PROSODIC FACTORS AND SOCIOPHONETIC VARIATION: SPEECH RATE AND GLOTTAL VARIANTS IN TYNESIDE ENGLISH

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ABSTRACT

This paper presents findings from an exploratory study of the effect of speech rate on the variable realisation of /p t k/ in the Tyneside (north-east England) variety of English. While previous work on this particular variety has shown that patterns of variation observed in /p t k/ are strongly related to a range of social factors, in line with most work on sociophonetic variation there has been relatively little focus to date on the possible role of prosodic factors in governing such inter- and intra-speaker variation. This study considers one such factor (speech rate) in the performance of 32 speakers on a sentence production task. Findings suggest that rate cannot be entirely excluded as a factor in accounting for the patterns of variation observed, but that its influence is somewhat marginal being clearly present only at particularly high rates.

Keywords: sociophonetic variation, speech rate, Newcastle English.

1. INTRODUCTION

The last decade or so has seen a significant increase in the attention paid to sociophonetic properties of speech and their implications for theories of speech production and perception (see overview in [6]). While this has resulted in a much broader understanding of the social-indexical value of phonetic variability, one area in need of much further investigation is the extent to which within- and between-speaker variance observed in such studies is influenced by a range of prosodic factors.

While the prosodic frame for an utterance is known to influence the realisational properties of syllables and words within the utterance [1, 2], sociophonetic studies have typically either not controlled at all for key prosodic features, or have controlled for only *some* of the relevant prosodic features by limiting their analyses to certain phonological environments (e.g. word-medial, or word-final position, etc,) and to certain stress environments (e.g. studies of glottaling of word-medial /t/ in English have tended to be restricted to tokens embedded in a *strong_weak* context).

This paper presents the results of an exploratory study of the effect of one key aspect of prosody (speech rate) on a pattern of variation which is known to have a strong social-indexical role within the Tyneside variety of British English (glottal/-ised variants of /p t k/ [4, 5]). Rate has typically not been controlled for in sociophonetic and variationist work to date, and yet it is clear that there is abundant variation in speech rate both within- and between-speakers. Since previous work on the phonetic correlates of different speech rates points to a significant impact on prosodic organization and segmental realization, the question arises to what extent the sociophonetic variability reported for Newcastle /p t k/ is governed by speech rate differentiation.

2. METHOD

2.1 Materials and speakers

The material for this study consisted of 12 sentences containing sites (underlined) likely to generate socially-correlated variation in plosive realisation (a hitherto unanalysed section of the Tyneside *Phonological Variation & Change* corpus [5])

- I had to do it tomorrow
- I had to put it off
- He meant what he said
- Jump up on the tractor
- Put a comma in it
- Pack it in or beat it
- He's putting it off
- He put in a bid
- A simple sentence
- He won't do that in a hurry
- He's booking separate tables for supper
- Pick up a packet of firelighters

The sentences were read once each at a "comfortable" tempo by 32 speakers sub-categorised by age (old/young [henceforth o/y]) sex (m/f) and "class" (working class [wc]/middle class[mc]). There were 4 speakers per cell (but 5 y-f-wc and 3 o-f-wc speakers). The analysis described below focused on the realisation of voiceless plosives occurring in an intervocalic environment (word-medially or across a word-boundary) within a *strong_weak*

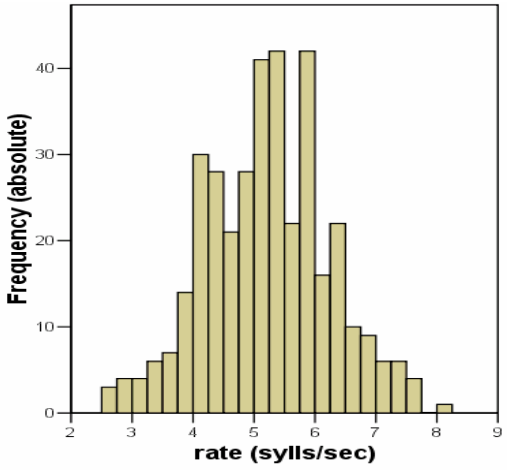
prominence frame, of which there were 347 tokens in the dataset.

2.2 Analysis

Potential variation sites were analysed spectrographically and auditorily, and tokens were classified in respect of specific variants of /p t k/ as determined by previous work on this variety [3, 4, 5]:
glottal/glottalised (not differentiated for the present purposes)
plain release – largely voiceless occlusion, no acoustic/auditory evidence of glottalisation
"pre-aspirated" release – covering a variety of properties including pre-aspiration *per se*, pre-affrication, and spirantisation (often in combination) all of which reflect a relatively early increase in DC airflow in a vowel-stop transition phase
voiced release – voiced occlusion with no acoustic/auditory evidence of glottalisation; sometimes with voicing continuing unbroken, but also with short-lag VOTs.
tap – acoustic/auditory evidence of a single instantaneous alveolar contact

Speech rate was calculated as syllable rate/sec for each utterance determined by the number of syllables corresponding to the citations form of each of the component lexical items in each sentence. Fig. 1 shows the distribution of speech rates across the utterances in the dataset.

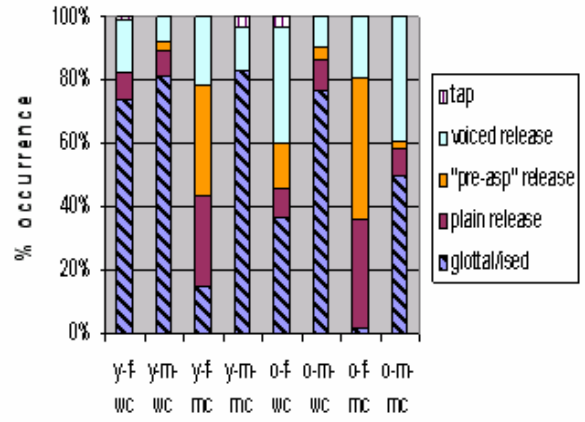
Figure 1: Distribution of speech rates across the utterances in the dataset.



3. RESULTS

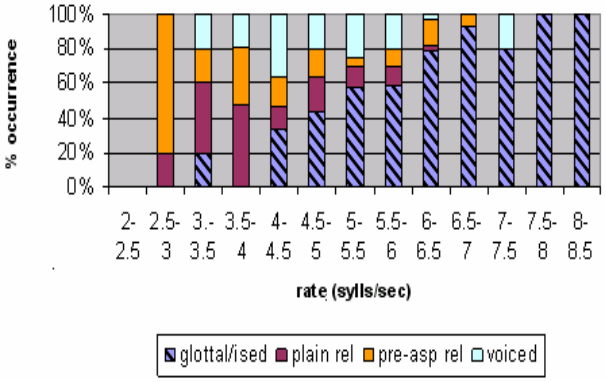
Fig. 2 shows the distribution of the variants tracked in the analysis by speaker category. These results show that the sociophonetic structuring of the variants in this read sentence dataset is much as reported in previous studies of this variety [3,4,5], with few glottals in f-mc speakers, more frequent use of glottals by m than f speakers (except y-f-wc), pre-aspiration most prominent in f-mc speakers, and voiced release prominent in o-m-mc speakers. But notwithstanding these general patterns the results evince a good deal of inter-/intra-speaker variability and the question is to what extent is speech rate a factor in accounting for this?

Figure 2: Distribution of plosive variants by speaker category.



Figs. 3 and 4 show for all 32 speakers the distribution of variants as a function of rate (n.b. for the tap, n=3, and this variant is therefore excluded from further discussion).

Figure 3: Distribution of plosive variants as a function of speech rate(sylls/sec).



The most striking pattern emerging from this representation of the data is that higher speech rates appear to be associated with a higher frequency of glottal/ised variants. However, on closer examination, the rate/variant relationship is not so straightforward.

Figs. 5 and 6 show the relationship of rate and variant realisation for the mid-range of rates, arbitrarily defined as those lying between 4 and 6.5

sylls/second (a constraint which encapsulates 80% of utterances analysed).

Figure 4: Mean speech rate (sylls/sec) by plosive variant across all speakers (error bars = 95% confidence intervals)

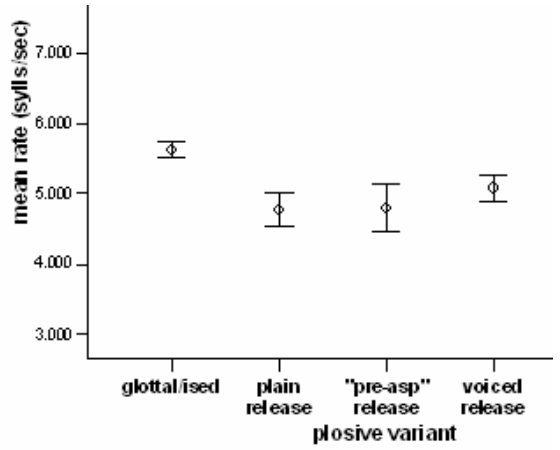


Figure 5: Distribution of plosive variants as a function of speech rate (sylls/sec) – mid-range of rates only.

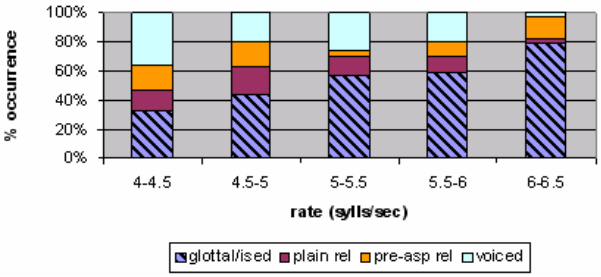
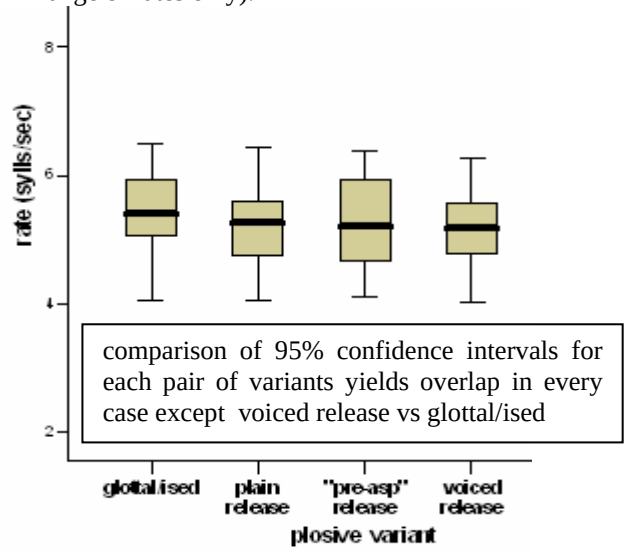


Figure 6: Median, interquartile range and overall range of rate (sylls/sec) by plosive variant – mid-range of rates only).



While for this subset of the data there is still a tendency for glottal variants to be more prevalent at higher rates, this relationship is not significant (comparison of 95% CIs for speech rate for each pair of variants yields overlap except in the case of voiced release vs glottal/ised) suggesting that for the large part of the dataset, rate does not appear to be a critical factor in relation to the occurrence of glottal variants of /p t k/. However, if we consider the data *outside* of the 4-6.5 sylls/sec range (shown in the Fig. 7) we can begin to discern where the effects of rate *are* most important (n.b. the low n's at the edges of the rate distribution – c.f. Fig. 1).

Figure 7: Distribution of plosive variants as a function of speech rate(sylls/sec) – high/low rates only.

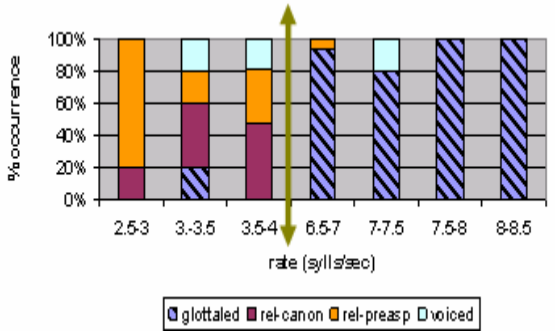


Fig. 7 shows that at the slowest rates very few glottal/ised token occur, and at the highest rates, glottal/ised tokens are predominant. However, note that 24/31 of the tokens <4 syll/sec are produced by o-f-mc speakers who produce only a single glottal/ised token in the entire data set irrespective of rate. Meanwhile, the tokens with rates > 6.5 sylls/sec were produced by speakers spanning all groups *except* o-f-mc.

4. SUMMARY OF RESULTS

In sum, these results suggest that rate cannot be discounted as a factor in relation to patterning of variants of /p t k/ in Tyneside English which are known also to be sociophonetically differentiated, but only at the higher tempo edge of the rate continuum where there is a skewing effect such that particularly high rates are conducive to the production of glottal/ised variants. The absence of glottal/ised variants at particularly low rates is likely due to the fact that those speakers do not have glottal/ised tokens at *any* speech rate. Some differences were evident in the central 80% of the data, but overall these are not significant (they are probably associated with fact that the o-f-mc speakers who produce the highest proportion of non-glottal/ised tokens happen to be those who are strongly present at the lower end of the mid range). It is notable that the socially-correlated differences observable in

the full dataset (shown in Fig. 2) are equally present in the mid-range dataset (see Fig. 8) indicating that rate differentiation cannot account for these differences. This conclusion is reinforced by a comparison of the sociophonetic patterning of variants in Fig. 2 and the overall rate distributions by social category shown in Fig. 9 where it can be seen that similar degrees of glottal/ised variants are found for speakers with very different rate profiles (y-f-mc vs o-f-mc) and conversely different frequencies of glottal/ised variants can be found in speakers with very similar rate profiles (y-f-mc vs y-m-mc).

Figure 8: Distribution of plosive variants by speaker category (mid-range rates only)

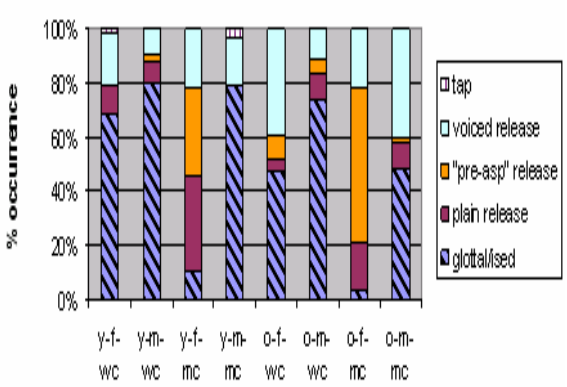
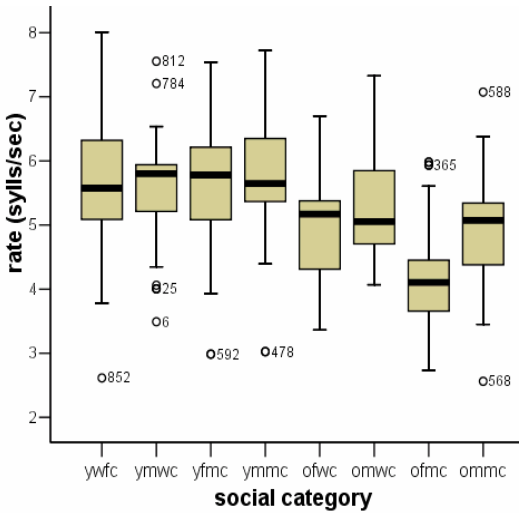


Figure 9: Median, IQ range and overall range of rate (sylls/sec) by social category of speaker



5. DISCUSSION

The analysis reported above is exploratory, involving a less-than-naturalistic dataset and a holistic measure of speech rate, but the results do point to rate not being *the* critical factor in our understanding of the socially-correlated patterns of realisation observed in this data. However, the effects which have arisen from this dataset do suggest that further investigation is warranted. For example, is it possible to elicit different profiles of sociophonetically structured variants by manipulating the rate at which speakers perform? To what extent do speakers differ in this (e.g. is there a difference between those who glottal/ise frequently and those who do so less often?). Is there evidence of a stronger rate effect in connected speech where the range of rates may be greater, especially at the top end? And, since Fig. 9 hints at an overall correlation between age and speech rate, it would also be interesting to explore any relation between age effects reported in sociophonetic studies and inter-generational differences in speech rate.

These results indicate the need for a more thorough integration of what we know about the prosodic structure of speech with what we know about sociophonetic variability. Other types of variability found in British varieties of English would equally lend themselves to furthering this line of investigation; e.g. “h-dropping”, “labial r”, “th-fronting”, and “/l/ vocalisation”.

6. REFERENCES

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