Maryland) saying English *between* with posteriorization of /t/ before /w/ in word-medial position (ABC News, 2021).

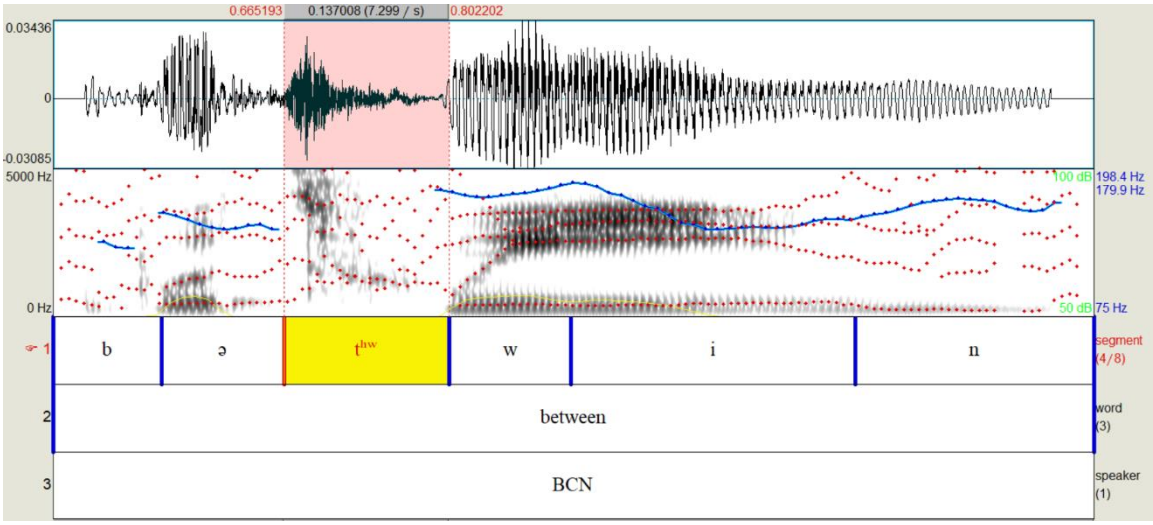

Figure 5. Waveform and spectrogram of first author BrettC Nelson (Louisiana) saying English *between* without posteriorization of /t/ before /w/ in word-medial position.

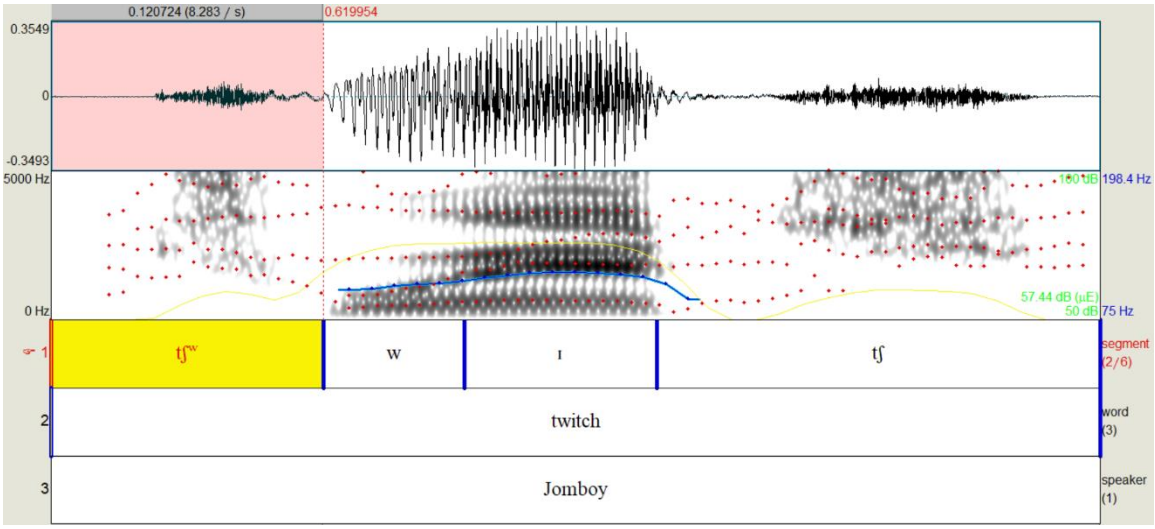

Figure 6. Waveform and spectrogram of YouTuber Jomboy (New York/New Jersey) saying English *twitch* with posteriorization of /t/ before /w/ in word-initial position (Jomboy Media, 2021).

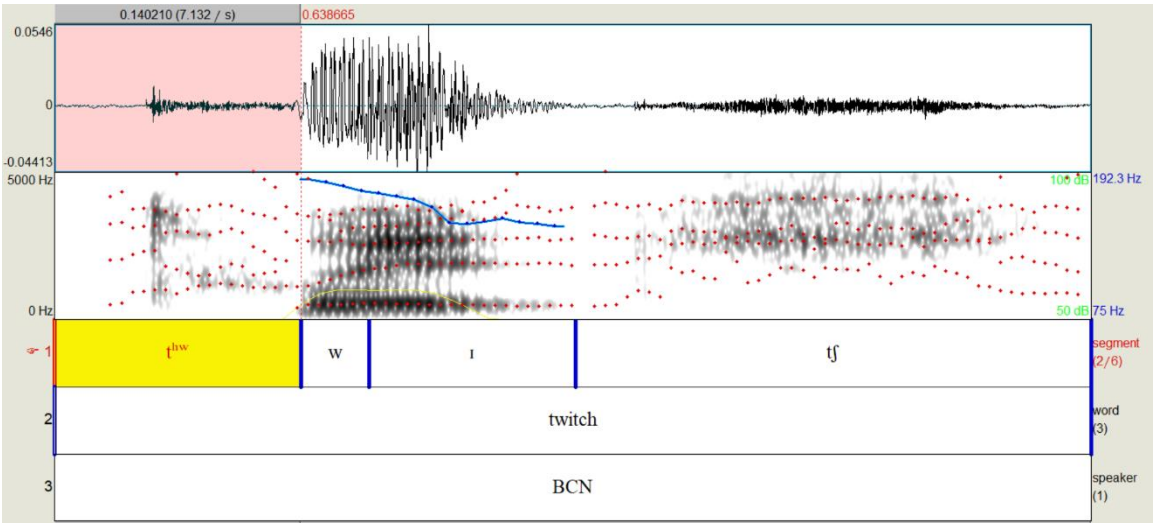

Figure 7. Waveform and spectrogram of first author BrettC Nelson (Louisiana) saying English *twitch* without posteriorization of /t/ before /w/ in word-initial position.

We then noticed that posteriorization occurs in other coronal obstruents clustering with /w/. Notably, we observed that these same speakers would posteriorize /d/ in the much rarer sequence /dw/, as seen with *Dwayne* in Figures 1 and 2 (section 1). Upon realizing that this change was not restricted to /t/, nor by frequency effects, we then turned to /s/, the other anterior obstruent that clusters with /w/, and found that it, too, showed

posteriorization, as seen with *swing* in Figure 8. (Cf. the first author's non-posteriorized pronunciation in Figure 9.)

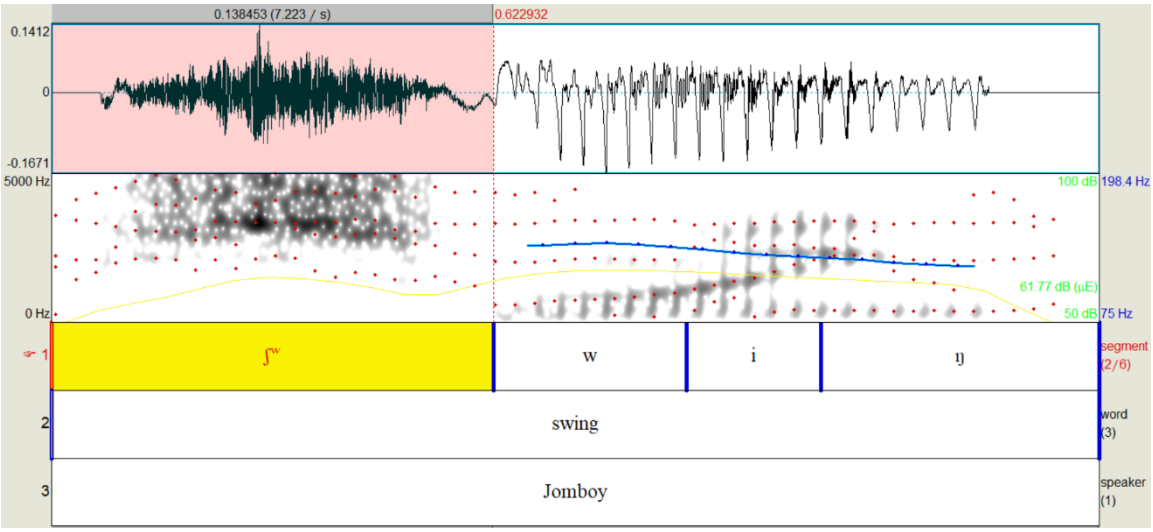

Figure 8. Waveform and spectrogram of YouTuber Jomboy (New York/New Jersey) saying English *swing* with posteriorization of /s/ before /w/ in word-initial position (Jomboy Media, 2019).

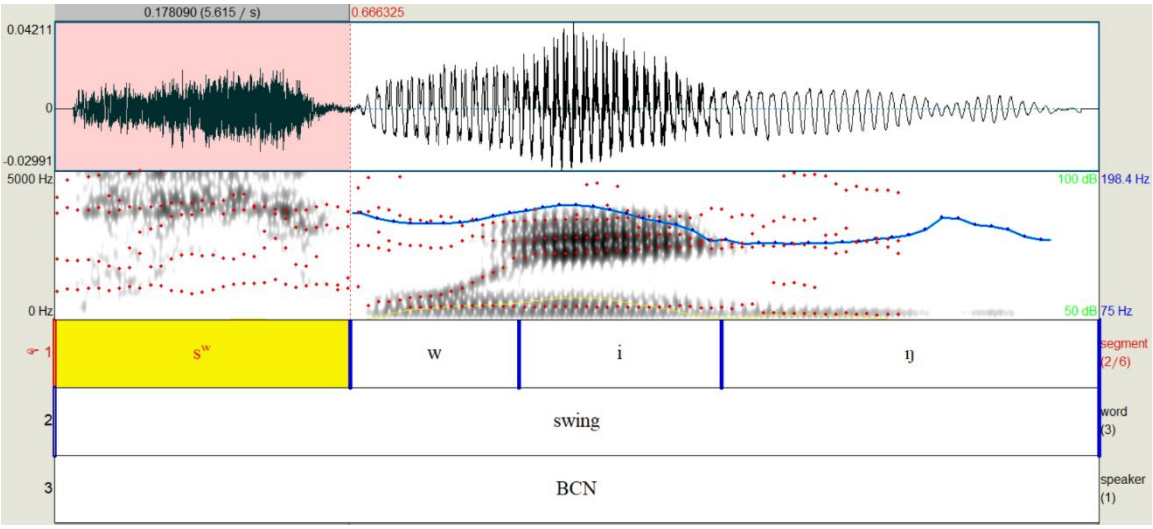

Figure 9. Waveform and spectrogram of first author BrettC Nelson (Louisiana) saying English *swing* <u>without</u> posteriorization of /s/ before /w/ in word-initial position.

5. The phonetics and phonology of obstruent posteriorization

5.1 Rounding

Lip rounding is intrinsic to the labiovelar approximant (back vocoid) /w/ and this gesture overlaps with adjacent segments. In /tw/, for example, the lips may be rounded during the entire articulation of the stop [t] in addition to the articulation of [w] (see Figures 4 and 6). This gestural overlap occurs even among speakers who do not posteriorize coronal obstruents in this position (see Figures 5 and 7). This coarticulated rounding lowers the spectrum prominence to the F3 range, as seen in Figures 8 and 9. Such effects of coarticulated rounding are present in all coronal obstruent + /w/ sequences, in all speakers of English, usually as [t^{hw}, $d̥^{w}$, s^{w}].

5.2 Reanalysis

Although all speakers have coarticulated lip rounding in obstruent clusters with /w/, most speakers retain the canonically anterior obstruents in this context: [t^{hw}, $d̥^{w}$, s^{w}]. However, a small subset of speakers who cluster around the New York City area (based on our observations so far) produce /t, d, s/ as [$t\widehat{ʃ}^{w}$, $d̥\widehat{ʒ}^{w}$, $ʃ^{w}$] before /w/. We propose that such speakers do not simply ascribe the presence of rounding in obstruent clusters with /w/ to co-articulation or spreading of lip rounding from /w/ onto the obstruent. Rather, these speakers have reanalyzed the lip rounding as an enhancement gesture for [posterior] (section 2). That is, they not only ascribe rounding to the presence of /w/, but also to the presence of [posterior] in coronal obstruents that cluster with /w/.

5.3 A new rule

Based on these speakers' reanalysis of the presence of coarticulated rounding in alveolar obstruents /t, d, s/ preceding /w/, we propose that they have phonologized a new rather "crazy rule" (Bach & Harms 1972) in which anterior obstruents become [posterior] in onset clusters before /w/ — as well as before /ɹ/, as they show regular posteriorization before /ɹ/ as well. Moreover, /t, d/ affricate before /w/ and /ɹ/ in their speech, as [posterior] obstruents in English are necessarily [strident] (section 2). And finally, /t, d, s/ also become [distributed] before /w/ and /ɹ/, as [posterior] obstruents are normally [distributed] in English. These changes are summarized in (2).[6]

(2) $$\begin{bmatrix}\text{obstruent}\\ \text{coronal}\end{bmatrix} \rightarrow \begin{bmatrix}\text{posterior}\\ \text{distributed}\\ \text{strident}\end{bmatrix} / \$\_\_ \begin{Bmatrix}ɹ\\ w\end{Bmatrix}$$

[6] The process does not apply to [distributed] /θ/ (although we have yet to encounter words with /θw/ in recordings of the relevant speakers).

Note that featurewise, /z/ might be expected to participate in (2), but in practice, /zɹ/ and /zw/ do not occur at the beginning of words or syllables in English (see fn. 1 above).[7]

5.4 Implications for affricate phonotactics

The general rule in (2) results in numerous affricates in complex onsets, in direct contradiction of a phonotactic restriction that is commonly assumed in the literature on English phonology, e.g.:

- "Affricates do not appear in complex onsets" (Hammond 1999:101)
- "the affricates /t͡ʃ/ and /d͡ʒ/ ... cannot occur in an onset with any other consonant: there are no English words like /t͡ʃlɪŋk/ "chlink," /d͡ʒlæm/ "jlam" ... while we find sequences like /tɹʌk/ "truck" or /dɹɑp/ "drop"" (Harley 2006:66)
- "in English, affricates cannot be the head of a complex onset" (van der Hulst 2020:302)
- "No affricate + sonorant, that is, *tʃ dʒ + l r w" (Alderete & Tupper 2018:18)
- "affricates in complex onsets are prohibited in English" (Magloughlin 2018:95)

That is, the general rule in (2) undermines "the general restriction against affricates in complex onsets" (Hammond 1999:101). Children who are less restricted by spelling conventions are certainly content to spell *tree* as <chree> and *Drew* as <Jrue> (Read 1971) and such spellings are increasingly common among adults, e.g. *chru* (*true*) and *Jrue Holiday* (Magloughlin 2018:139–40). Duanmu (2009) argues explicitly that "[tr] ... is an affricate" (p. 30) and shares this anecdote from a colleague: "Rob Burling (p.c.) also told me that a friend of his once insisted that *try* should be spelled as *chry*, where the word starts with an affricate" (ib.). The point is: the rarity of words like *Jrue* or *Chwezi* in present-day English may be strictly accidental, due to phonological history; the prohibition on affricates in complex onsets seems no longer active — notably among speakers who apply posteriorization as in (2).

6. Concluding remarks: limitations and speculations

As stated in section 2, this study took place during the COVID-19 pandemic that began in March 2020. There were no in-person observations, recordings, or measurements made, except those of the authors, neither of whom exhibit the sound changes of interest. All data

[7] Barber (2004:1814) reports that in the French proper name Zouave is variably rendered with vowel hiatus ([zuːˈɒv]) or with a /zw/ onset ([zwɒv]), neither of which is favoured in English phonology.

were collected over the internet and (rarely) through television media. As such, a consistent or even quiet recording environment could not be controlled for.

In the absence of robust phonetic and experimental data, we leave a broad question unanswered: all English speakers produce /tw, dw, sw/ with lip rounding, and all speakers are implicitly aware of the enhancement relationship between lip rounding and the defining tongue gesture for [posterior] (section 3), so why are relatively few speakers compelled to assume the presence of [posterior] in /t, d, s/ before /w/? We leave this question for future research. In the meantime, we hope that the present paper acts as a call to ears to listeners of English across Canada, North America, and the world. We suspect that the phenomenon of obstruent posteriorization before /w/ occurs more broadly among speakers of English today, but goes unnoticed because /t, d, s/ rarely contrast with /t͡ʃ, d͡ʒ, ʃ/ in complex onsets with /w/. Thus we ask that linguists and listeners, now made aware of this sound change in progress, keep an open ear to productions of it!

Another question that remains is why speakers around the New York City area seem more likely to reanalyze /tw, dw, sw/. New York has long had the largest community of Yiddish speakers in the world, so it is tempting to suggest that this language's affinity for affricates and /ʃ/ in complex onsets has influenced some English speakers in New York, notably through loanwords but also simply by being part of the linguistic environment, e.g., *sweat* is pronounced with initial /ʃ/ in Yiddish and Yiddish-accented English and, even more strikingly, *twelve* is pronounced with an initial affricate (cf. Jacobs 2005:121). At present, however, we have no proof of direct or indirect influence of Yiddish on English speakers who pronounce /t, d, s/ as [t͡ʃ, d͡ʒ, ʃ] before /w/.

Finally, we have ignored the fact that English /ɹ/ involves lip rounding. This is also an enhancement gesture, according to Keyser and Stevens (2006):

> "lip rounding functions to enhance the difference between the liquids /l/ and /r/ ... In the case of /r/, the frequency of F3 is low, and ... the lowering of F3 is enhanced if the front-cavity length is increased by rounding the lips. For /l/, by contrast, F3 is higher in frequency and the front-cavity length is shorter. Lip rounding is avoided in order to guarantee a higher F3." (p. 51)

Our claim is that speakers who posteriorize /t, d, s/ before /w/ do so because obstruents are coarticulated with lip rounding, which they reanalyze as enhancement of [posterior] in an obstruent. This raises the possibility that speakers who posteriorize /t, d, s/ before /ɹ/ may do so because obstruents are coarticulated with lip rounding in this context, too. This coarticulation can also be reanalyzed as a phonetic enhancement gesture that normally accompanies [posterior] in obstruents. This new account predicts that /t, d/ may show posteriorization and affrication before variants of English "r" which are not post-alveolar, such as British [ʋ] or Scottish [ɾ ~ r], which may well involve some lip rounding or protrusion. We leave this prediction with researchers with access to relevant dialects (but cf. fn. 2 above).

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