Where and what is (t,d)? A case study in taking a step back in order to move sociophonetics forward.

Rosalind A. M. Temple

New College, Oxford[1]

AUTHOR-ACCEPTED MANUSCRIPT OF PAPER IN C. CELATA & S. CALAMAI (EDS, 2014). *ADVANCES IN SOCIOPHONETICS*. (STUDIES IN LANGUAGE VARIATION 15). AMSTERDAM: JOHN BENJAMINS. PP. 97-136. DOI: 10.1075/silv.15
https://benjamins.com/#catalog/books/silv.15/main

1. Introduction

The ultimate aim of sociophonetics, consistent with the vision of variationist sociolinguistics more broadly since its inception, goes beyond mapping the distribution of variants across social categories to integrating variability into the grammar (see, for example, Stuart-Smith *et al*'s discussion of exemplar theory in this volume). At the heart of sociophonetics is phonetic detail, and the crucial contribution of the field, if it may be called such[2], is the accurate description of patterns of phonetic variation in naturalistic data, on which theoretical constructs may be built. However, notwithstanding the work of Stuart-Smith, Scobbie and their collaborators, reported here and elsewhere, and phonetically informed variationist analyses of, for example, /t/-glottalisation (e.g. Docherty & Foulkes 2005), insufficient attention has been paid to the phonetic substance of some major consonantal variables. The present paper focuses on one such variable, perhaps the most widely studied consonantal variable in English sociolinguistics, whose social indexicality has been shown to be restricted to relatively few dialects but which has garnered so much attention within and beyond sociolinguistics because of its claimed implications for phonological theory.

[1] My heartfelt thanks to the following colleagues and friends for encouraging, advising and challenging me during the preparation of this paper: at Pisa, Gillian Sankoff and Jane Stuart-Smith; in Oxford, John Coleman and Sali Tagliamonte; remotely and elsewhere, Ricardo Bermúdez-Otero and John Glyn. Thanks too to the editors of this volume for their painstaking reading of the first draft of the paper. Its shortcomings remain, of course, my own.
[2] See Calamai & Celata and Stuart-Smith *et al*, this volume, for brief discussions of the scope of the term 'sociophonetics'.

The variable deletion of coronal stops in word-final clusters (e.g. *stopped* pronounced as variably [stɒpˀt] or [stɒpˀ]) seems to occur in all varieties of English and has been one of the most studied variables in the variationist sociolinguistics of the language. It has been used as a diagnostic in debates about the origins of African American Vernacular English (AAVE) since the late 1960s (e.g. Wolfram, 1969) and more recently it has figured prominently in the exploration of cross-dialectal differences (e.g. Santa Ana, 1992; Smith *et al*, 2009), the acquisition of variable constraints (e.g. Guy & Boyd, 1990; Roberts, 1997; Smith *et al*, 2009) and particularly the relationship between variation and phonological theory (e.g. Guy, 1991; Guy & Boberg, 1997; Bermúdez-Otero, 2010a,b; Coetzee & Pater, 2011). The phonological model most widely applied to the variable has been one rooted in Lexical Phonology (LP), which characterises (t,d)[3] as an iterative derivational rule that applies variably in the lexical and postlexical phonology. The analysis is motivated crucially by there being a consistent (statistical) morphological constraint on (t,d) whereby monomorphemic forms undergo deletion of the final consonant considerably more frequently than bimorphemic forms. However, findings from several recent studies (e.g. Tagliamonte & Temple, 2005; Smith *et al*, 2009; Guy *et al*, 2008; Hazen 2011) have introduced an element of doubt as to the role of this particular constraint, thus undermining the LP account of the variable. Temple (submitted) goes a step further in an exploration of some of the theoretical and methodological issues which arose during the research reported in Tagliamonte & Temple (2005), arguing that once the morphological constraint is called into question the case for treating (t,d) as a phonologically categorical[4] variable rule within any framework needs to be made anew, since there remain no obvious grounds for treating it in this way[5]. Moreover, the phonetic issues highlighted in that paper suggest that there are good grounds for treating (t,d) as a

[3] The variable notation will be used here as a shorthand means of referring to both the variable rule which deletes word-final coronal consonants in clusters and the set of consonants affected by that rule.
[4] There is a mismatch between the use of the word *categorical* by variationists on the one hand and general phonologists on the other: the former oppose *categorical* rules, which always apply (as in cases of regular allophony) to *variable rules*, which apply probabilistically (e.g. coronal stop deletion is more likely to occur before consonants than vowels); the latter differentiate between *categorical* processes (e.g. the "replacement" of a voiced stop by a voiceless one under assimilation) and *gradient* ones (e.g. the partial devoicing to various degrees of a voiced stop under the same conditions). Both dichotomies apply to the discussion of (t,d) but the term *categorical* is used here to mean non-gradient, since all analyses of the variable in question agree that it is probabilistic.
[5] Some scholars (e.g. Bermúdez-Otero, 2010a; Myers, 1996) argue for a dual view of (t,d) as both a categorical and a gradient rule, as explicitly allowed for in Kiparsky's (1985) view of LP. The case for the categorical rule still needs to be made under this view.

function of common Connected Speech Processes (CSPs) observed by many phoneticians in English rather than a particular variable rule restricted to these coronal clusters.

The present paper will attempt to make the case for the CSP view of (t,d) through a qualitative re-examination of data from the some of the 38 speakers analysed by Tagliamonte & Temple (*op. cit.*), together with comparable data from the same corpus containing other underlying coda consonant clusters and singleton consonants. The data are all taken from audio recordings of sociolinguistic interviews collected for the York Corpus of British English under the direction of Sali Tagliamonte and described in Tagliamonte (1998)[6]. As Stuart-Smith *et al* (this volume) demonstrate in their analysis of the complex social indexicality of the detailed phonetics of rhotics, even cutting edge articulatory techniques cannot in isolation give us a full picture of sociophonetic variability, and need to be triangulated with auditory and acoustic analyses, which are themselves imperfect representations. Articulatory data are not available for the York recordings, so the analysis in this paper will draw on acoustic and auditory observations, illustrated by detailed phonetic transcriptions and a small sample of illustrative spectrograms; however, since the issues raised also crucially concern articulations which are not necessarily audible or observable from the acoustic signal, reference will be made throughout to the literature reporting relevant articulatory studies.

In Section 2, I examine a range of CSPs to ascertain whether the range of phonetic patterns found in (t,d) consonants is consistent with a CSP analysis and whether these patterns are exclusive to (t,d) consonants. The analysis will touch on issues which must be taken into account in deciding whether word-final clusters and / or other CSPs are amenable to analysis in terms of variable rules. These are issues which have long been the subject of discussion in the phonetics literature and they have not gone entirely unnoticed in discussions of (t,d), having been raised by e.g. Wolfram (1993), but there is little subsequent evidence that Wolfram's concerns have been heeded. In the discussion in Section 3, I turn to the implications of these observations for

[6] The data collection was funded by a research grant (#R000238287) from the Economic and Social Research Council for the United Kingdom. Digitisation of a subset of the data for the present paper was funded by the John Fell fund of the University of Oxford. I am grateful to Damien Mooney for his efficient assistance with the digitisation.

modelling the behaviour of word-final stop consonants in the grammar in the light of ongoing debates about the phonetics:phonology interface, a prerequisite to sociophonetic/sociophonological modelling. I thus hope in to demonstrate how, paradoxically, advances in sociophonetics might sometimes be achieved by stepping back and re-examining the phonetic detail behind a rule which is generally held to be predominantly a categorical phonological one. It will be seen that much can emerge from such an apparently retrospective approach which can contribute to advances in sociophonetics and wider debates concerning the relationship of its findings to phonetic and phonological theory, albeit there are questions which will remain unanswered until further advances are made by applying particularly articulatory techniques to this variable.

2. (t,d) and Connected Speech Processes[7]

In contrast to the phonologically based accounts of (t,d), which posit a categorical alternation between the presence and absence of a surface reflex of underlying word-final /t,d/, CSPs provide, in Nolan's words, "a way of describing a continuum of decreasing phonetic explicitness" (1996: 15). The degree of explicitness is influenced by adjacent segments or by prosodic and other factors like speech rate or by language-specific or variety-specific conventions or, most likely, by a combination of some or all of these factors. Thus some processes are more "phonetically natural" than others in that they arise more directly from the physical constraints inherent in the vocal mechanism, while others must be seen as arising from cognitive processes (*ibid.*: 19). Between the two extremes "phonetic naturalness" is a matter of degree, rather than there being a simple dichotomy between effects resulting, "from the mind or from the mouth" (*ibid.*: 17). Of course, phonetically natural processes may also be overridden even in very rapid speech, a choice which must be cognitive, so there are evidently interactions between levels of constraints[8]. There is no reason why there should not be

[7] The process-based characterisation of these phenomena implies an analysis in terms of rules operating on segments in citation forms; the discussion here will adopt that descriptive convenience, following Nolan and others, but this should not be taken as representative of a commitment to any theoretical analysis in such terms.

[8] Nolan points out that both variable phonetic explicitness and phonetic naturalness are continua. In order to avoid confusion in the following discussion, I shall use the term "scale" to refer to the continuum between physiologically constrained and cognitively governed CSPs and "continuum" to

abstraction from phonetic continua to discrete phonological categories, provided a case can be made for such analysis, but in the absence of a watertight case for (t,d) (see above) the aim here is to determine conversely whether there are parallels between the behaviour of word-final (t,d) stops and that of other word-final stop consonants, as characterised in terms of points along the CSP continuum, or whether (t,d) does in fact merit the special status accorded to it in variationist sociolinguistic analyses.

A comparative analysis is not an entirely straightforward undertaking, since there are some structural obstacles to direct comparisons between word-final consonants. Comparison with non-cluster /t/ and /d/ has to take account of the fact that acoustic cues are available for postvocalic consonants which are not present for /t/ and /d/ in clusters, such as formant transitions into closure from the preceding vowel. Clusters involving other word-final stop consonants are more limited in distribution than (t,d) clusters: they are always tautomorphemic with the preceding consonant; /g/ never occurs in word-final clusters; /b/ occurs in a very few, rare lexical items preceded by /l/; /p/ and /k/ are only preceded by /l/, /s/ and homorganic nasals, although it should be noted that monomorphemic (t,d) also occurs almost exclusively with preceding /s/, /l/ and homorganic nasals (94% of the tokens analysed by Tagliamonte & Temple (2005) and 95% of tokens in the "demographic" part of the British National Corpus[9]; see Temple, submitted: Tables 2 and 3), other consonants appearing mainly or exclusively in past-tense verb forms (accounting for about 28% of the total number of tokens in Tagliamonte & Temple and less than 15% of all the BNC (t,d) tokens[10]). Nevertheless, with these *caveats* in mind, some useful comparisons can be made.

For convenience, the discussion will be structured round an adapted version of Nolan's (*op.cit*) classification of CSPs, expanding it to include other combinatorial properties of word-final consonants which might be considered as leaving the essence of the segment in tact, such as [t^{h}] *vs* [t] *vs* [t$^{\neg}$]. I thus examine in turn release

---

refer to degrees of phonetic explicitness. Neither continuum is truly unidimensional, as Nolan acknowledges.

[9] The BNC spoken corpus is described in Crowdy (1995); the figures here are taken from the word-frequency list provided by Kilgarrif and downloaded from http://www.kilgarrif.co.uk/bnc-readme.html on January 7th, 2011

[10] Total Ns = 1118 and 78726 respectively.

characteristics, lenition, glottalisation, voicing assimilation, place assimilation and coalescence, although the boundaries of classification are far from clear-cut, and this will be evident throughout. The analysis is qualitative: once one focuses on phonetic detail in specific contexts, numbers of tokens per cell fall to a level where it is not possible to use the kinds of statistics which can be performed on a categorial binary alternation ([t,d] *versus* zero) across aggregated contexts (such as "before obstruents/nasals"). It is not the proportion of tokens concerned which is central to the present argument, but whether the range of realisations present in the data corresponds to that predicted by a CSP analysis of (t,d).

2.1 Release characteristics

Prepausally and prevocalically, alveolar stop reflexes of the York (t,d) consonants show the range of release characteristics one might expect to find in British English: unreleased (prepausally) and released more or less strongly, /t/ with and without aspiration, /d/ sometimes devoiced. We shall not dwell further on prepausal or prevocalic tokens in this sub-section. It is no surprise that rates of deletion of non-prepausal (t,d) consonants across studies have consistently been found to be considerably higher before consonants than before vowels[11], and highest before other stops, where they are least likely to be released audibly. This effect would rank very much towards the phonetically natural end of Nolan's "mouth-mind" scale. Nevertheless, logically if there is stop closure this has to be released somehow in order to articulate any following sound, including consonants. Henderson and Repp (1981) examined word-internal heterosyllabic and word-final tautosyllabic stop sequences in read speech. On the basis of acoustic analysis and perceptual tests they propose a five-point scale of phonetic classification of stops: unreleased, silent-released (no clear acoustic burst), inaudible release (clear acoustic evidence of a weak burst, but imperceptible), weak release, strong release. They did not test C.C sequences across word boundaries, but suggest that the word-internal condition (where the consonants were generally heteromorphemic as well as heterosyllabic) is somewhat comparable, so one might expect to find the same range of effects. The articulatory and aerodynamic conditions affecting the second consonant in a word-

[11] In African American English (e.g. Wolfram, 1969) the difference can be much less, but these varieties also show patterns of social stratification (particularly pre-vocalically) which are generally not found elsewhere and arguably cluster reduction here is a truly sociolinguistic variable and not just the effect of a combination of CSPs.

final cluster are, of course, different but it remains the case that where there is consonantal closure there will have to be separation of the articulators in order for a third, word-initial consonant to be produced. Before looking at cluster-final consonants followed by stops in the more naturalistic York data, we first examine the range of releases in word-final singletons in the same context.

Various types of release[12] occur in word-final singleton /t/ and /d/ followed by stops, though the limited distribution of word-final /t/ and the preponderance of glottalised realisations, particularly in the highly frequent words where it most often occurs (e.g. *it, got*), makes examples of voiceless final alveolars harder to find[13]. There are nevertheless examples of clearly released [t], as in (1):

(1) *and hot coals* [hɒtkʰðʊlz] *used to drop out*

and of clearly articulated [tˀ] with no acoustic or auditory evidence of release, as in (2):

(2) *another catch would detect that you 'd got eight bales* [ɛɪtˀbɛɪlᵛz]

as well as less clear examples of unreleased voiceless stops whose place of articulation is difficult to determine, as in (3), where the very short preceding vowel and glottal reinforcement make it hard to tell whether the word *cut* ends in a [tˀ] or a [pˀ] assimilated to the following [m]:

(3) *they cut my* [ˈkʰʊʔt͡ˀmə] / [ˈkʰʊʔp͡ˀmə] *trousers off me*

/d/ occurs in a wider range of lexemes and shows all types[14]. Examples (4) and (5), where the following consonant is /m/, illustrate the same sequence of words uttered by the same speaker in the same stretch of discourse (talking about traditional Morris dancing), with the word-final /d/ weakly released in (4) and unreleased, with no acoustic burst, in (5):

(4) *So we do Escrick which is long sword metal* [sɔːdmɛtl̩]

[12] We make no distinction here between Henderson & Repp's first two categories (unreleased *vs*. silent release with no acoustic burst), since none of the tokens discussed are in absolute final position. Neither is it necessary here to make a systematic distinction between weak and strong audible release, although the presence or absence of audible aspiration is noted in the transcriptions.

[13] For example, the recording of SW, who produced examples (1) and (2), contains 48 tokens of word-final singleton /t/ followed by stops, 39 of which were in frequent function words.

[14] Speaker SW produced fifteen tokens of singleton /d/ before stops, including examples (4) and (5).

(5) *there 's long sword metal* [sɔːdˀmɛtl̩ː]

There are also a few examples by this and other speakers of inaudible release accompanied by a clear, if weak, acoustic burst, as in (6):

(6) *and I never did get* [dɪdgɛʔˀ] *round to seeing it*

Word-final stop consonants at other places of articulation are rarer[15], but cases of both released and unreleased articulations are found with following stops, as in (7)-(8) and (9)-(10) respectively, and there are even examples of inaudible release with a weak acoustic spike, as in (11), which is illustrated in Figure 1[16]:

(7) *my grandfather used to go to a pub down* [pʊbdaʊn] *there*

(8) *there's a lot of (…) sick people* [sɪkpiːpl] *as in…*

(9) *followed the the cop car* [kʰɒpˀkaːɹ]

(10) *and you roll it up into a big ball* [b̥ɪgˀbɔːl] *and stick it on the end*

(11) *primary school goes from reception up to* [ʊptʰə] *Year 6*

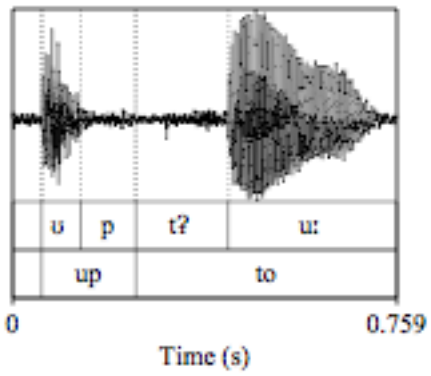


Figure 1. Waveform showing up to year s[ix] *(11) with inaudibly released [p]; female speaker.*

[15] SW, for example, has eighteen pre-stop singleton tokens of /p/, fourteen of them in the word *up*, sixteen tokens of /k/, six of /g/ and none of /b/.

[16] Unfortuately space precludes spectrographic illustration of every example so a small selection is provided.

As for the (t,d) cluster tokens[17], there are no cases of inaudible release with clear acoustic bursts, but both released and unreleased reflexes of both consonants may be found before following stops. Many of the released tokens occur when the speaker is hesitating, as in (12), or pausing for a discourse effect, as in (13)[18]:

(12) *he'd left* [lɛftᵊ] (.) *Betty with nothing*

(13) *and he found Minesweeper* [faʊnd̥] (.) [maːɪnswiːpʰə]*, have you played Minesweeper?*

But there are also clear cases where no pause is involved, as in (14) and (15):

(14) *like my hands would have been fucked basically* [fʊʔtbe̞sɪklɪ]

(15) *in an underground bunker* [ʊndəgɹaʊndbʊnkʰə̹]

(16) and (17) show unreleased /t/ and /d/ respectively:

(16) *your needles left particles* [lɛftˈpɑːtɪklʸz] *in the groove of the record*

(17) *been told by* [tɔ̣ːldˈbaɪ] *that many people*

In non-(t,d) clusters the same range of patterns is found, albeit to a much lesser extent, as illustrated by examples (18) and (19):

(18) *I'm trying to think now* [θɪŋk̟naʊ] *how I can make…*

(19) *just don't ask me* [askˈmi] *for help*

These examples demonstrate clearly that coronal-stop reflexes of (t,d) consonants exhibit the same range of realisations as other singleton and cluster-final plosive consonants when followed by a stop in connected speech. This observation on its own poses no problem for the generally accepted account of (t,d), but we now turn to some rather more problematic issues for that account.

2.2 Lenition

In this section we first compare the range of lenition patterns in (t,d) with that in the comparator word-final consonants, then examine the possibility that there are

[17] (t,d) tokens are taken from the original analysis in Tagliamonte & Temple (*op.cit.*), which was selective in order to maximise even distribution across speakers, morphological classes and lexical items. The average number of tokens per speaker with a following stop was 8.6.

[18] This is example (11) in Temple (submitted) and is illustrated there by a spectrogram in Figure 7)

sociolinguistic constraints on (t,d) which might differentiate it from other cases of full lenition at word boundaries; we next assess whether the contextual influences on full (t,d) lenition are consistent with a CSP analysis or require specific phonological rules, and finally identify cooccurrence patterns with lenition of other consonants in a given string.

2.2.1 Lenition patterns in word-final stops

In his commentary on Nolan's (1992) discussion of alveolar–to–velar place assimilation, Hayes proposes a general phonetic rule of word-final alveolar weakening, on the grounds that, "[f]or example, the segment /t/ is often weakened in its articulation even when no other segment follows" (1992: 284). In fact, very few of the unambiguously realised (t,d) consonants are weakened alveolars in the York data, but there is some evidence of the expected "continuum of phonetic explicitness" whether or not another consonant follows. Examples (20)[19] and (21) show somewhat lenited prevocalic /t/ and /d/, the latter also being devoiced, along with the preceding and following segments, and (22) shows a rather greater degree of gestural weakening, to a retracted fricative articulation. (20) is illustrated in Figure 2.

(20) *(it) was the discipline I liked and* [lɐɪt̬ˢən] *that was all there was to it*

(21) *she wa'n't very pleased wa'n't* [pl̥ʸi̯z̥tˌʰʍɒnʔ] *my mum*

(22) *they went and knocked on* [nɒ̰ʂɔn] *Andrew's door*

Parallel examples of lenition are found with singleton /t,d/ and other stops but again these are relatively uncommon. (23), illustrated in Figure 3, is a very lax, slightly fricativised articulation:

(23) *it really reminded me* [ɹ̥ʷmɑ̤nd̥ʊ̤d̥ʷᶻmei]

Examples (20) to (22) would count along with non-lenited stops as non-applications of a variable rule of coronal stop deletion, and that is how they were treated by Tagliamonte & Temple (*op.cit.*). The deletion rule would be said to have applied only at the extreme open end of the continuum of lenition, where there is no residual

[19] There is some debate in the literature (*cf.* Buizza 2011a, 2011b) as to whether affricated release constitutes lenition or fortition, but the York data seem similar in this respect to the alveolar affrication found in "Modern RP" by Buizza and to be further instances of lenition, often co-occurring with a lenited stop articulation, as here.

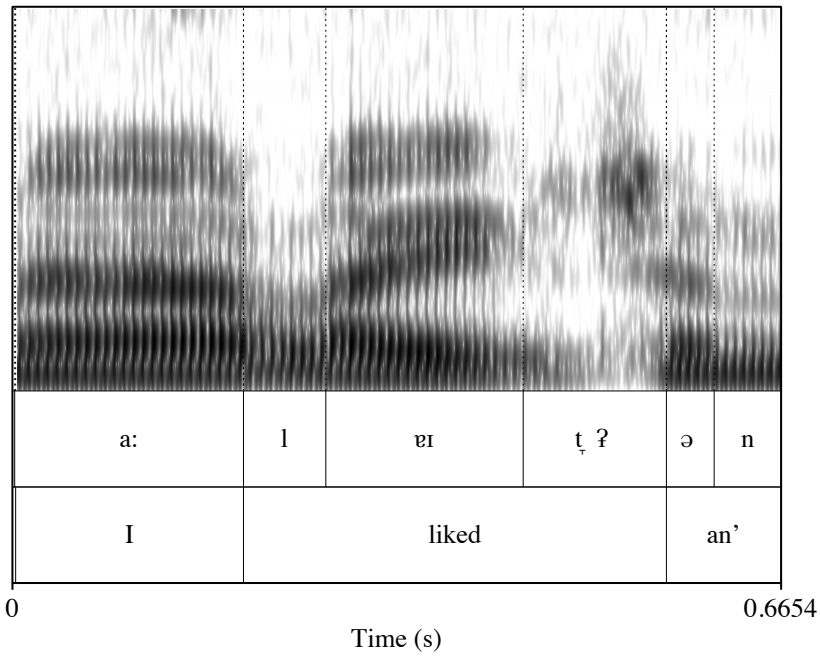


Figure 2. Spectrogram showing I liked an' *(20); male speaker.*

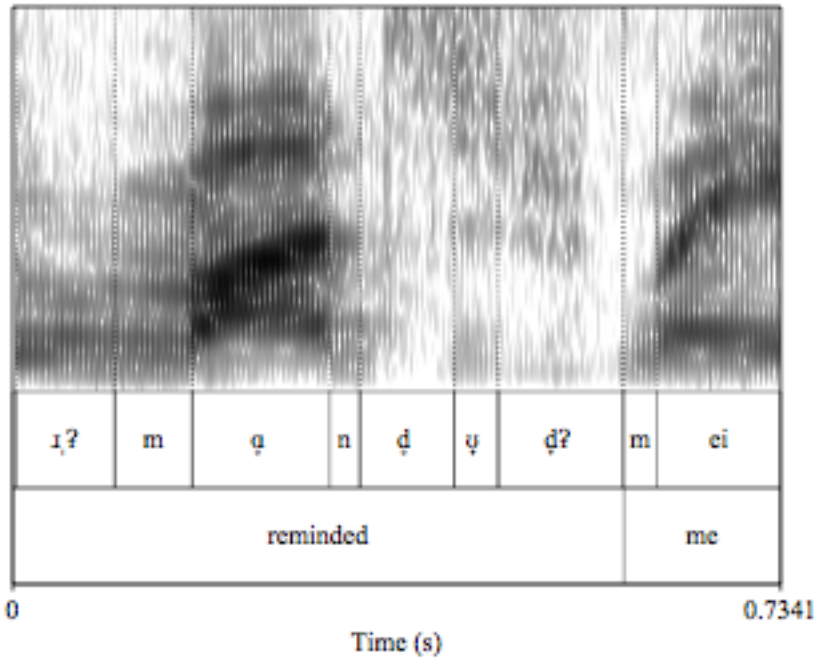


Figure 3. Spectrogram showing reminded me *(23); female speaker.*

auditory or acoustic evidence of a reflex of /t/ or /d/. Once again we find parallel cases: there are examples of fully lenited word-final singleton consonants, as in (24), which is very rapid speech, and (25), where the vowel preceding the deleted

consonant is stressed and lengthened, indicating that this full lenition is not necessarily dependent on a rapid speech rate:

(24) *they had the coal <u>delivered</u> by* [dɪlɪvəbə] *rail*

(25) *and it was very <u>vague</u> because* [vɛːɪbɪkʰʊ̯ʒ]

and examples of full lenition in non-(t,d) clusters:

(26) *and my grandchildren are able to <u>help</u>* [təɦɛlʸ][20]

(27) *they didn't <u>ask</u> me* [ˈˈʔasˑmi] *so….*

Word-internally, deletion is probably lexicalised in most cases, occurring nearly categorically in words like *grandmother*, *grandfather* and *Christmas*, but it also occurs in less frequent compounds, such as *landmarks* (28) and *second-hand* (29):

(28) *one of the local <u>landmarks</u>* [lɔːklʸːanmɑːks] *was this brickyard chimney*

(29) *they bought things in <u>second</u>-hand shops* [sɛʔn̩ˈhant͡ʔʃɒps]

As with (t,d), most, though not all, of these examples are pre-consonantal and so an unsurprising outcome of "phonetically natural" CSPs. Indeed Nolan (1992) gives a hypothetical example of the total lenition of word-internal /d/ in the word *hundred* ("[ˈhʌndɹəd] (? → [ˈhʌnḍɹəd]) → [ˈhʌn̩ɹəd]" 1992: 23), which he classifies under "Target Undershoot" at the phonetically natural end of his scale. Is there, then, any alternative evidence that word-final (t,d) clusters are quantitatively or qualitatively different from examples (24) to (28), which would justify their treatment as a special variable rule?

2.2.2 Sociolinguistic variation in lenition

One type of evidence for the special treatment of (t,d) would be sociolinguistic effects not applying to other cases of word-final lenition / deletion. Such effects have been found for AAVE and some southern US dialects, but not for other varieties of English. Gimson's classic text on English pronunciation (as re-edited by Cruttenden) is peppered with what are essentially sociolinguistic judgements, such as the comment

[20] This token has no trace of labialisation, despite the fact that it is followed rapidly by an inbreath and the word *When*, beginning a new sentence.

that, "the elision of one of a boundary cluster of only two consonants sometimes occurs in casual speech but is usually characterised as substandard, e.g. *He went away* /hɪ wɛn ə`weɪ/ (…) *Let me come in* /lemɪ kʌm `ɪn/ " (Cruttenden 2008:302). Interestingly, where word-final clusters are concerned, these contexts correspond exactly to the prevocalic cluster reduction noted as a qualitative and quantitative sociolinguistic difference between African American and other varieties of North American English. By contrast, it is striking that (a) word-final clusters are grouped in the above quotation with cross-boundary clusters, suggesting no special status, and (b) no such evaluative judgements are proffered in comments on the deletion of alveolars before consonants, which Gimson / Cruttenden seem to treat as straightforward, socially unmarked CSPs, entirely to be expected in RP:

> … sounds may be elided in fast colloquial speech, especially at or in the vicinity of word boundaries (…) In addition to the loss of /h/ in pronominal weak forms and consonantal elisions typical of weak forms, the alveolar plosives are apt to be elided. Such elision appears to take place most readily when /t/ or /d/ is the middle one of three consonants (*ibid*.: 303).
>
> Where the juxtaposition of words brings together a cluster of consonants (particularly of stops), elision of a plosive medial in three or more is to be expected, since because of the normal lack of release of a stop in such a situation, the only cue to its presence is likely to be the total duration of the closure (*ibid*.: 304).

2.2.3 Contextual effects on full lenition

(t,d) in the quantitative analysis of York data was not found to pattern with independent social variables, except for a weak tendency for male speakers to delete more frequently than females (Tagliamonte & Temple *op. cit.*: 296-297), but it did follow all previous studies in showing a very strong effect of following phonological segment, with deletion highly favoured before following consonants and disfavoured before following vowels. Gimson/Cruttenden's account of elision/deletion, just cited, and similar patterns found in other languages such as Dutch (e.g., Schuppler *et al* 2009) suggest that this is more likely to be the result of variable CSPs than of a

specific variable phonological rule. The more detailed distributional effects are consistent with this interpretation: following obstruents and nasals favour deletion more than glides and liquids. A further breakdown of the data is presented in Table 1, which shows the results of a multivariate analysis of the effects of preceding and following phonological segment using GoldVarb (Sankoff *et.al.* 2011). The factor weights assigned to following nasals, stops and fricatives appear to justify their treatment as a single statistical factor, which is the common practice with this variable; however, /h/ is here separated from the other following fricatives and clearly behaves very differently. In fact, over half the tokens with following /h/ have a following phonetic vowel and the rates of deletion are identical in these tokens and those with following [h] (90% *vs*. 89%). This again is consistent with a CSP analysis of (t,d), showing that it is following consonants with close oral constriction which inhibit overt reflexes of /t,d/, whereas /h/, with glottal constriction but more open oral articulation, patterns more like vowels.

	FACTOR WEIGHT	% DELETION	TOTAL N
FOLLOWING CONSONANT			
nasal	.918	70	69
stop	.890	66	93
fricative	.887	62	101
glide	.690	38	106
/r/	.605	28	29
/l/	.496	25	24
/h/	.354	11	62
vowel	.291	8.3	507
pause	.200	5.5	127
RANGE	[72]		
PRECEDING CONSONANT			
/s/	.690	41	303
/ʃ/	.565	31	64
nasal	.497	21	329
stop	.382	16	169
liquid	.374	21	126
non-sibilant fricative	.298	12	127
	[39]		
TOTAL			1118

Table 1. Results of GoldVarb analysis of the effect of following and preceding phonological context on deletion of /t,d/.

Although the quantitative results appear to confirm that the CSP analysis of (t,d) is reasonable, the causal link is not so straightforward since, as indicated in the comments on following /h/, they follow the convention of analysing the phonological context in terms of the underlying representation. This practice is consistent with theview of (t,d) as a variable rule which applies in the lexical phonology as well as post-lexically, but it poses analytical problems such as the relative ordering of this and other rules affecting particularly the preceding phonological context, for example /l/-vocalisation. These problems are discussed in more detail in Temple (submitted). They are far less problematic when (t,d) is analysed in terms of CSPs, so we once again turn to the qualitative data to confirm whether the non-phonological analysis can be justified.

We present here just a small sample of typical (t,d) tokens with different combinations of preceding and following consonants where the variable rule analysis would state that deletion has applied, beginning with cases where the preceding and following consonants are pronounced in their unlenited citation forms. Examples (30)-(33) are typical of target undershoot in continuous speech:

(30) *oh I'd <u>booked</u> my* [bʊkˈmə̃] *ticket, yes*

(31) *but we still <u>kept</u> corresponding* [kʰɛpˈkʰɔɹɪspɔndɪŋ] *all the time*

(32) *so of course I <u>left</u> school* [lɛfskuˑlʏ] *at fourteen*

(33) *... whether I spent the <u>first</u> few* [fɜːsfjuʷ] *months of my life*

It is not necessary to assume here that the speaker has deleted the (t,d) consonant in the phonology and therefore produces no alveolar closing gesture; rather, it is perfectly plausible that these are cases where the hypothetical target for the /t/ or /d/ is, "attained less completely in phonetically less explicit pronunciations" (Nolan, 1992: 23). Such undershoot is not solely a function of the segmental context, as shown by the lenition of word-final singletons in (24) and (25), but as pointed out in the quotation from Cruttenden (2008) above, it is especially to be expected in sequences of three consonants, particularly with stops. This is not always the case (see (14)), but nineteen of the twenty-two tokens in the York data set with both preceding plosives and following plosives or nasals are elided. Similarly, the progression from

fricative to fricative without an intervening stop articulation in (32) and (33) is normal in fluent (British) English. In fact, only four out of a total of 71 York (t,d) tokens with both preceding and following fricatives have any audible or acoustic phonetic reflex, and those are all preceded by the voiced weak fricative /v/. These effects are compounded when preceding and following consonants share both place and manner of articulation, as shown in (34), where there is a fluent transition from [p] to [m] with the speaker maintaining the bilabial closure:

(34) *they stopped making* [stɒpˈmeˑkɪm] *bricks er yonks ago*

In (35), where the manner of articulation is different but place is labial in both consonants, the elision is again unsurprising with a fluent transition from labiodental constriction to bilabial closure:

(35) *' think that's what saved my* [seːvmə] *back*

In some cases, the preceding consonant is slightly lengthened, which might be construed as cueing the underlying coronal segment, as in (36) and (37):

(36) *and we were kept busy* [kɛpˑˈbɪziː]

(37) *only when I left school* [ˈlɛfˑskʊˠlˠ]

However, this is not always the case, and indeed evidence for a direct link between closure duration and the number of underlying consonants is equivocal, as confirmed by Kühnert and Hoole, whose articulatory data obtained from electromagnetic articulography (EMA) showed that "the complete fusion of two velar stops in fast speech could […] result in closure durations identical to an individual stop […,] a healthy reminder that the interpretation of closure duration in fluent speech still has to proceed cautiously" (2004: 572).

In all the cases of deletion, there may, as indicated by Gimson/Cruttenden, be a residual alveolar gesture indicating that from a production point of view the (t,d) consonant is somehow present. This could involve a lenited gesture resulting in the uninterrupted frication of (37) or full contact masked by the maintenance of bilabial closure in, e.g. (34) and (36). Note, however, that the (t,d) cases are not unique in this respect: it is perfectly possible that gestural overlap might have occurred in *delivered by* in (24) resulting in the percept of deletion despite a full or lenited alveolar gesture

for the final singleton /d/. We return to the matter of such residual gestures in the discussion of assimilation in Section 2.5.

Relative timing of gestures may also account for deleted tokens with preceding sonorants. In (38) there is coronal closure for the preceding lateral consonant; it is possible that the sides of the tongue were raised before the release of this closure, essentially forming a [d] or [d̥]:

(38) *but there was all <u>old</u> carpets* [ɔ̥lkʰa̠pʰɪʔ͡ts] *and pictures*

In (39) the timing overlap is between the transition from alveolar to bilabial closure on the one hand and the raising of the velum for the cessation of nasality on the other:

(39) *something like eight <u>thousand</u> people* [θaʊz̥n̥pʰiːpəlˠ]

(39) contrasts with (40), where nasality ceases before the bilabial closure:

(40) *they were rather like <u>unmanned</u> bombs* [ʊnmandˀbɒmz]

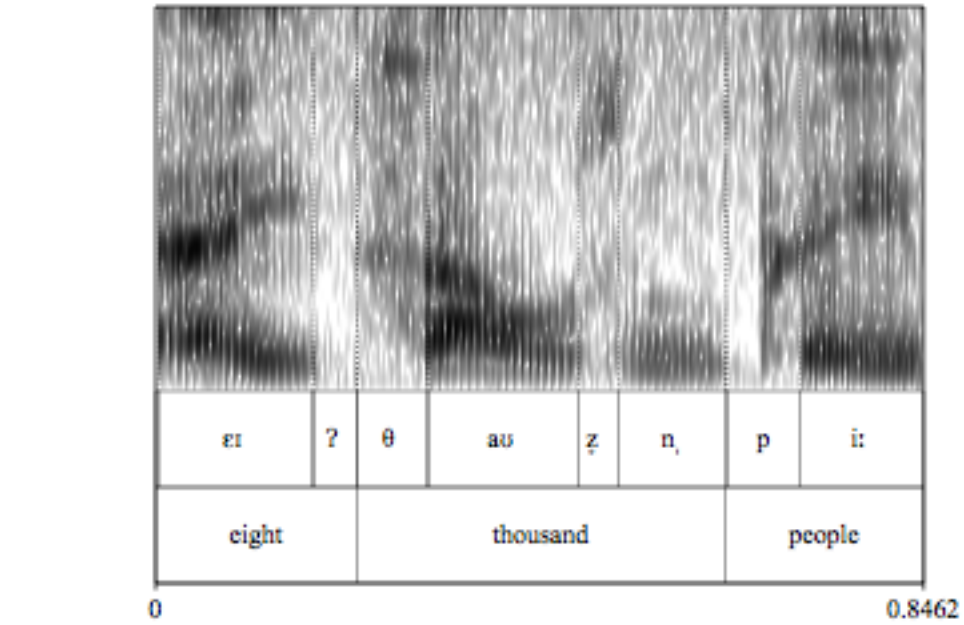
(39) and (40), which are illustrated in Figures 4a and 4b, are directly analogous to Nolan's hypothetical continuum for *hundred* (see above, p.23), suggesting again that the most straightforward account of deletion or not here is a CSP one.

In similar vein, CSPs towards the natural end of the scale provide a straightforward account of deletion between nasals. The velum is known to move more slowly than other articulators. It would therefore require extra articulatory effort to produce (41) with an oral [d] closure (released or unreleased) between the alveolar and nasal preceding and following consonants:

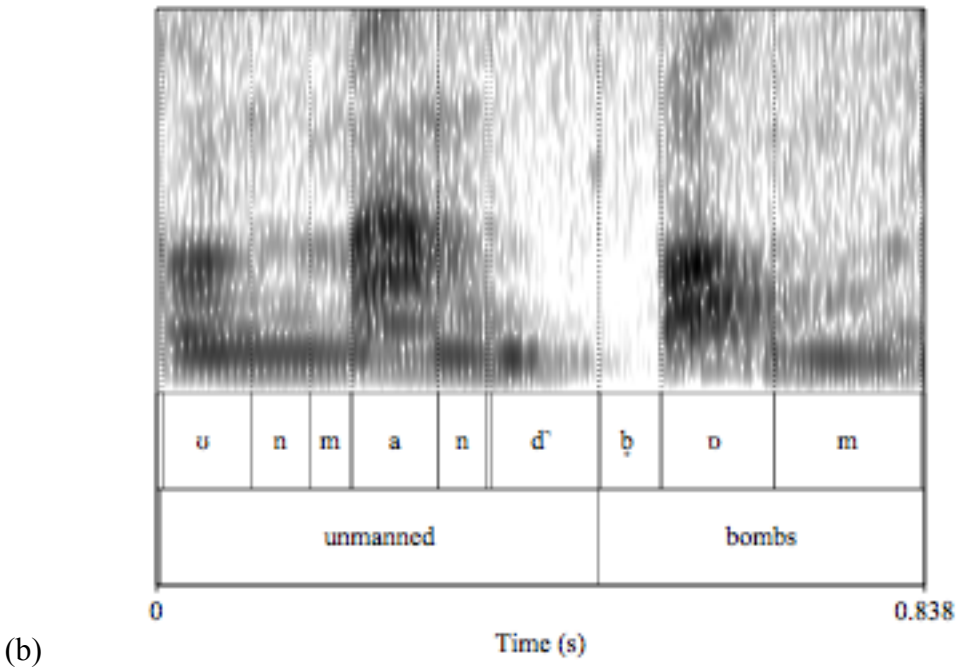
(41) *then it'll have locked <u>behind</u> me* [bɪɲɐɪnmi]

2.2.4 Co-occurring patterns of lenition

Finally, if these cases of lenition are a function of general CSPs on a continuum of decreased phonetic explicitness, one would expect that they would co-occur with characteristics of lenition in other segments, and this is indeed what we do find. In (20) and (22), above, lenition of final /t/ is accompanied by lenition of the first consonant of the cluster, /k/, which in (20) is fully elided and in (22) is realised with glottalisation, in the form of creaky voice, but no acoustic evidence of a velar gesture.



(a)



(b)

Figure 4. Spectrograms showing (a) eight thousand peo[ple] *(39); male speaker and (b)*unmanned bomb(s) *(40); female speaker.*

/l/-vocalisation is not a common feature of the York dialect, but there are ten tokens (out of 130) where /l/ in (t,d) clusters is vocalised, and some where it is elided

altogether. When there is a following word-initial consonant, these always co-occur with /t,d/ deletion, as in (42). *told* here is unstressed and spoken very fast; as well as deletion of preceding /l/, the following vowel is reduced and the /t/ of the following preposition is also lenited. The stressed /ld/ cluster of *hold*, by contrast, has both preceding [l] and released [d]. Here the cumulative evidence suggests that the deletion of /d/ is simply one of a set of cooccurring CSPs, which are a function of speech rate and accentual patterns[21].

(42) *and they said (.) <u>told</u> me to* [tʰɒmɪdə] *hold it*

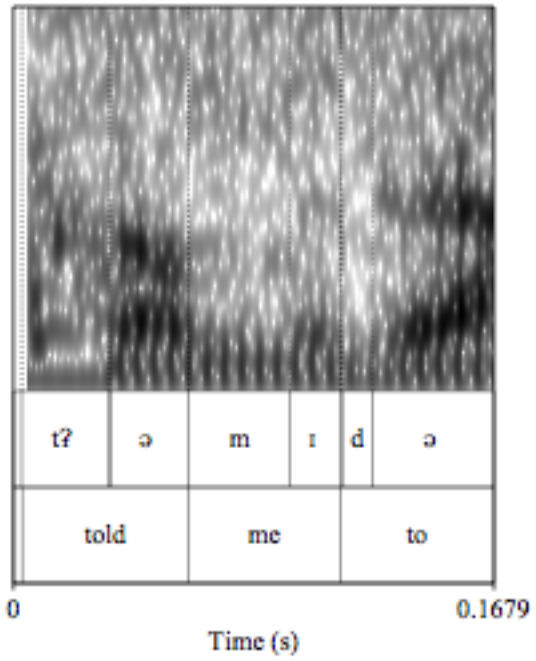


Figure 5. Spectrogram showing <u>told</u> me to *(42); male speaker.*

Viewed through the lens of lenition, then, the behaviour of (t,d) preconsonantally shows a range of decreasing phonetic explicitness paralleled in other word-final singleton and cluster consonants, and explicable in terms of lenition partly as a function of the surrounding phonetic context. In British English, at least, (t,d) lenition shows no distinctive sociolinguistic patterning and it is seen to co-occur with varying levels of phonetic explicitness in surrounding segments. We now turn to examining

[21] *cf.* Nolan again: "Segmental CSPs are not independent of prosodic CSPs – they are sensitive to the prosodic restructuring which the latter bring about, and ultimately may turn out to be treated best in conjunction with the prosodic changes" (1992: 18).

the interactions, as opposed to simple co-occurrence patterns, of (t,d) lenition with other well known CSPs.

2.3 Glottalisation

Hayes further comments on weakly articulated /t/ that, "in such cases, the weakened /t/ is usually 'covered' with a simultaneous glottal closure." (*ibid*.: 284-5) There are many instances in the York data of (t,d) tokens clearly surfacing as glottals (N=47), although these were generally not accompanied by auditory or acoustic evidence of an alveolar articulation except in a relatively small number of cases, such as the second element in the compound of (43) (the same utterance as (29)):

(43) *they bought things in second-hand shops* [sɛʔn̥ˈhant͡ʔʃɒps]

The percept was most frequently as a glottal stop, but the acoustic evidence showed that the data included both full glottal stops, as in (44), and continuous glottalised realisations perceived as glottal stops or creaky voice, as described by Docherty and Foulkes (2005) and exemplified in (45).

(44) *all the way, went all the* [wɛnʔɔːlˠə] *back way because*

(45) *it really spoilt my* [spɔɪəlˠmaɪ] *memories of school*

Most were reflexes of underlying /t/, but there were a few cases of devoiced glottalised /d/ followed by a voiceless consonant, as in (43) above.

Non-cluster /t/ is very frequently realised as a glottal (46), as is /k/ (47):

(46) *he got knocked over* [gɒʔnɒʔᵊtʰɔːvə]

(47) *I used to quite like bikes* [lɛə̯baɪks]

Word-final /p/ (48, 49) and /k/ in clusters are also glottalised, the latter most frequently in *think* (50)[22], but also in other words (51):

(48) *she had to come and help me* [ɛːʊ̯w̃i]

(49) *'cos it's finished being a training camp now* [kamʔnaʊ]

(50) *I think we went* [θɪŋ̟ʊwɛnʔ] *to Scarborough*

[22] Speaker NB, for example, produces 105 tokens of *think*. All 46 tokens with following stops are glottals; all 47 tokens followed by vowels or /h/ are realised as [kʰ]; with a following pause there are three glottals and nine plosives.

(51) *you're not supposed to take it with <u>milk</u>* [mɪlʸ̰]

Apart from one token with preceding /s/ and one with preceding /p/, both in very frequent words (*just* and *kept* respectively), all glottal (t,d) tokens were preceded by /l/ or /n/. However, this is a slightly misleading observation, since two thirds of velar stops forming the preceding phonological context (75/109) were frequently also realised as glottals, as illustrated in (46) above. This is unproblematic in cases such as (46) or (52) or (53)[23], where there is a clear sequence of a glottal plus following released [tʰ]:

(52) *if if a <u>project</u> or* [pɻəʊdʒɛʔtʰɔˑ] *contract comes up*

(53) *and they evacuated the whole place <u>except</u> us* [ɪ̰sɛ̰tʰʊʂ]

However, in cases such as (54), where there are not two clearly distinguishable articulations, it is often impossible to determine of which underlying segment the glottal is a reflex:

(54) *if if a project or <u>contract</u> comes* [kɒntɻaʔˑkʊmz] *up*[24]

In (54) the glottal is slightly lengthened, which may possibly be taken as evidence that it is a reflex of the two consonants, but there are many other examples where the glottal is not notably long, such as (55), and as mentioned above, length is not an unequivocal indicator of the presence of more than one consonant.

(55) *She <u>knocked</u> straight* [nɒʔstɹɛɪ̰] *into us yeah*

Cases such as (54) and (55) pose problems for a rule of consonant deletion conditioned primarily by the following and preceding phonological context: should the glottal in any given case be taken as the reflex of the preceding consonant or the (t,d) coronal stop or both? how might one decide the correct analysis in each case? The answer to these questions determines whether or not the (t,d) consonant is deemed to have been deleted. These and related questions are discussed by Temple (submitted) as methodological / analytical problems for the treatment of (t,d) clusters with a categorical deletion rule. In the light of the present discussion, viewing the

[23] (53) is the only case of glottalised preceding /p/ in the York data set.
[24] (52) and (54) represent the same utterance and reproduce (3) and (7) from Temple (*op.cit.*), which are illustrated there with spectrograms in Figures 3 and 5 respectively.

behaviour of the clusters as the expected result of variable CSPs would seem to provide a coherent alternative analysis. Variable glottalisation of any voiceless stops is context-specific and dialect-specific, and known to be a sociolinguistically changing feature of British English (e.g. Fabricius 2002, Foulkes & Docherty 2005, Stuart-Smith *et al* 2007) and therefore must feature in the speaker's cognitive phonetic plan. Moreover, as Nolan points out, glottalisation cannot be seen as phonetically natural lenition, since it involves increased constriction of the glottis, "an articulation in direct conflict with the opening gesture required for [tʰ] (or any other non-glottalised stop)" (*op.cit.*: 21). As we have seen, it is normal in this variety for all final stops and for penultimate /k/[25] be realised as glottals; the pertinent variability would seem, then, to be between glottalised and non-glottalised realisations of final clusters, rather than between C_2 alternating between zero on the one hand and [t] or [ʔ] on the other, with word-final (cluster) codas that consist only of a glottal stop somewhat arbitrarily being deemed as having a deleted or undeleted /t/. Whether or not these glottal-only codas simultaneously "cover" a weakened (or indeed non-weakened) alveolar articulation is unknowable from auditory/acoustic data alone, but all except one of the 55 (t,d) tokens with "preceding" glottals and following vowels or pauses have alveolar release, which suggests that some alveolar articulation could be present preconsonantally too. Any alternation between the presence or absence of a "covered" alveolar gesture in glottal-only codas may well be a combination of idiosyncratic (and therefore cognitive) and physiological constraints (target undershoot). And the presence of an observable release before almost all vowels and no stop consonants, and before four out of nine following continuants is towards the natural end of Nolan's scale. The behaviour of all glottal codas would appear, then, to be a function of a combination of both cognitive and more "natural" CSPs. Once again this observation is reinforced by the co-occurrence of glottalisation with other CSPs, as in (56), with its fully lenited nasal, which is illustrated in Figure 6:

(56) *they <u>went</u> and* [ðɪwɛ̰ʔən] *knocked on Andrew's door*

[25] This occasionally also applies to /k/ before plural /s/ as in *I've only done it for three weeks* [wi̯ːʔs].

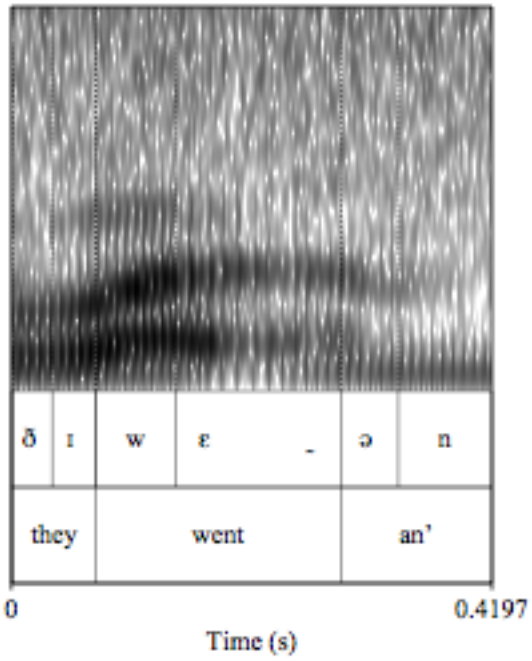


Figure 6. Spectrogram showing they went an' *(56); male speaker.*

2.4 Voicing assimilation

There is no assimilatory voicing of voiceless (t,d) to following voiced consonants in the York data set, although there is at least one token of partially voiced /k/ in a cluster, which is shown in (18) above. By contrast, most released tokens of /d/ are devoiced by assimilation to a following voiceless consonant, as in (57) and (58):

(57) *how I can make an old-fashioned copper* [faʃn̥d̥kʰɔpʰə]

(58) *there was a lot of old people* [q̟lʸtpʰiːpl̩]

This is as might be expected from the well known phenomenon of Yorkshire assimilatory devoicing, although York English seems to show gradient devoicing rather than the categorical neutralising devoicing described by Wells, where "*wide trousers*, having undergone Yorkshire Assimilation, is a perfect homophone of *white trousers* [ˈwaɪt ˈtraʊzəz]" (1982: 367) and it is clearly different from the categorical assimilatory glottalisation in the West Yorkshire variety studied by Broadbent, where "the /d/ never surfaces as a [t], as one might expect, so 'vodka' *[vɒtkə] and

'godfather' *[gɒtfaːðə] are impossible realisations" (1999: 19)[26]. This gradience is also evident in the singleton consonants in (59) and (60):

(59) *it was a* lad *called* [laḍkʰɒlˠ] *Wayne*

(60) *choose to be a* good *friend* [gʊ̯tˈfɛːə n̪ːt]

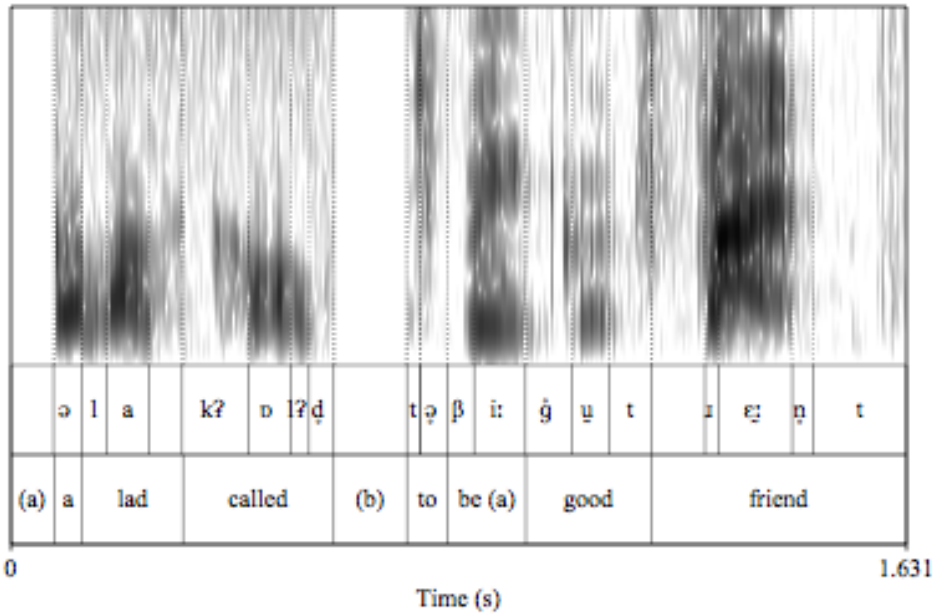


Figure 7. Spectrograms showing (a) called Wayne *(59) (b)* to be a good friend *(60); female speakers.*

In clusters, the devoicing can extend to the first consonant, as in (61) and this can apply in cases of apparent deletion, like (62):

(61) *so she's* moved *quite a* [muːʏ̥tkwɐɪ̯ə̯ʷ] *way away*

(62) *he actually* lived *seven* [lɪʏ̥ːsɛ̯ʏ̯ə̯n]

The juxtaposition of these two examples shows once again that coarticulatory phenomena affecting the first consonant of the cluster cannot necessarily be taken to indicate the deletion of the second. More importantly, here again we have unsurprising CSP patterns both with (t,d) clusters and with other singleton and cluster word-final stops.

[26] In fact, the only (t,d) token with a lexical /d/ realised as an assimilatory glottal is the glottally reinforced final consonant of *second-hand* shown in (43) above.

2.5 Place assimilation

Assimilation of place has become a central topic in discussions of the relationship between phonetics and phonology in the wake of numerous studies examining gradience versus categoricity, particularly with reference to residual gestures (e.g. Barry, 1985; Nolan, 1992; Ellis & Hardcastle, 2002; Kühnert & Hoole, 2004; Bermúdez-Otero 2010b). It is well known that in English, "word-final /t d n s z/ readily assimilate to the place of the following word-initial consonant" (Cruttenden *op.cit.*: 301) but there are no clear manifestations of this in the York (t,d) tokens. The very few examples which might be interpreted this way are of glottalised tokens with preceding /n/ produced with a lengthened bilabial nasal assimilating to a following bilabial, as exemplified in (63) and Figure 8[27]. As already noted, however, length is an unreliable indicator of multiple underlying segments, although the qualitative change in the creaky voice suggests there may be oral reflexes of both /n/ and /t/ here.

(63) *and then I* <u>*went*</u> [wɛ̰ m̩] *back to work again*

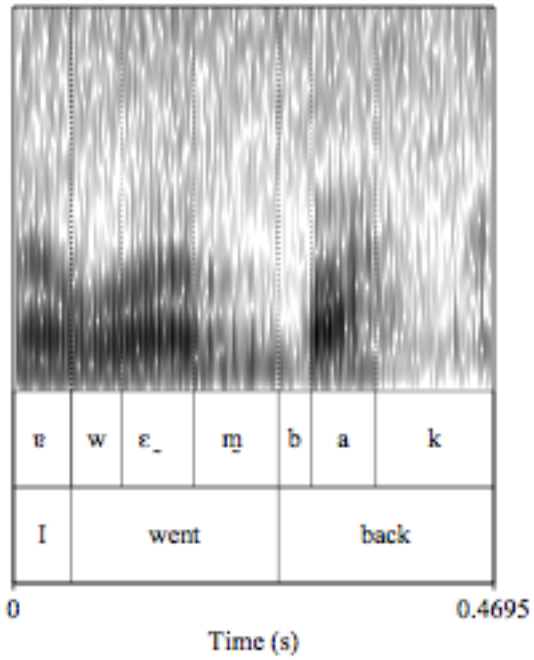


Figure 8. Spectrogram showing extract from and then I <u>went</u> back *(63); female speaker*

[27] This token was excluded from the statistical analyses reported in Tagliamonte & Temple (*op.cit.*) for reasons explained in that paper.

Singleton alveolars assimilate fairly frequently to following bilabials and velars, as in (64) - (66), although this seems to be limited to certain individual speakers and there are plentiful examples in preceding sections of non-assimilated tokens. This shows, nevertheless, that regressive assimilation of alveolars is a feature of this variety of English.

(64) *the next morning they were all brought back* [bɹɔːpˈbaʰkʰ] *again*

(65) *they were really like sad people* [sabˈpipl̩] *straight up*

(66) *and my leg could move* [kʰʊbˈmuːv]

The absence of assimilation in (t,d) tokens is in fact not so surprising when the phonetic details of the data are considered. There are clearly non-assimilated alveolar stop articulations illustrated in Section 2.1, but there are many tokens where it was impossible to determine the place of articulation of the (t,d) consonant because of the absence of formant transitions into and out of the closure, due to the presence of the preceding and following consonants. An example with preceding /l/ is given in (67) and Figure 9 which is acoustically and auditorily ambiguous.

(67) *we've been told by* [tʰɔːldˈbaː]/[tʰɔːlbˈbaː] *that many people*

Glottally reinforced tokens are equally difficult to identify even in singleton consonants, as illustrated by (3) above, which is reproduced here for convenience:

(3) *they cut my* [ˈkʰʊʔ͡tˈmə] / [ˈkʰʊʔ͡pˈmə] *trousers off me*

Moreover, fully glottal realisations of both (t,d) consonants and their preceding stops might not only be masking a possible residual alveolar gesture, as noted in Section 2.3, but also any assimilatory gesture which might be present, as in (68), from the same sentence as (41).

(68) *then it'll have locked behind* [lɒʔˈbɪɦɐɪn] *me*

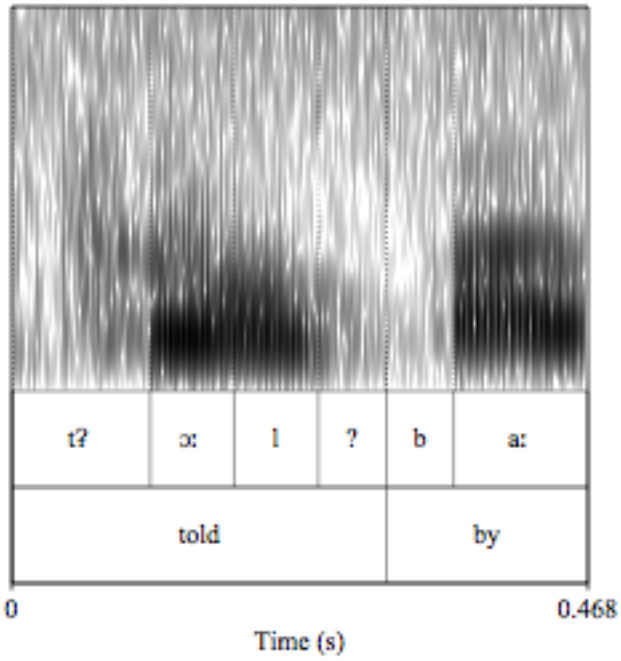


Figure 9. Spectrogram of told by *(67)*; *female speaker.*

The presence of assimilation in the York (t,d) data is much easier to determine when it involves the preceding consonant, as predicted by Gimson/Cruttenden: "When alveolar consonants are adjacent in clusters or sequences susceptible to assimilation, all (or none) of them will undergo assimilation" (Cruttenden *op.cit.*: 302). However, although this is certainly true of all the unassimilated examples presented in this paper, the assimilation of preceding consonants has the consequence of rendering the word-final consonant difficult to identify and there are no tokens in this data set with assimilated penultimate and word-final consonants both unambiguously present. Instead we find assimilating preceding consonants in cases of apparent deletion, which may well be masking residual alveolar gestures, just as Browman and Goldstein found for *nabbed most* [næbmoːst] and *seven plus* [sɛvn̩plʌs] in their study of X-ray microbeam data (1990: 365-367). This is perhaps unsurprising, since there is evidence that alveolar nasals are more susceptible to assimilation than stops (Hardcastle 1994) and most assimilated preceding consonants in the York data are nasals, as illustrated in (69) and (70), although there are also some assimilations involving preceding /s/, as in (71):

(69) *a a a sound box* [saʊmbɔks] *was only a diaphragm*

(70) *we built, um, Bradford* <u>*combined*</u> *court* [kʰəmbaĩŋkʰɔːʔ] *centre*

(71) *went to Ireland* <u>*last*</u> *year* [laʃjiˤ] *fishing*

There are very few articulatory studies of assimilation in word-final clusters as opposed to singleton consonants, so it is not clear whether assimilated CC# clusters exist in quite so clear-cut a way as suggested by the hypothetical examples provided by Cruttenden (e.g. "*He won't* /wəʊŋk/ *come* […] *He found* /faʊmb/ *both*, *a kind* /kaɪŋ/ *gift*"; *op.cit.*: 302). It would be possible to disambiguate cases where the (t,d) and following consonant differ in voicing, from auditory / acoustic data but it is difficult to see how to decide whether, for example, one or two voiced bilabial consonants are present in *found both*, where this is not the case. However, the very fact that Gimson/Cruttenden see no need to comment on this difficulty suggests that this is a non-issue for them. Thus, although assimilation creates analytical problems for categorical phonological analyses of (t,d), the assimilated tokens again fit well into an integrated analysis of (t,d) as a CSP.

2.6 Coalescence

In the CSP literature, the term "coalescence" is generally used to refer to the generation of, "a third 'new' segment […] instead of two other abutting segments" (Nolan 1996: 22). As with assimilation, there are examples of coalescence of both (t,d) consonants and their preceding consonants in the York data. All examples involve following /j/, as does Nolan's example ([əʊzjʊ] > [əʊʑə] in *suppose you*). (72) and (73) illustrate /t#j/ sequences yielding [t͡ʃ] and (74), taken from the same stretch of speech as (73), shows the preceding /s/ in *shortest* coalescing with following /j/ to yield a slightly lengthened [ʃˑ]. The latter two tokens are shown in Figure 10. (74) would presumably count as an instance of deletion in a variable rule analysis, whereas (73) would not, which seems to be imposing an artificial categorical divide on what looks like a continuum of phonetic explicitness.

(72) *like [the baby]* <u>*kept*</u> *you up* [kʰɛpˀ t͡ʃʲʊpˀ] *24 hours a night*

(73) *the (.)* <u>*longest*</u> *you* [lɒŋgɪst͡ʃɪ̥] *can wear is to there*

(74) *the* <u>*shortest*</u> *you* [ʃɑ̟ːtʰɪʃˈʊ] *can wear is to there*

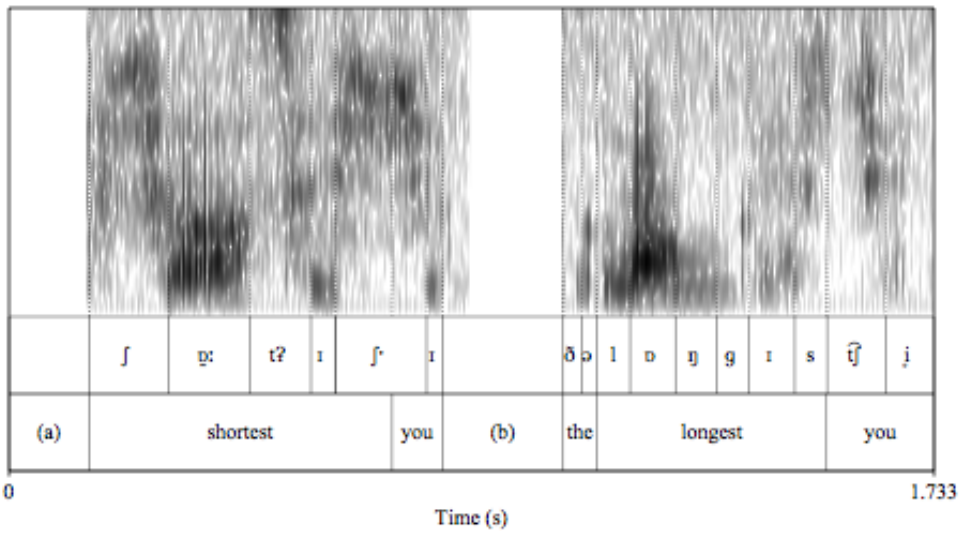


Figure 10. Spectrogram showing (in sequence) (a) <u>shortest</u> you *(74) and (b)* longest you *(73); female speaker.*

In (75) we observe a singleton word-final /z/ coalescing in the same way (but with additional devoicing):

(75) ’<u>*cos*</u> *you* [kʰəʃə̟] *can’t really do dances if you only get five turn up*

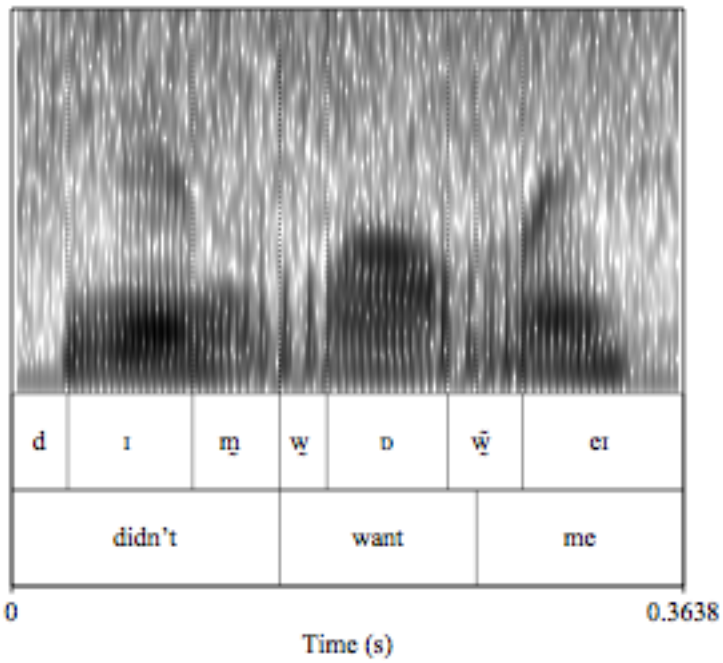


Figure 11. Spectrogram showing didn’t <u>want</u> me *(76); female speaker.*

(76) shows a glottalised, nasalised glide resulting from the coalescence of properties from three segments, nasalisation from /n/, glottalisation from /t/ and labiality from /m/. It is illustrated in Figure 11.

(76) *and he didn't want me* [ʍɒʍ̃eɪ] *to leave*

Coalescence in a more general sense is also seen in (t,d) between identical preceding and following consonants, where a single segment is generated from a sequence of two, with an intermediate "deleted" (t,d) consonant. Sometimes these are more or less lengthened, as in (77) but frequently they are not (78).

(77) *and just stabbed him* [ⁿd͡ʒ̊ʊsːtabˈdəm]

(78) *it was my youngest son* [juŋgɪsʊn] *what caught me*

In (79) it is hard to decide whether the preceding /p/ is elided and the creaky voicing on the vowel is the reflex of the final /t/ (or indeed /pt/), or whether the /t/ is lenited or elided and there is a coalesced realisation the of preceding and following bilabial stops.

(79) *and he kept putting* [nikʰɛ̰pʰʊtʰɪn] *it up and putting it up*

Tokens with following /ð/ are not part of the York (t,d) data because it constitutes a "neutralisation" context and such contexts are routinely excluded from analyses, but (80) is included here because the intervocalic [n] appears to be the result of progressive assimilation of nasality and stopping (unsurprising in /ð/-initial function words: *cf.* Manuel 1995), yielding what looks like a single, coalesced nasal:

(80) *if any of the schoolteachers found that* [faʊnəʔ] *you were misbehaving*

The issues raised for the analysis of (t,d) by tokens with coalesced preceding and following consonants (in both the narrow and broad sense) are essentially the same as those discussed under lenition and assimilation in Sections 2.2 and 2.5 above, so we shall not revisit them here. Suffice to say that once again we find a range of examples of a well known CSP in both (t,d) and non-(t,d) contexts.

3. Discussion

In the light of the above detailed phonetic observations of the behaviour of (t,d) and other word-final consonants in York English, we now turn to the question of where they fit into a model of speech perception/production: do the facts about (t,d) merit its modelling as a variable phonological rule, as assumed in most of the variationist sociolinguistic literature? There are two aspects to the discussion, firstly whether (t,d) consonants are different from other word-final stops, which appears not to be the case, and then how the phenomena observed fit into the phonetics/phonology of English. Both, in my view, require if not resolution, then serious consideration before the further question of whether there is socioindexical variation in (t,d) and other word-final stops.

3.1 (t,d) and CSPs

The phonetic evidence surveyed in this paper has demonstrated that where direct comparison is possible word-final (t,d) consonants exhibit the same patterns of variability as other word-final stops including variable pre-consonantal release characteristics and a range of degrees of lenition, crucially including full (auditory/acoustic) deletion. They also show parallel patterns of interaction with adjacent consonants resulting from Connected Speech Processes such as assimilation and cophonation. Such parallels have also been observed by Browman and Goldstein (e.g. 1990) using articulatory data from X-ray pellet-tracking: cluster-final /t/ and /d/ in *perfect memory* and *nabbed most*, when auditorily deleted, manifest a similar residual alveolar tongue gesture to word-final /n/ assimilating to following /p/ in *seven plus*. Moreover, even where direct comparisons across different consonants are not possible, there appears to be a plausible explanation in terms of CSPs for the whole range of variability observed in (t,d) clusters, including the behaviour of the first consonant of the cluster.

Furthermore, if (t,d) is a manifestation of general word-final CSPs, we would expect evidence of the cooccurrence of other CSPs in the surrounding speech. Thus (75) above shows voicing assimilation of the schwa of *you* to the preceding coalesced, devoiced [ʃ] and following /k/, the type of cophonation Nolan focuses on (1996: 223). Cooccurence of CSPs is illustrated more starkly in (76), where the whole sequence

except the last word, *leave* shows decreased phonetic explicitness: the comments in Section 2.6 focussed on the coalescence at the end of *want* but in fact the whole sequence is highly reduced, *and he didn't want me to* being pronounced [əndjɪ̃ mʊ̯ʊ̃ːtʰə]. [d] and [j] are clearly articulated sequentially, but [n] and [d] are heterosyllabic, suggesting that the [d] is part of a coalesced pronunciation of *he di-*; [i] is nasalised in anticipatory assimilation to the following /n/, which assimilates in place to the /w/ of *want*; that /w/ is itself creaky-voiced, suggesting it bears the reflex of the final /t/ of *didn't*. In (81)[28] there is no acoustic or auditory evidence of any alveolar closure in the whole sequence /nt͡ʃt/, close alveolar approximation not appearing until the following consonant /ð/. Note that nasality is also absent:

(81) *so they pinched the* [piːʲʃðə] *typewriter*

The (artificial) borderline between coalescence and cooccurrence breaks down at this point, but as noted at the outset, these categorisations are a descriptive convenience rather than a theoretical taxonomy. More importantly, abstracting a specific (t,d) rule from examples such as (76) and (81) for the deletion of cluster-specific word-final /t/, rather than taking a holistic view of the sequence would seem to call for independent justification.

Browman & Goldstein observe that the hitherto universally observed constraint ranking of following phonological segment on (t,d) is, "exactly what we would expect when we consider the consequences of gestural overlap" (*op.cit.*: 367). The gestures best able to mask an alveolar closure gesture are precisely those which favour "deletion" of /t,d/, which leads them to conclude that, "the ordering of probabilities on deletion of final /t,d/ in clusters could follow directly from the view of deletion that we are proposing here, without these differential probabilities needing to be 'learned' as part of a rule" (*ibid.*:368). Does a CSP analysis mean, then, that (t,d) should be viewed purely as a function of physical constraints which in turn vary as a function of factors such as speech rate? This is clearly not the case: there is plenty of evidence of dialect-specific patterning of the effect of following pause on deletion rates, for example (*cf.* Tagliamonte & Temple *op.cit.*: 289), which must have a cognitive rather

[28] The (t,d) cluster in (81) would again be excluded from a variationist analysis because of the following "neutralisation" context.

than a physical explanation. Individual speakers seem to show varying rates of "deletion", so there must also be an idiosyncratic element in the phonetic implementation of word joins involving consonant sequences[29]. Speaker-specific manipulation of fine phonetic detail has long been known of and studied; for example, though physiological factors may play a role, in sex-specific variability, they cannot always explain the whole picture (e.g. Bladon, Henton & Pickering 1984, Temple 2000; see further Docherty 1992, Docherty & Foulkes 2005, Solé 2007). Indeed, in this volume Simpson shows how ejectives can be an epiphenomenon in one language and manipulated for interactional purposes in another.

Interactional effects are evident in the York (t,d) data too: as suggested by the contextualising comments accompanying some of the above examples, speakers appear to manipulate the phonetics of word-final stops for discourse purposes. Thus in (82) the speaker is recounting a sleepwalking episode after he had had rather too much to drink. His speech rate slows down and he produces a lengthened, preaspirated /s/ followed by a clear, but low-amplitude unaspirated released [t] followed by a pause lasting a second and *oh dear*. This is all clearly for comic effect, and the interviewer duly begins to giggle during the pause.

(82) *must have been completely <u>lost</u> (.)* [lɒʰsːt] *oh dear*

(83) shows reported speech where the speaker is describing her rather large father threatening to take a "chopper" to the man who came round to means test her for welfare payments in the 1930s. Again the utterance is intended to amuse and elicits the obviously anticipated laugh from the interviewer after the subsequent comment that "the man never moved so fast in his life"[30].

(83) *"<u>hand</u> me* ["ʔand miˑ] *that so an' so chopper"*

[29] This has not been studied systematically in the York data. Impressionistically, speakers also appear to differ in the extent of phonetic explicitness in their speech overall. An empirical investigation of any correlation between lenition in word joins and other indicators of decreased explicitness would shed further light on this issue.

[30] Examples (82) and (83) show interactional effects in that they are intended to produce a response in the interlocutor. It seems likely that (t,d) and other word-final stops may also be manipulated interactively in the management of turn taking in the ways discussed by Simpson (this volume). As for Simpson, the nature of the data under discussion here make it difficult to be precise about this: sociolinguistic interviews are designed to elicit as much speech as possible for one party in the interaction, thus drastically reducing the number of potential and actual turn-transition points by comparison with naturally occurring conversation.

Note that the released [d] cooccurs with other indicators of fortition or increased phonetic explicitness such as the glottal stop at the beginning of *hand* (/h/-dropping is the norm for this speaker, including the *his* of the following sequence, which is produced vowel-initially) and the full vowel in *me*. Here too the behaviour of (t,d) consonants appears to be consistent with surrounding CSPs rather than being independent of them.

Examples (82) and (83) and others like them suggest that, for these speakers at least, it is the surfacing of a released stop which is marked rather than its deletion. This said, however, in (84) a speaker who produces relatively high rates of surface cluster stops conversely twice elides the word-internal /d/ when quoting his friend's girlfriend getting her own back after his nagging over her driving (leading to an embarrassing accident!)

(84) *need the handbrake,*[ambreˑkˀ] *take the handbrake off* [ambreˑkʰɒf]*, do this, do that*

3.2 Modelling variation in word-final stops

Does the cumulative evidence of speaker control over (t,d) mean that in fact (t,d) is a phonological rule after all, and the standard variationist account can be redeemed? In this view, the phonetic details observed in this paper would fall out from the production mechanism only after a variable categorical rule of deletion had applied. Such an argument is obviously a case of a *reductio ad absurdum*: the individual manipulation of fine phonetic detail first studied by phoneticians is now a generally accepted fact. The answer to the question of what (t,d) is and where (t,d) is properly to be located depends, then, on where the line is drawn in the grammar between phonology and phonetics, and how the interaction of cognitive and physical phonetic effects is modelled in the speech production model more broadly.

One possible answer to that question lies in the assigning of categorical processes to the phonology and gradient ones to the phonetic component of the grammar, and CSPs have played a central role in exploring this. Literature on categoricity *vs*. gradience in patterns of assimilation has been taken in the past to indicate that assimilation is either the result of a categorical phonological rule or of gradient

phonetic constraints on articulation in fluent speech. Studies such as Ellis & Hardcastle (2002) show that in articulatory terms alveolar-to-velar assimilation may be gradient for some individuals and categorical for others, which is partly accounted for by accent differences. Aside from showing how the possibility of a total absence of the residual alveolar gesture is a problem for an Articulatory Phonology account of assimilation, they do not go into detail on the theoretical implications of their findings. However, such studies are taken by, for example, Bermúdez-Otero (*op.cit.*) to suggest that if (t,d) shows a mixture of gradient and categorical deletion then it must merit a two-step phonological derivation[31]:

(1) *phonology:* variable, categorical, morphologically sensitive
(2) *phonetics:* variable, gradient, morphologically insensitive

(Bermúdez-Otero 2010b: 7)

The view of CSPs used as a framework for the present paper holds that they can be a function of both cognitive and physiological constraints, as Nolan notes with regard to assimilation: "it is a phenomenon over which speakers have control. This will provide further evidence that a greater amount of phonetic detail is specified in the speaker's phonetic representation or phonetic plan than is often assumed" (1992: 278; also cited by Ellis & Hardcastle *op.cit.*: 387). This implies a tripartite set of rules/constraints rather than a simple phonetics / phonology dichotomy, with the phonetic component consisting of both cognitive and physiologically constrained elements which can and do interact with each other[32]. However, the potential existence of categorical deletion still need not necessarily entail that a categorical phonological rule is at work. Categorical deletion without a residual gesture may be viewed, as argued above, as a cognitively governed (phonetic) CSP at one end of a continuum of responses to the physiological challenge of producing an interconsonantal alveolar gesture. Thus at the "natural" end speakers may be producing a full or partial alveolar gesture which is masked by surrounding gestures, whereas at the cognitive end of the scale they "choose" not to. Indeed, Kühnert and Hoole (*op.cit.*) report complex interactions of speaker-specific responses to articulatory challenges posed by alveolar-to-velar

[31] It should be pointed out that for Bermúdez Otero this is crucially also justified by the existence of the morphological constraint on (t,d) apparently found in many studies following Guy (1991).
[32] This is not incompatible with Bermúdez-Otero's position, which clearly includes gradient phonetic rules in the grammar and acknowledges the role of physiologically constrained processes in the production and perception of speech.

sequences showing the interaction of physiological and cognitive, language-specific and idiosyncratic effects. Cases with lenited alveolar gestures, which would be parallel to deleted (t,d) tokens, showed a range of qualitative differences between assimilatory and non-assimilatory contexts, showing that even in full "deletion" CSP effects are at work.

If some speakers can be shown by articulatory methods to be producing only categorical alternation between deletion and non-deletion with no gradient tokens, there may nevertheless be a case for saying that they represent a more advanced stage in a diachronic process of phonologisation of non-cognitive phonetic processes and their subsequent stabilisation as categorical phonological rules. This would follow the interpretation by Bermúdez-Otero and Trousdale (2011) of the inter-individual differences in assimilation patterns found by Ellis and Hardcastle. However, so far as (t,d) is concerned there is no evidence in the literature for ongoing change: outside AAVE it does not show the sociolinguistic patterning (e.g. age-grading, a marked gender effect) which are expected to accompany change in progress, nor, to my knowledge, have published studies demonstrated real-time changes in patterns of deletion[33]. In any case, the examples in the present paper of deletion of non-(t,d) consonants, could well also be categorical in the sense that a residual gesture could be entirely absent (e.g. (24) to (27), although we cannot say whether any of them produces nothing but categorical presence or absence). If categoricity is taken as requiring a phonological rule, then a phonological rule would also have to be formulated for these cases. Once again (t,d) does not look unique, and the problem of where to model these effects in the grammar remains.

As a phonetic-based approach, might Articulatory Phonology, which views phonological structure as "an interaction of acoustic, articulatory, and other (e.g. psychological and/or purely linguistic) organizations" (Browman and Goldstein 1990: 341), provide a solution to the problem of situating (t,d) and related CSPs? (t,d) features prominently in early accounts of the theory, but there has been very little articulatory study specifically of the variable since then. However, Lichtman's recent study of cluster and (mainly) non-cluster word-final /t/ examines data from the

[33] Bybee (2002) implicitly assumes ongoing change in examining frequency effects on (t,d) in the context of lexical diffusion, but does not actually demonstrate that a diachronic process is underway.

Wisconsin Microbeam Database and a complementary EMA study. While her results confirm the predictions of Articulatory Phonology regarding the effect of following phonological context on /t/ deletion, they also confirm Ellis & Hardcastle's finding that some individuals produce elided tokens without any residual alveolar gesture, which is not consistent with an AP account (Lichtman 2010; p.c.).

Interaction with other abstract levels such as morphophonology is another criterion which has been advanced for treating a phenomenon as phonological rather than phonetic (*cf.* Tucker and Warner 2010: 318). The motivation for situating (t,d) in the (lexical) phonology originally was the apparent effect of morphology on its variability (e.g. Guy 1991). However, despite the many papers showing a statistical morphological effect, doubt has been cast by several recent studies on its veracity (see Section 1 above). Moreover, there is a fundamental methodological problem in the absence of large quantities of articulatory data: the evidence for the morphological constraint has generally been provided by auditory and acoustic data where it is impossible to tell whether the apparent deletion is categorical (and therefore by the logic of this account the result of a phonological, morphologically constrained rule) or gradient (and therefore the result of phonetic processes applying only after the morphological effect would have come into play). Lexical Phonology is a production-based model and so even a dual, "rule scattered" account incorporating both categoricity and gradience stands on rather shaky ground in this respect until advances in articulatory sociophonetics allow us to collect large quantities of naturalistic conversational data, as acknowledged by Bermúdez-Otero (*op.cit.*).

The grammatical contrast between verbs with and without final *–ed* was invoked in pre-LP studies of (t,d) to account for the greater rates of retention of /t,d/ observed in past tense as opposed to monomorphemic forms. The role of contrastivity has received rather less attention in recent years than categoricity~gradience, but perhaps it would be fruitful to consider restricting an account of the phonology of (t,d) to stating their lexically contrastive terms, in which case both categorical and gradient deletion would be a phonetic phenomenon. A declarative, polysystemic analysis in the tradition of Firthian Prosodic Analysis (e.g. Robins, 1970) would observe the limited distribution of word-final stops in general and of stop-final coda clusters other than (t,d) ones, and that there are very few minimal pairs contrasting cluster-final /t/ and

/d/. Word-final postconsonantal stops would thus constitute a very restricted (sub?)system of phonematic contrasts. From the point of view of perception and comprehensibility, then, this view predicts that there is scope for a wide range of phonetic variability, which is indeed what we have observed in this paper.

To my knowledge no Firthian analyses yet exist of related English data. However, working from a very different perspective, Steriade (2000) explores critically the role of contrastivity in the categorisation of intervocalic flapping in American English (a phonetic phenomenon by this criterion). Her driving agenda is that, "the distinction between phonetic and phonological features is not conducive to progress and cannot be coherently enforced. It is unproductive because in order to understand phonological patterns one must be able to refer to the details of their physical implementation, in perception and production" (Steriade 2000: 314). Tucker and Warner explore the contrast between this view and the alternative strict separation of phonology and phonetics in the light of their analyses of the devoicing of nasals in Romanian. Having shown that the devoicing "derives from both phonetic and phonological causes" they point out that this does not necessarily entail the existence of two sharply delineated systems; it may simply be that "all sound patterns fall somewhere on each of several dimensions that make up what we attempt to separate into phonetics and phonology" (2010: 319). They argue that the answer to this is neither strict separation nor total integration but the classification of sound patterns on several, mostly continuous dimensions, "which all together make the phenomenon relatively phonetic or phonological" (*ibid.*: 320). This approach would seem very promising for the analysis of word-final stops since it would obviate the need for a sharp dividing line between cognitively and physically constrained phonetic effects. We have seen the evidence for both here, and yet it is difficult to separate the two: as Kühnert and Hoole (*op.cit.*) show, they interact at a highly detailed level, at least in assimilation, and their surface manifestations are often the same, and this seems also to hold for (t,d).

One aspect of the variable behaviour of final stops that these models do not cover, however, is the cooccurrence of CSPs. If it is the case that the pertinent dimension of sociophonetic variation is not the lenition / assimilation etc. of given word-final segments, but the manipulation of phonetic explicitness across longer stretches of

speech, a segmental based model would fail to capture the facts. Simpson demonstrates in this volume and elsewhere how restricting the analysis of variability to a single segment whose phonetics are governed by the immediate segmental context can obscure significant generalisations. In his analysis of glottals in Suffolk English (Simpson, 1992), he examines the insight of Trudgill (1974) and Lodge (1984) that there are cooccurrence restrictions on glottalisation in some East Anglian varieties of English, and demonstrates that even one of the authors who drew attention to these misses some examples of the phenomenon because the analysis is couched in terms of derivational reduction rules which apply to individual segments. Simpson's solution is inspired by the Firthian notion of "prosody", a phonological construct which has phonetic exponents across a given stretch (or "piece") of speech. This would seem a promising avenue for exploration of the variability of word-final stops, although it should be noted that the Firthian approach is declarative, with strict separation between phonology and phonetics, and is therefore on the face of it not compatible with Steriade or Tucker and Walker's advocation of total or partial integration of the two.

4 Conclusions

This paper has, I hope, made a case for an answer to the first set of issues explored in the discussion, relating to the "what" of the title. It is clear from the data examined that the behaviour of word-final /t,d/ in clusters is not qualitatively different from that of other word-final consonants, either in their segment-specific physical manifestations or in their interactions with common Connected Speech Processes in this variety of English. This does not conclusively prove that a phonological analysis is wrong: CSPs could be part of the post-lexical phonetic implementation processes which interacts with the output of a variable phonological rule, as suggested by Bermúdez Otero (2010, 2011). However, since the CSP account seems perfectly capable of accounting for the observed behaviour of word-final coronal clusters, it would seem that there is no need to invoke such a rule in the absence of positive evidence for an unambiguously phonological effect. It appears, then, that WHAT (t,d) is is simply one manifestation of the general phenomenon that, in Browman and Goldstein's words, "in casual speech […] segments are routinely elided, inserted and substituted for one another" (1990: 359).

The other set of issues, that is WHERE this situates (t,d) and associated phenomena in the grammar, is less easy to resolve and depends on the place of this and other CSPs which, "can neither be modeled adequately at a symbolic, phonological level, nor left to be accounted for by the mechanics of the speech mechanism" (Nolan 1992: 280). But some well motivated model is needed in order to provide a sound basis for any sociophonetic/sociolinguistic analysis The exploration in Section 3.2 of potential different frameworks for analysis was necessarily brief and far from exhaustive, although it is clear that there are grounds for concluding that some are not satisfactory. With respect to more promising frameworks, the data reviewed here are insufficient to draw definitive conclusions about which approach to the phonology:phonetics interface best fits with the empirical observations of word-final stops. More articulatory data would be needed to implement a metric of gradience/categoricity[34], for example, whereas a Firthian-inspired approach would require more data on other terms in the contrastive symbolic system and on the wider context. Ultimately the choice of model depends on the preference of the analyst, subject to the data. However, the exploration of some of these avenues with naturalistic data would provide opportunities for further advances in the interaction between sociophonetics and phonetic and phonological theory, and provide a better motivated model to serve as a foundation for the exploration of the social indexicality of these consonants.

References

Barry, M. (1995). "A palatographic study of connected speech processes." *Cambridge Papers in Phonetics and Experimental Linguistics* 4: 1-16.

Bermúdez-Otero, R. (2010a). "Currently available data on English t/d-deletion fail to refute the classical modular feedforward architecture of phonology. Paper presented at the 18th Manchester Phonology Meeting." http://www.bermudez-otero.com/18mfm.pdf

[34] Although even articulatory data would not be able to disambiguate tokens with preceding /n/ which involve alveolar closure.

Bermúdez-Otero, R. (2010b). "Morphologically conditioned phonetics? Not proven!" Paper presented at On Linguistic Interfaces (OnLI) II, University of Ulster, 2nd December 2010. http://www.bermudez-otero.com/belfast-handout.pdf

Bermúdez-Otero, R. & G. Trousdale (2011). "Pathways of phonological change." http://ling.auf.net/lingBuzz/001235

Bladon, R. A. W., Henton, C. & B. Pickering (1984). "Towards and auditory theory of speaker normalization." *Language and Communication* 4: 59-69.

Broadbent, J. (1999). "A new approach to the representation of coronal segments." In Hannahs, S. J. & M. Davenport (eds). *Issues in Phonology: Papers from an International Workshop*. Amsterdam: John Benjamins. Pp. 1-25.

Browman, C. & L. Goldstein (1990). "Tiers in articulatory phonology, with some implications for casual speech." In Kingston, J. & M. E. Beckman (eds). *Papers in Laboratory Phonology I. Between the Grammar and Physics of Speech*. Cambridge: Cambridge University Press. Pp. 341-376.

Buizza, E. (2011a). "Frication and affrication of /t/ in RP English." In *Proceedings of Language at the University of Essex (LangUE)*. Pp. 16-28.

Buizza, E. (201b1). "/t/ lenition in RP English spontaneous speech." Paper presented at the 8th UK Conference on Language Variation & Change, Edge Hill, September 14th, 2011.

Bybee, J. (2002). "Word frequency and the context of use in the lexical diffusion of phonetically conditioned sound change." *Language Variation and Change* 14: 261-290.

Coetzee, A. & Pater, J. (2011). "The place of variation in phonological theory." In Goldsmith, J. A., Riggle, J. & A. Yu (eds). *The Handbook of Phonological Theory*. 2nd edn. Oxford: Blackwell. Pp. 401-434.

Crowdy, S. (1995). "The BNC spoken corpus." In Leech, G., Myers, G. & J. Thomas (eds). *Spoken English on Computer: Transcription, Mark-up and Applications*. Harlow: Longman. Pp. 224-235.

Cruttenden, A. (2008). *Gimson's Pronunciation of English*. London: Hodder.

Docherty, G. J. (1992). *The Timing of Voicing in British English Obstruents*. Berlin: Foris Publications.

Docherty, G. J. & P. Foulkes (2005). "Glottal variants of /t/ in the Tyneside Variety of English: an acoustic profiling study." In Hardcastle, W. J. & J. Beck (eds) *A Figure of Speech*. London: Lawrence Erlbaum. Pp. 173-197.

Ellis, L. & W. J. Hardcastle (2002). "Categorical and gradient properties of assimilation in alveolar to velar sequences: evidence from EPG and EMA data." *Journal of Phonetics* 30: 373-396.

Fabricius, A. (2002). "Ongoing change in Modern RP: evidence for the disappearing stigma of t-glottaling." *English World-Wide* 23: 115-136.

Foulkes, P. & G. Docherty. (2005). "The social life of phonetics and phonology." *Journal of Phonetics* 34: 409-438.

Guy, G. (1991). "Explanation in variable phonology: an exponential model of morphological constraints." *Language Variation and Change* 3:1-22.

Guy, G. & Boberg, C. (1997). "Inherent variability and the obligatory contour principle." *Language Variation and Change* 9: 149–164.

Guy, G. & Boyd, S. (1990). "The development of a morphological class." *Language Variation and Change* 2: 1-18.

Guy, G., Hay, J. & A. Walker. (2008) "Phonological, lexical and frequency factors in coronal stop deletion in early New Zealand English." Abstract for poster at Laboratory Phonology 11, Wellington, New Zealand. www.victoria.ac.nz/labphon11/.../Guy,%20Hay%20&%20Walker.pdf

Hardcastle, W. J. (1994). "Assimilation of alveolar nasals and stops in connected speech." In Windsor-Lewis, J. (ed.) *Studies in General and English Phonetics in Honour of Professor J. C. O'Connor*. London: Routledge. Pp. 49-67.

Hayes, B. (1992). "Comments on Chapter 10." In Docherty, G. J. & D. R. Ladd (eds). *Papers in Laboratory Phonology II. Gesture, Segment, Prosody*. Cambridge: Cambridge University Press. Pp. 280-286.

Hazen, Kirk. (2011). "Flying high above the social radar: coronal stop deletion in modern Appalachia." *Language Variation and Change* 23: 105-137.

Henderson, J. B. & Repp, B. H. (1981). "Is a stop consonant released when followed by another stop consonant?" *Haskins Status Reports in Speech Research* SR-67/68: 71-82.

Kiparsky, P. (1985). "Some consequences of Lexical Phonology." *Phonology Yearbook* 2:85-138.

Kühnert, B. & P. Hoole (2004). "Speaker-specific kinematic properties of alveolar reductions in English and German." *Clinical Linguistics and Phonetics* 18: 559-575.

Lichtman, K. (2010). "Testing Articulatory Phonology: variation in gestures for coda /t/." Paper presented at the Illinois Language and Linguistic Society Conference 2 (ILLS2), University of Illinois at Urbana-Champaign, 29 May 2010.

Lodge, K. R (1984). *Studies in the Phonology of Colloquial English*. London: Croom Helm.

Manuel, S. Y. (1995) "Speakers nasalize /ð/ after /n/, but listeners still hear /ð/." *Journal of Phonetics* 23: 453-476.

Myers, J. (1996). "The categorical and variable phonology of variable t-deletion in English." Revised version of paper presented at the International Workshop on Language Variation and Linguistic Theory, University of Nijmegen, September 1995. http://www.ccunix.ccu.edu.tw/~lngproc/t-deletion-manuscript.pdf

Nolan, F. J. (1992). The descriptive role of segments: evidence from assimilation." In Docherty, G. J. & D. R. Ladd (eds). *Papers in Laboratory Phonology II. Gesture, Segment, Prosody*. Cambridge: Cambridge University Press. Pp. 261-280.

Nolan, F. J. (1996). "Overview of English Connected Speech Processes." In Simpson, A. P. & M. Patzold (eds). *Sound Patterns of Connected Speech. Description, Models and Explanation.* = Arbeisberichte 31, Institüt für Phonetik und digitale Sprachverarbeitung, Universität Kiel. Pp. 15-26.

Roberts, J. (1997). "Acquisition of variable rules: a study of (-t,d) deletion." *Journal of Child Language* 24: 351-372.

Robins, R. H. (1970). "Aspects of prosodic analysis." In F. R. Palmer (ed.) *Prosodic Analysis*. Oxford: Oxford University Press. Pp. 188-200.

Sankoff, D., Tagliamonte, S. A. & E. Smith (2011) GoldVarb Lion. A multivariate analysis application. http://individual.utoronto.ca/tagliamonte/goldvarb.htm

Santa Ana, O. (1992). "Chicano English evidence for the exponential hypothesis: a variable rule pervades lexical phonology." *Language Variation and Change* 4: 275-288.

Schuppler, B., van Dommelen, W., Koreman, J. & M. Ernestus (2009). "Word-final [t] deletion: an analysis on the segmental and sub-segmental level." In

Proceedings of the 10th International Conference of the International Speech Communication Association (Interspeech 2009). Pp. 2275-2278.

Simpson, A. (1992). "Casual speech rules and what the phonology of connected speech might really be like." *Linguistics* 30: 535-548.

Smith, J., Durham, M. & L. Fortune. (2009). "Universal and dialect-specific pathways of acquisition: caregivers, children and t/d deletion." *Language Variation and Change* 21: 69-95.

Solé, M.-J. (2007). "Controlled and mechanical properties in speech. A review of the literature." In Solé, M.-J., Beddor, P. S. & M. Ohala (eds). *Experimental Approaches to Phonology*. Oxford: Oxford University Press. Pp. 302-321.

Steriade, D. (2000) "Paradigm uniformity and the phonetics-phonology boundary." In Broe, M. & J. Pierrehumbert (eds). *Papers in Laboratory Phonology V: Acquisition and the Lexicon*. Cambridge: Cambridge University Press. Pp. 313-334.

Stuart-Smith, J., Timmins, C. & F. Tweedie (2007). " 'Talkin' Jockney'? Variation and change in Glaswegian accent." *Journal of Sociolinguistics* 11: 221-260.

Tagliamonte, S. A. (1998). Was/were variation across the generations: View from the city of York. *Language Variation and Change* 10:153-91.

Tagliamonte, S. A. & R. A. M. Temple (2005). "New perspectives on an ol' variable: (t,d) in British English." *Language Variation and Change* 17:281-302.

Temple, Rosalind A. M. (2000). Now and then: the evolution of male-female differences in the voicing of consonants in two varieties of French. *Leeds Working Papers in Linguistics and Phonetics* 8:193-204.

Temple, R. A. M. (submitted). "Rethinking (t,d): a new 'new look' at a variable construc[t]."

Trudgill, P. (1974). *The Social Differentiation of English in Norwich*. Cambridge: Cambridge University Press.

Tucker, B. V. & N. Warner (2010). "What it means to be phonetic or phonological: the case of Rumanian nasals." *Phonology* 27: 289-324.

Wells, J. C. (1982). *Accents of English.* Cambridge: Cambridge University Press.

Wolfram, W. (1969). *A Sociolinguistic Description of Detroit Negro Speech*. Washington, D.C.: Center for Applied Linguistics.

Wolfram, W. (1993). “Identifying and interpreting variables.” Preston, D. (ed.) *American Dialect Research*. Amsterdam & Philadelphia: John Benjamins. Pp. 193-221.