

FRICATION OF AUSTRALIAN ENGLISH /p t k/: GROUP TENDENCIES AND INDIVIDUAL DIFFERENCES

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ABSTRACT

This paper examines group and individual patterns in the rate of frication of voiceless plosives in Australian English. /k/ was fricated most often (17.2%), then /p/ (11.6%), both exhibiting extensive individual variation. /t/ was rarely fricated (0.9%) and therefore showed little variation among speakers.

Keywords: consonants, fricated plosives, Australian English, individual variation

1. INTRODUCTION

This paper presents an investigation the frication of /p t k/ in Australian English. The term *frication* is used here to refer to instances of a phonemic stop being realised as a phonetic fricative. Frication of voiceless plosives is a common connected speech process in English, patterning in different ways across dialects. In some varieties of English, frication appears to occur simply in phonetically weak environments [1: 29]. However, frication of certain voiceless plosives is a marked feature in other dialects; e.g. fricated /t/ is phonologised in Irish English [5], and fricated /k/ is common in Liverpool and surrounding areas [e.g. 10].

Of the voiceless plosives, frication of /t/ has been analysed in detail for various English dialects of the British Isles. Frication of /k/ has received less attention than /t/, but has been commented on for Liverpool and surrounding areas (see [9] for a summary). Frication of English /p/ has not been the focus of detailed phonetic research, aside from the study of a subset of the data reported here [8, 9].

Studies of the frication of plosives in Australian English have largely focused on /t/; to date frication across the class of stops has not been analysed within a single study of this dialect (although see [5] for Dublin and Middlesbrough English).

Horvath's 1985 study of Australian English spoken in Sydney [4], notes tapped, affricated, aspirated and heavily aspirated variants of /t/, but there is no mention of a fricated variant.

Sociophonetic patterning in /t/ variants is reported, the tap being 'clearly male and possibly teenage' while the heavily aspirated variant is 'associated with females and Greeks' [4: 103].

The first documentation of a fricated variant of /t/ in Australian English is by Tollfree [12]. This variant is discussed further in her analysis of occurrences of /t/ in conversational and citation speech of teenaged speakers from Melbourne and surrounding rural areas [13]. For the lower socioeconomic group fricated /t/ occurred only in citation speech in prepausal word-final context (13% of tokens), whereas for the middle socioeconomic group 22% of tokens in these contexts were fricated, as well as 20% of intervocalic tokens in citation speech and 12% of intervocalic tokens in conversational speech.

More recently, Jones and McDougall [6] carried out an acoustic-phonetic study of fricated /t/ in the read speech of six female speakers of Australian English from Melbourne. /t/ was very frequently fricated in the two read contexts elicited: between 4 and 6 out of 6 tokens were fricated in both contexts by all but one speaker, resulting in overall frication rates of 72% (29/36) for the word-medial and 81% (26/36) for the word-final context.

Frication of plosives is an interesting source of individual differences in the production of speech. One reason for speaker-specific behaviour in frication of the English voiceless plosives is that /p/-/ɸ/, /t/-/t̥/ and /k/-/x/ are not contrastive pairs in English [cf. 7]. Extensive individual variation in the rates of frication of /p/ and /k/ in Australian English was observed by Loakes and McDougall [9], even amongst pairs of twins who had lived together all their lives. Such individual differences have important implications for speech recognition and forensic phonetics, as well as speech production theory.

The present study thus extends the earlier investigation to determine patterns of frication across the full class of voiceless plosives for a group of Australian English speakers from Melbourne. Rates of frication of /p t k/ are

examined in the spontaneous speech of a group of twin pairs to assess group and individual patterns, and in particular whether the individual variation found for /p/ and /k/ is also present for /t/. Speakers were recorded on two separate occasions to evaluate the degree of within-speaker stability in the patterns of individual variation observed.

2. METHOD

2.1. Twins' speech

The speech data examined here are drawn from a larger corpus collected by the first author as part of an investigation of individual variation in the speech of Australian English speaking twins [8]. Analysing speech from twins (identical and non-identical) who have grown up and still live together can help to account for sociophonetic variation. If one twin exhibits a certain behaviour and the other does not, the feature is very likely to be due to individual variation rather than sociophonetically determined (although it should be acknowledged that twin siblings may sometimes have different social circles). Identical twins provide a further level of control – examining pairs of speakers whose vocal tract anatomies are as close to identical as possible enables the observation of differences in articulatory behaviour without these being convolved with anatomical differences [11].

2.2. Participants

The participants are 8 male speakers of Australian English from Melbourne with a 'general' accent [3], aged between 18 and 20 (3 identical twin pairs and 1 non-identical twin pair). Each pair of twins had grown up together and was living together at the time of the recordings. The speakers are TbY & TfY, PF & CF, and LG & RG (identical twin pairs), and RH & ZH (non-identical twins).

2.3. Recording and labelling

Each speaker took part in two Labovian-style interviews in which he discussed his interests and experiences with the first author. Approximately 8 minutes of spontaneous conversational speech from each interview (8 speakers × 2 sessions) are analysed in the present study. The two recording sessions with each speaker were separated by approximately 6 months.

The participants were recorded in the phonetics laboratory at The University of Melbourne. The recordings were made on 120 minute Sony Digital

Audio Tapes using a Sony ECM-999 PR electret condenser stereo microphone positioned approximately 80 cm from the participant's mouth and set to 120°, using a studio quality rack mount Tascam DA-30 DAT recorder.

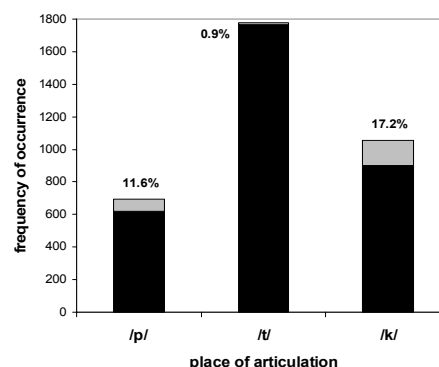
The two non-contemporaneous recordings were re-digitised at 22 kHz from the digital audio tapes on a Sun Ultra workstation using the *EspS/Xwaves+* function *s16record*. Consonant and vowel segments were labeled manually with *The EMU Speech Database System*. Fricated tokens were identified acoustically by the lack of a silent gap and no evidence of a burst, as well as presence of activity in the higher spectral regions.

3. RESULTS

3.1. Rates of frication

Occurrences of /p t k/ and their rates of frication across the group of speakers are shown in Figure 1.

Figure 1: Number of occurrences of /p t k/, showing the proportion of tokens fricated above each bar. The grey sections on the bars represent fricated tokens, while the black indicates all other variants.



Since the data are from naturally occurring spontaneous speech, token numbers are unbalanced across the data set: 619 for /p/, 1763 for /t/ and 900 for /k/. /k/ was fricated the most often, at a rate of 17.2%. /p/ was fricated 11.6% of the time, while /t/ was rarely fricated, at only 0.9%.

The environments in which /p t k/ were most commonly fricated were intervocalic word-medial and intervocalic word-final; for example in words such as *piPer* and phrases such as *blaCK and white* (see [8] for further discussion). When /p/ and /k/ were not fricated, they were usually realised as canonical released stops or glottal variants such as preglottalised and postglottalised tokens (but not glottal stops) [cf. 13]. Some affricated stops were also observed, for example [kx] for /k/, as well as some approximated tokens. A similar range of

variants was observed for /t/. In intervocalic position /t/ was very often realised as a tap, which is typical in Australian English [see 2, 4]. A number of ‘intermediate’ stops were also observed for /t/ [cf. 6], and these were included in the ‘all other variants’ category.

3.2. Individual variation

Loakes and McDougall [9] showed that the extent of frication of /p/ and /k/ varies greatly between speakers. The present data show that this is not true for /t/, since frication of this consonant occurred so rarely. Table 1 shows the distribution of /p t k/ and fricated variants of these in the data, for each speaker, and for each recording session separately.

Table 1: /p t k/ tokens produced by each speaker in sessions 1 and 2. For each consonant, the columns show the total number of tokens, the number of these which were fricated, and the resulting percentage of fricated tokens (rounded, and in bold type).

Speaker & session	p / [p̥] / %	t / [t̥] / %	k / [x] / %
TbY1	67 / 15 22	176 / 1 1	95 / 25 26
TbY2	39 / 7 18	139 / 0 0	40 / 14 35
TfY1	72 / 6 8	123 / 0 0	89 / 3 3
TfY2	45 / 3 7	86 / 3 3	48 / 1 2
PF1	20 / 0 0	78 / 0 0	29 / 2 7
PF2	32 / 1 3	118 / 0 0	59 / 5 8
CF1	16 / 1 6	98 / 5 5	24 / 0 0
CF2	31 / 2 6	135 / 2 1	53 / 6 11
LG1	29 / 0 0	101 / 0 0	59 / 8 14
LG2	20 / 0 0	71 / 1 1	44 / 3 7
RG1	41 / 4 10	90 / 1 1	88 / 31 35
RG2	36 / 3 8	78 / 2 3	54 / 17 31
RH1	68 / 11 16	115 / 0 0	81 / 14 17
RH2	37 / 5 13	150 / 2 1	60 / 8 13
ZH1	36 / 8 20	86 / 0 0	47 / 12 26
ZH2	30 / 6 20	119 / 0 0	30 / 6 20

The results in Table 1 show that while frication of /t/ is rare, there is considerable individual variation in the proportions of /p/ and /k/ fricated, including marked differences within twin pairs. Further, the individuals’ proportions of fricated tokens are relatively consistent within-speaker across the two recording sessions. These patterns of between-speaker variability and within-speaker consistency can be seen more clearly in the scattergraphs in Figures 2-4. For each consonant, plot (a) shows the percentage of tokens fricated in the first recording session plotted against the percentage of tokens fricated by the same individual in the second session. The (b) scattergraphs for each consonant show the percentage of fricated tokens of the consonant in question

Figure 2: (a) Scattergraph of percentage of /p/ tokens fricated in Session 1 against Session 2 for each individual. (b) Scattergraph of the percentage of /p/ tokens fricated by the first member of each twin pair against the percentage of /p/ tokens fricated by his twin brother, with a separate datapoint for each recording session.

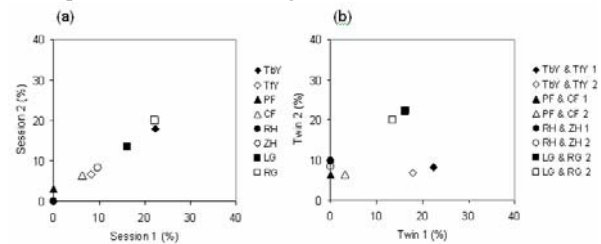


Figure 3: Scattergraphs for /t/ (details as for Figure 2).

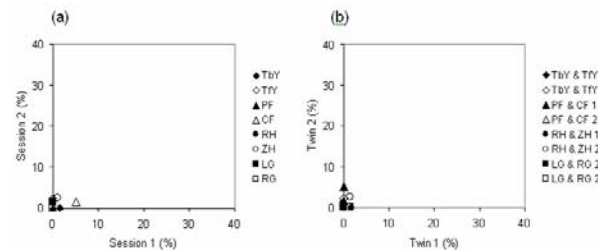
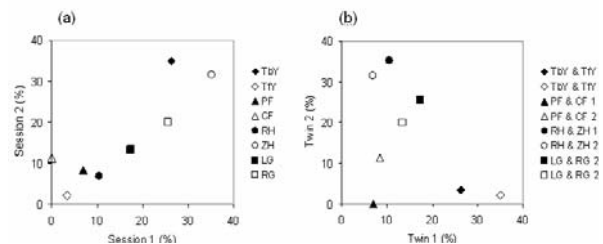


Figure 4: Scattergraphs for /k/ (details as for Figure 2).



produced by the first member of each twin pair against the equivalent percentage for his twin.

For /p/, the datapoints in Figure 2a form an approximately straight line with a positive gradient; the performances of any given individual on the two different occasions are very similar. This is supported by a Spearman’s rank correlation coefficient of 0.997 ($p = 0.000$). The datapoints in Figure 2b show little evidence of linearity; rather they appear as pairs of points in different regions of the graph. Each individual’s two performances are close together, but do not correspond with those of his twin brother in any systematic way. This is confirmed by a Spearman’s rank correlation coefficient of 0.146 ($p = 0.729$).

Figure 3 shows very different results for /t/: /t/ is rarely fricated and therefore does not exhibit individual differences. There is no evidence of a straight line relationship for either scattergraph. This is confirmed by a Spearman’s correlation coefficient of 0.224 ($p = 0.595$) for Session 1 against Session 2, and of -0.280 ($p = 0.503$) for Twin 1 against Twin 2.

Figure 4 shows that /k/ patterns similarly to /p/: frication of /k/ is consistent within speakers, and variable between speakers (including between members of a twin pair). The datapoints in Figure 4a show evidence of a positive linear relationship, indicating a close degree of correspondence between the performances of any given individual on the two different occasions. This is borne out by a Spearman's rank correlation coefficient of 0.810 ($p = 0.015$). The datapoints in Figure 4b show no evidence of linearity; rather they appear as four pairs of points in different regions of the graph. Each pair of points corresponds to a given twin pair's two recording sessions, and the two points are close together because of the similar performances of each individual. However, the pairs of points do not form a straight line because the behaviour of each twin is different from his brother's. This is confirmed by a Spearman's rank correlation coefficient of -0.262 ($p = 0.531$).

4. DISCUSSION

Patterns of frication of /t/ are very different from those for /p/ and /k/. Whereas /p/ and /k/ were fricated to differing extents between speakers, /t/ was rarely fricated at all. It is possible that this is due to frication of /p/ and /k/ being below the level of awareness of the speaker, while frication of /t/ is emerging as a sociophonetically defined feature in Australian English. Tollfree [13] observed greater use of fricated /t/ by speakers of middle as compared with lower socioeconomic background and greater use in citation speech than conversational. Further, Jones and McDougall [6] documented extensive use of the variant in read speech by female private school (fee-paying) and university-educated speakers. More data are needed to establish the patterns clearly, but it appears that fricated /t/ is a variant favoured by female speakers from higher socioeconomic backgrounds, and less preferred by male speakers and speakers from lower socio-economic backgrounds. It is possible that the male speakers in the present study actively avoided /t/ frication due to its association with a different sociological group. By contrast, the most commonly used variant of /t/ by the male speakers in the present study was a tap [cf. 2, 4].

5. CONCLUSION

This study presented an analysis of frication of /p t k/ in the spontaneous speech of eight male

speakers of Australian English from Melbourne. /p/ and /k/ exhibited extensive individual variation in frication behaviour even within twin pairs and proportions of fricated tokens were relatively consistent within-speaker across sessions. /t/, by contrast, was very rarely fricated by this group of speakers, offering no obvious source of individual differences. Further work will address the socio-linguistic implications of frication and potential individual variation in other variants of /p t k/.

6. ACKNOWLEDGEMENTS

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