The Gender Variable in Australian English
Stop Consonant Production

by

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Declaration

This thesis is a presentation of my original research work. Wherever contributions of others are involved, every effort is made to indicate this clearly, with due reference to the literature, and acknowledgement of collaborative research and discussions.

The work was done under the guidance of Associate Professor Janet Fletcher and Dr. Deborah Loakes at the University of Melbourne.

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Abstract

This sociophonetic study investigates the social variable of gender in Australian English consonant variation. In particular, 18-22 year old male and female speech from Melbourne will be examined for variation in the production of English voiceless stops /p/, /t/ and /k/. The corpus includes citation speech in a controlled wordlist and sentence as well as spontaneous speech. Auditory and acoustic analyses were used to identify non-canonical variation. The findings of this study are presented and discussed with reference to previous work done. Several gender correlations were found in relation to speaker sex, phonetic environment and speech style. Male speakers’ speech was especially marked for /k/ and /p/, taps and glottalization of /k/. Female speech was marked for the affrication of /t/ across speech styles. Both speaker sexes showed more variation in connected speech than in cited speech.
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Chapter 1: Introduction

Consonant variation has only recently become an area of interest in Australian English. Previously, studies tended to give more focus to the study of vowel production (Baker, 1945, Mitchell & Delbridge, 1965). It was also mainly in the last ten years that attention has been turned to the general field of sociophonetic variation and how it relates to actual human speech (Foulkes & Docherty, 2005). In particular, gender has been an area that has not received much attention in Australian English. A number of studies have made cursory observations on phonetic features that have been associated with gender differences during the course of their investigation of Australian English consonant production. For example, Loakes & McDougall (2007) suggest that ‘fricated /t/ is a variant favoured by female speakers from higher socio-economic backgrounds’ (p.1448). This study will examine in detail the aspect of gender in relation to consonant variation in the Australian English voiceless stops /p/, /t/ and /k/.

Although sound change is considered to be the main leading force of linguistic change in languages (Labov, 2001), it is unpredictable and does not always follow noticeable patterns, which makes it difficult to study. However, as ‘no natural human utterance can offer linguistic information without simultaneously indexing one or more social factor’ (Foulkes & Docherty, 2005: 11), the current study was motivated by the belief that by studying particular social factors and their correlations to phonetics, important findings can be contributed to the growing field of descriptive variation studies as well as sociolinguistics.

Gender is a social factor that is particularly interesting as it has largely been seen to be a socially constructed means of categorization based on biological differences between sexes. Unlike other social categories such as social class and ethnicity, any evidence of sound correlations ‘may be parasitic on phonetic differences derived from biological differences’ (Foulkes & Docherty, 2005: 3). For example, male speakers tend to have a lower fundamental frequency than females because of their generally
longer vocal tract and vocal folds (Foulkes, in press). However, numerous studies have shown that children pick up on gender-related phonetic behaviour from a young age to distinguish themselves according to their gender identities (Roberts & Labov, 1995; Sorenson, 1989).

In this study, the terms ‘sex’ and ‘gender’ will be used interchangeably to encompass both the physiological and social differences between males and females. Although it may be difficult to draw a clear line between which phonetic behaviours relate to physiology and which relate to the gender identities that individuals are socialized into, ‘it is in examining a range of similar local situations that we can understand how and when this particular kind of global/local dynamic manifests itself in variation, and how local meanings are mobilized in the process’ (Eckert & McConnell-Ginet, 1999: 191). The most consistent results have been found when men and women are distinguished and studied, rather than focusing on sex-preferential methodologies. Labov (1990) cites two principles of language and gender; firstly that within a standard social class, females tend to have a higher frequency of standard forms than male speakers, and that women are more likely to use innovative forms of language. Labov’s (2001) principles will be explored within this study. The study will also discuss other relevant literature on gender variation.

In this sociophonetic study, the social variable of gender will be studied in relation to Australian English consonant variation. In particular, university-age male and female speech from Melbourne will be examined for variation in the production of English voiceless stops /p/, /t/ and /k/. The area of consonant variation is especially interesting because it frequently involves a change in manner of articulation. The corpus includes citation speech in a controlled wordlist and sentence as well as spontaneous speech. Previous findings on consonant variation will be discussed, along with sociolinguistic findings particularly in relation to gender. The findings of this study will then be presented and discussed with reference to previous work done. To date, there has been no known work done in this area of gender and consonant variation in Melbourne English. The findings of the study will hopefully make new contributions to the area of sociophonetics in Australian English.
Chapter 2: Literature Review

In this section, relevant findings and contributions of previous studies on consonant variation in different dialects of English will be discussed. The range of variants found in those studies will be presented, along with the factors which prior research has deemed to be influential in consonant variation. The findings of research done on Australian English in particular will be discussed along with important research on gender relations to the production of consonants. Finally, the motivations and aims of the current study will be presented.

2.1 Background of Study in Consonant Variation

In Ohala’s (1996: 206) words, ‘the more we look at connected speech in detail, the larger the ‘zoo’ of strange and exotic phonetic animals becomes’. This whimsical analogy has been concretized by a number of recent studies looking at how consonants diverge from their canonical forms.

Phoneticians have widely found the process of lenition, or the ‘diminution of the energy used to pronounce an underlying phonological unit within a word in a particular linguistic environment’ (Shockey, 2003: 112), to be a key factor in consonants being realised in various lenited, non-canonical ways. In this process, the ‘reduced forms of a word are simplified with respect to the canonical (underlying) form and often involve assimilations, vowel centralization , and the deletion or simplification of segments’ (Byrd, 1994: 41). This process has been found to be especially prevalent in connected speech where ‘phonetic undershoot takes place as less time is available for each linguistic unit’ (Shockey, 2003: 11). Studies done with electropalatography have supported the finding, showing that casual speech tends to see consonants lenited more than in careful read speech (Shockey, 1991; Shockey & Farnetani, 1992).
In her study of American English consonants, Lavoie (2002) focuses /k/ consonants, and discovered a spectrum of non-canonical realisations that involved a change in manner of articulation. She notes in her previous work (Lavoie, 2001) that there was a lot more variation than was accounted for in the studies on consonants at the time. From a Map Task corpus of spontaneous speech, Lavoie (2002) found the following inventory of variants:

- incomplete stop with frication
- voiced /k/
- approximant
- voiced glottal fricative

A language’s phoneme inventory is a limiting factor on the extent of variation that speakers can produce in terms of a consonant’s manner of articulation (Lavoie, 2002). Consonant variation is confined by the need for intelligibility to prevail over other factors (Labov, 2001). Therefore in the case of the English language, which contains a considerably restricted consonant inventory, the chances of variation occurring even without listeners perceiving it is fairly high.

Honeybone (2001) focuses on the phonetic environments where weakening occurs in Liverpool English, citing the word-medial intervocalic environment and coda position to be sites of ‘lenition promotion’ (Honeybone, 2001). He also cites phonetic environments that inhibit lenition. He draws up a lenition trajectory to show the basic stages that a consonant would pass through as it encounters greater levels of lenition.

An influence of consonant weakening that has been commonly cited in a number of studies is phonetic environment. Shockey (2003) discusses how the onsets of syllables are environments that are less susceptible to consonant change than syllable codas. Particularly in English, sonority is stronger in word-initial than word-final position (Keating, Wright & Zhang, 1999). Unstressed syllables have a higher tendency to be undershot than stressed syllables because they are areas of phonetic weakness (Shockey, 2003:28, Tollfree, 2001; Honeybone, 2001). Stress is also an important
factor affecting consonant change and ‘onsets of syllables immediately following a stressed syllable are vulnerable, especially if they are a single plosive (not part of a cluster), even more if they are alveolar plosive’ (Shockey, 2003: 34).

Lavoie (2002) makes a similar claim that a consonant’s sonority and prosodic context are interdependent in determining its realisation. Therefore in unstressed or medial positions, ‘consonants may receive more sonorous realizations’ (Lavoie, 2002: 44) whereas a consonant produced in a stressed syllable and the initial position would be less sonorant in nature. A voiceless stop, for example, would be classified as the least sonorant manner of articulation as it requires the vocal tract to be entirely sealed in its production.

Other studies have also supported these claims, and will be presented below.

In summary, some of the factors that have been found to be associated with consonant change are:

- Phonology
- Word predictability
- Collocations
- Previous use of a word: words are shorter if they have been used before
- Speaker sex
- Prominence of word
- Prosody

2.1.1 Frication

The frication of plosives has generally been considered to be a phonological weakening process of lenition (Jones & McDougall, 2006). This process has been observed to be characteristic to some varieties of British English, including Liverpool
English (Newbrook, 1999; Sangster, 2002; Honeybone, 2001), Middlesbrough English (Jones & Llamas, 2003) and Dublin English (Jones & Llamas, 2003). ‘Spirantization’ has been another term used to describe frication. However, in this study, it is used to distinguish the fricated variants which have no stop gap and steady or gradient frication that begins with ‘a period of silence or low amplitude frication followed by frication which is characterised by an average of more than 3 times as high a maximum rate of airflow’ (Shockey & Gibbon, 1993).

As seen from the studies cited above, frication variants are not uncommon. Fricated forms ‘lack the period of full occlusion associated with plosive forms’ (Tollfree, 2001: 48). In a stress language like English, unstressed syllables go through the reduction process when targets are incompletely met (Shockey, 2003). This results in some closures being ‘more open than might be expected in their traditional descriptions’ (Shockey, 2003: 27). It is important to note that the strength of the fricatives produced through reduction is not as full as that of a ‘true fricative’ (Lavoie, 2002: 49). Shockey and Gibbon (1993) describe how the spirantization of stops lacks the complete energy that actual fricatives have. They have referred suitably to these partial fricatives as ‘stopless stops’.

Loakes and McDougall (2007) point out that although the frication of stops appears to be a purely phonological process at certain weak environments in some dialects, it is a ‘marked feature’ (Loakes & McDougall, 2007: 1445) in dialects such as Irish English (Jones & Llamas, in prep.) and Liverpool English (Newbrook, 1999; Honeybone, 2001, Shockey, 2003). Their paper also points out that compared to /t/, the consonants /k/ and /p/ have received less attention from researchers.

In their study on male Melbourne English, Loakes & McDougall (2007) found that the environments in which frication of /p/, /t/ and /k/ occurred most frequently were intervocally and following a stressed vowel. However, an interesting finding arises when they studied individual differences between speakers, and found that those who fricated /k/ and /p/ most in these environments also tended to fricate the most in unexpected phonetic environments such as word-initially and when located before a
stressed vowel. Their findings support the reduction-favouring conditions found by previous research of other varieties of English to apply to Melbourne English.

In Loakes and McDougall (2007)’s results, they found that approximately 17% of /k/ tokens were fricated, and 11.6% of the /p/ tokens. Frication of /t/ was uncommon at only 0.9%. The most common variant of /t/ found in this study is the tap. They suggest that the male speakers may have avoided /t/ frication because of the associations with the feminized associations with the feature. This might relate to findings by Horvath (1985) in Sydney English. She talks about the ‘extremely aspirated, even affricated’ stop that is especially salient in female speech and those of Greek background (p.103), and attributes it as a prestige feature. Also in Sydney English, Haslerud (1995) also talks about affricated /t/ as a female and high-status variant (Tollfree, 2001: 54).

Frication was found to occur more in spontaneous speech and not in read speech by their participants, and most frequently in weak phonological environments such as intervocally or beside other voiceless fricatives where assimilation would take place. Their study contributes new understanding to Australian English reduction of the class of voiceless stops which had not been examined closely before.

Jones and McDougall (2006) studied six female speakers of Melbourne English and found that /t/ was fricated in read speech 72% of the time in word-medial context and 81% of the time in word-final context. These were the two environments that were the most susceptible to consonant change. For the consonant /k/, they also came across affricated stops [kx] in their data.

Looking also at individual variation, they find that although variation is great for /p/ and /k/, /t/ shows less variation. They hypothesize that this is because fricated /t/ is becoming a sociophonetic feature in Australian English that was produced more by middle than lower socioeconomic class background, and more so in cited speech than in the spontaneous speech in their data.
Jones and McDougall (2006) went on to investigate the frication of /t/ in Australian English produced by female speakers and found that Australian English fricated /t/ showed more similarities to Australian English /ʃ/ than /s/ although the duration and amplitude were lower than that of the actual fricative. Their sociolinguistic focus shows how the study of consonant variation to be able to lend important understanding to how language changes and is influenced by different social factors over time.

In another variety of English, Docherty, Hay & Walker (2006) found in their study that New Zealand English speakers produced 49% of phrase-final /t/s with frication in spontaneous speech, with the likelihood to fricate corresponding with the likelihood to release the stops. They make an important correlation linking aspiration to frication which requires further substantiation in other English varieties.

The class of affricates also needs mention. Horvath (1985) documents the occurrence of an affricated variant of /t/ in her study on Sydney English, with the finding that girls of higher social status, and those of Greek descent tended to produce more of this variant. In the current study, the correlations between fricatives, affrication and gender will be further discussed.

In studying the consonant /t/ in Australian English, Tollfree (2001) notes that only the tap, aspirated and unaspirated variants of /t/ were recognized as part of the English inventory before. In her previous study (Tollfree, 1996), examples of fricated /t/ were first found in Australian English. Her 2001 study showed that a range of variants of phonemic /t/ including voiced taps, fricated /t/s, glottalized (including pre-glottalized and post-glottalized variants) also exist in Australian English.

2.1.2 Tapping

Another prominent variant of /t/ found in varieties of English has been the tap/flap. Tapping occurs when alveolar plosives or clusters like [nt] are articulated ‘in a
ballistic rather than in a controlled fashion’ (Shockey, 2003: 29). Alveolar tapping is prevalent in Australian, American and Irish varieties of English, and occur most frequently in environments where an alveolar stop occurs in an unstressed syllable that is preceded by a stressed one and also in intervocalic environments. Fukaya & Byrd’s (2005) study of American English shows through analysis of electromagnetic articulography (EMA) that the shortening of consonants was found dominantly in word-medial intervocalic positions where a stressed syllable was followed by an unstressed one.

Byrd (1994) found that women tend to tap less than men. Word-medial /t/ in the word water was tapped by 99% of her speakers, with dialectal and gender differences being influential factors in the frequency of tapping. The frequency of tapping has also been found to correlate with the proportionate frequency of the words containing the /t/ tokens appearing in the utterances. Also, morphologically simple words showed a higher tendency of tapping than more complex ones (Patterson & Connine, 2001).

2.1.3 Glottalization

In some English varieties, voiceless alveolar stops in syllable-final position have been found to be likely to be lenited to a glottal stop (Shockey, 2003: 36). This is largely characteristic of Cockney English, and can occur intervocalically in varieties such as Edinburgh English (Lodge, 1984). Holmes (1995) has also found this to be an increasing occurrence in New Zealand English. Shockey (2003) explains this to be a result of syllable-final simplifications where word or syllable-final /t/, /p/ and /k/ in some dialects have the potential to go through ‘glottal reinforcement’ (Wells, 1982: 260), causing the final consonant to be either combined with or replaced by a glottal stop [ʔ]. Tollfree (2001) found that the glottalized variant may appear as a pre-glottal [ʔt] or post-glottal [tʔ] position or even simultaneously with the glottal stop (Tollfree, 2001: 52).
In a study done on Tyneside English, Carr (1991) found that /p,t,k/ voiceless stops would become glottalized most frequently when following a primary stressed vowel, intervocalic positioning or before an obstructant. In a related study done on Australian English by Tollfree (2001), she found that glottalized /t/ occurs in the following environments:

- before syllabic nasals
- intervocalic word-final position
- pre-consonant vital contexts
- intervocalic word-final context (eg. *that one*)

In her corpus of Melbourne speech, the glottal variant does not occur in word-initial position or intervocalic word-medial position. She found that glottalization occurred commonly in medial contexts with morpheme boundaries, for example in words like *hitman* and *cutlass*. They also appeared in intervocalic word-final positions, and in word-final contexts. No glottal variants were found in medial intervocalic contexts (Tollfree, 2001: 52).

### 2.2 Gender and Sociolinguistic Variation

The field of sociophonetics is a relatively new one, and became more prominent through the work of researchers like Labov (1966, 1994-2001). It involves variation in speech patterns which frequently correlate with social factors such as gender, age or social class. Foulkes and Docherty (2005) state that this variation is often more gradient than categorical (p.3). A ‘given form may be observed to be used statistically more by one group than another, or in one speech style than another’ (Foulkes & Docherty, 2005: 3). The field of sociophonetics now includes investigations of the impact of variation on speech perception, linguistic and sociolinguistic theory, first and second language acquisition and forensic speaker identification (Foulkes & Docherty, 2005).
In terms of gender, sociolinguists have argued that women generally try to produce more standard forms in order to avoid the criticism that their position in society subjects them to (Cheshire, 2002; Deuchar, 1989). In Labov’s (2001) study, he found that ‘women show a lower rate of stigmatized variants and a higher rate of prestige variants than men’ (p.266, italics author’s own). A number of studies across different English-speaking environments have similarly found women tending to choose standard forms over non-standard ones, especially when compared to men (Labov 2001: 266-267; Eckert et.al., 1999).

Trudgill (1972) discusses a notion of ‘covert prestige’ whereby males try to project masculinity by avoiding standard forms which are often associated with femininity. Male speakers have been generalized as aiming to produce language that promotes solidarity between themselves and other men (Holmes, 2001). It has been postulated that men aim to fit in with their local networks through the use of vernacular pronunciations (Watt & Milroy, 1999).

In terms of phonetics, less is known about female speech as compared to male speech (Johansson, Sundberg & Wilbrand, 1982; Byrd, 1994). The variant of speaker sex has not been commonly studied in phonetics despite the important contributions it can make to the field of sociolinguistics (Byrd, 1994; Foulkes & Docherty, 2005). Female voices are considered more difficult to analyse because of their higher formant frequencies and the comparatively little data available (Foulkes & Docherty, 2005). However, through the growing number of phonetic studies that have undertaken female speech, interesting speaker sex variation has been found.

In a study done almost thirty years ago, Wolfram (1969) found in the Detroit African-American community that women who speak with vernacular grammatical forms are regarded as sexualized women from a lower class. This perception was held throughout all socioeconomic classes, and was the cause of women using more standard forms than men. According to Eckert & McConnell-Ginet, (1999) this study showed the ‘most consistent gender pattern that has been found in any community study of variation’ (p.193). Gordon (1997)’s study on New Zealand female speakers
had similar findings whereby women tended to associate non-standard pronunciations with lower social class and ‘sexual looseness’, and therefore leaned toward using more standard forms themselves.

Focusing more specifically on the gender aspect of consonant variation, Jones and Llamas (2003) found in their study of fricated /t/ across Irish English and Middlesborough English that Irish English use of the variant has no apparent correlation with speaker sex, but Middlesborough English which has only been recently reported occurs more frequently in female speech. Extensive use of fricated /t/ was also found by Jones and McDougall (2006) in private school girls and university female students.

Trudgill notes in his 1986 study that female speakers tend to produce more strongly released word-final stops than men do, as that is considered a more standard and prestigious pronunciation (Trudgill, 1986). Similar results are found by Whiteside (1995; 1996), where women were seen to articulate consonant clusters more fully, and also at a slower rate. In the same studies, she also found that men had a higher tendency to delete and lenite sounds. Men were also found to have higher rates of consonant reduction in Byrd’s (1994) study of American English speech.

In Loakes & McDougall’s (2007) study, with relation to gender in particular ‘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’ (Loakes and McDougall, 2007:1448). Byrd (1994) found unexpectedly in her sociophonetic study of allophonic variants between male and female speakers of American English that women produced more glottal stops than men in all word positions. She suggested that glottalization of the /t/ stop could be a devoicing mechanism used by women. Her study makes an interesting point that listeners traditionally expect female speech to be breathier in voice quality than male speech, and therefore would predict a lower incidence of reduction to glottal forms by females, but the results proved contrary to this. Therefore, although a number of studies have drawn the generalization that women are ‘more conservative,
more polite, more cooperative, or more egalitarian than men’ (Eckert & McConnell-Ginet, 1999: 191) this does not hold true in all circumstances.

Other studies have also drawn clear relations to gender as well as other social aspects like ethnicity and social background. Horvath’s (1985) earlier study on Sydney English found that the tap is associated with teenage males, whereas the heavily aspirated /t/ and affricated variant tended to be produced more by females and those of Greek backgrounds. Docherty, Hay and Walker’s (2006) research on phrase-final /t/ in New Zealand English looked first at whether the stop was released in male and female spontaneous speech. They found that females showed a higher number of released forms than males.

However, Eckert & McConnell-Ginet (1999) claim that some studies have proven the generalizations to be inconsistent. In terms of grammatical forms, women have been found to produce more standard forms than men. However they argue that when phonological forms have been studied, ‘women tend to be more standard in their use of apparently stable variables, but they commonly lead in the use of non-standard variables that represent sound change in progress’ (Eckert & McConnell-Ginet., 1999: 192), which agrees with Labov’s (1990) proposition of women as innovators of language.

2.3 Motivation of Study

In summary of findings on speaker sex, Labov (2001) suggests: ‘women conform more closely than men to sociolinguistic norms that are overtly prescribed, but conform less than men when they are not’ (p.293). Sociolinguists often make the claim that people tend to etch out their identities through ‘negotiating their participation in multiple communities of practice’ (Eckert and McConnell-Ginet, 1999: 188). Frequently, this creation of self-identity is done through language and sound choices.
The focus of this study was chosen out of personal interest, and also designed to try to contribute to a limited pool of research discussing the area of gender differences in Australian English. It was also an incentive to follow up study in this field because consonant variation is an area in Melbourne English phonetic studies that has received more research attention recently by researchers like Loakes & McDougall (2007). It is valid to keep in mind that although the generalization of communities’ speech may uncover various patterns which may lead to stereotypes being made, the findings are seldom able to fully account for these patterns (Eckert and McConnell-Ginet, 1999: 90).

2.4 Aims of Study

In this study, three main questions were addressed through the combination of qualitative and quantitative methods:

1. Is there gender variation between male and female production of voiceless stop sounds in Melbourne English?
2. Does any consonant variation found occur in similar ways in cited and spontaneous speech?
3. How does phonetic position affect this variation, and is this relevant for both male and female speakers?
Chapter 3: Methodology

Current sociophonetic investigations use a combination of auditory and acoustic phonetic analysis techniques to study consonant variation (Foulkes et al., 2005; Shockey, 2003 etc.). Spectrographic acoustic analysis is required for the study of consonant to identify stop release bursts which may not be observable through auditory observation, especially in connected speech. Lavoie (2002) notes that “[m]issing the burstless stops is likely due to the ways in which linguists are trained to identify phonetic segments and assign them symbols, which focuses on elements which are phonemic in some languages’ (p. 40). Spectrograms are useful in aiding the identifying of patterns that deviate from the typical expected pattern for stops. At the same time, auditory analysis is also essential to impressionistically identify areas of interest that can then be examined acoustically. Therefore, this study employs a combination of auditory and acoustic analysis techniques to investigate voiceless stop production in the speech of young Melbourne English speakers.

3.1 Corpus Design & Participants

For this study, a three part corpus was set up with the intention of eliciting /p/, /t/ and /k/ tokens in controlled settings as well as in a naturalistic spontaneous speech style.

A word list was constructed, with 18 words containing the tokens in various phonetic positions and within different vowel environments. A sentence list incorporating the 18 words from the word list was designed, with the tokens occurring in various prosodic positions that varied in terms of stress and word-position. For the natural speech data, a set of 3 topical questions was included in the data set to elicit spontaneous speech. Labovian style questions (Labov, 2001) about topics like travel experience, university courses and primary school experience were used to elicit free speech from the participants. The wordlist, sentence list and spontaneous speech questions are attached in Appendix A.

The participants involved in this study were sourced through personal contacts of the researcher. The criteria set was that the participants must be within the age range of 18-22
and be first language native Australian English speakers who grew up in Melbourne. Four
speakers, who were all students from various courses at the University of Melbourne were
involved in the study. Two of the speakers are male and two are female. Ethics approval was
obtained from the Human Research Ethics Committee for this study.¹

3.2 Data Collection

The data were collected through digital recordings done at the University of Melbourne. Each
of the sessions lasted for about 30 minutes, with the participant and researcher present at each
session.

Three sets of recordings were done in the Phonetics Laboratory at the University of
Melbourne. The participants spoke into microphones that were placed at about 30cm from
their mouths. The recorded utterances were written in .wav format at 22 kHz. For the
recordings conducted in the Phonetics Laboratory, the phonetics program Praat v. 4.5.16
(Boersma & Weenink, 1992-2007) was used to record the word and sentence lists, and
Audacity (Mazzoni, 2007) was used to record the spontaneous speech. The fourth recording
was made in the Recording Studio at Horwood Language Centre, and was also digitized at 22
kHz.

For the controlled speech data, the participants were instructed to number each of the words
and sentences before reading them three times. They were given time to look through the
words and sentences before the recording and were assured that they could continue
recording and simply repeat the material if they made a mistake.

For the spontaneous speech data, participants were instructed to pick one of three topics from
the list and to describe their experiences to the interviewer. They were prompted by the
interviewer at appropriate junctures to keep the flow of conversation. The participants were
each recorded for about 5-8 minutes. Only the first 5 minutes of the data was used for
analysis.

¹ This study was approved under the minimal risk scheme by the University of Melbourne Human Research
Ethics Committee (HREC no.: 0714342.1).
3.3 Analysis

3.3.1 Process

The analysis of the collected data was done both acoustically and auditorily. The *Emu Speech Database System Version 2.0prev* (Cassidy & Harrington, 2006) was used to label the controlled speech data, and *Praat version 4.5.16* (Boersma & Weenink., 1992-2007) was used to acoustically analyse the spontaneous speech.

For the controlled speech data, only focal tokens were labelled and analysed. Each repetition in the wordlist and sentence list readings was labelled for primary stressed and unstressed syllables (for example in the word *clock* the token /k/ was marked as a coda of a stressed syllable), word-position, syllable-position, phrase-position, phonemic and phonetic realisations. In terms of word position, the tokens in the word and sentence lists were annotated with the positions where they occurred in the word i.e. *initial, medial, final*. The tokens in the controlled data were also marked for intervocalic position. The *Emu-R* programme was then used to compile a statistical tally of the actual realisations found. Table 1 gives a brief example of how some of this prosodic information was compiled.

<table>
<thead>
<tr>
<th>Controlled Data /p/</th>
<th>Stressed onset</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fricated Initial</td>
<td>Stressed onset</td>
<td>1/18 5.56%</td>
</tr>
<tr>
<td>√</td>
<td></td>
<td>2/18 11.1%</td>
</tr>
<tr>
<td>Initial</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stressed onset</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Final</td>
<td>Stressed coda</td>
<td>5/18 27.8%</td>
</tr>
<tr>
<td>Medial</td>
<td>Unstressed onset</td>
<td>10/18 55.6%</td>
</tr>
<tr>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fricated Medial</td>
<td>Unstressed onset</td>
<td>2/4 50%</td>
</tr>
<tr>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medial</td>
<td>Unstressed onset</td>
<td>2/4 50%</td>
</tr>
</tbody>
</table>

Table 1: Example of /p/ fricated data tabulated for phonetic environment

In the spontaneous speech data, all instances where voiceless stop consonants occurred phonemically were labelled with the actual phonetic realisations and included in the analysis. Where the tokens occurred, labelling was done at word-level, phoneme level and for phonetic realisations. The realisations were tabulated for each of the speakers in *Microsoft Excel*. Notes were also made on the phonetic environment in which the realisations occurred.
3.3.2 Acoustic Analysis
Wideband spectrograms were visually inspected and a range of criteria was used to identify different types of variants. Acoustic analysis through looking at spectrograms proved to be crucial as participants produced unpredictable patterns at times. Variants that diverged from the typical stop spectrographic pattern were more easily identified at their expected positions even when they were not very obvious impressionistically.

Canonical released stops were identified through a definite period of closure reflected by a gap in the spectrogram, and release burst recognized by a spike. In aspirated stops, a period of random high frequency energy followed after the release burst. The acoustic waveform was also used to identify the period of closure and release for each stop. Figure 1 shows an example of two clear stops /p/ and /t/ in the words ‘up to’ with clear closure and release phases as labelled below.

![Example of [pt] stop cluster with clear closure and release bursts in male speaker NB’s spontaneous speech](image)

Shockey and Gibbon (1993: 5) report that in ‘the stopless [t], there is normally a period of silence or low amplitude frication followed by frication which is characterised by an average of more than 3 times as high a maximum rate of airflow. Jones and Llamas (2003) refer to the period of lower frequency as ‘pre-affrication’. The tokens in this study that were labelled as
‘spirantized’ refer to variants that started with less energy that gradually became random high frequency that was associated with frication. There were no stop gaps in those variants, although they were impressionistically less noticeably fricated than the ‘pure’ fricatives. An example of a spirantized /t/ stop is shown in Figure 2.

Fricated variants appeared on the spectrogram as an area or high frequency energy with no stop gap and no release phase, as shown in Figure 3, where a velar stop /k/ is fricated to become a voiceless velar fricative [x]. These tokens were categorized together under the term ‘fricated stop’ in the analysis because of their similar auditory qualities.

Figure 2: Example of spirantized /t/ in sentence list utterance by female speaker ER
Figure 3: Fricated realization of /k/ produced by female speaker GP

Glottalized variants were identified at areas where there were no formant transitions occurring adjacent to the canonical stop. This indicated that there was no oral gesture (Tollfree, 2001: 62). There was also laryngealization visible before the stop gap. The glottal stops appeared on the waveforms as pulses of energy and as periodic pulses of voicing usually in the lower range of the spectrum. Figure 4 shows an example of a glottalized /t/.

Figure 4: Glottalized variant of /t/ in wordlist produced by female speaker GP
Taps were first identified mainly through auditory analysis, and they appeared on spectrograms with a short closure phase and a very short period of voicing usually for about 10-30ms. Formants surrounding the closure phase are obvious. The acoustic patterning of taps could be differentiated from approximant variants, which occurred in specific phonetic environments and for usually longer durations. The /t/ approximant variant was impressionistically similar to the taps on a purely auditory basis, but could be differentiated through the spectrograms, where they had formant characteristics that were similar to vowels and approximant articulations. Figure 5 shows an example of a tapped /t/ variant.

![Figure 5: Example of tap in wordlist by female speaker GP](image)

Affricates, especially the [tʰ] realisation of /t/ was identified auditorily and could be seen on the spectrogram with a stop closure and usually a period of aspiration which began with a short period of higher energy. The short period of higher energy where the [s] occurs was also visible on the corresponding waveform. Although this variant has been considered in under the category of ‘fricated variants’ in this study when looking at gender, it has been kept separate when considering prosodic environment (i.e. word-position, stress) because it clearly occurs in different environments from the fricated/spirantized variants. An example is shown in Figure 6.
3.3.3 Statistical Analysis

For the controlled speech data, the distribution of the variants was analysed for gender, phonetic realisation and phonetic/prosodic environment and speech style and phoneme category correlations. For example, for the consonant /t/, speaker gender was compared as the main variable in relation to the frequency of each variant, its phonetic environment, and finally whether it occurred in strong or weak syllables. The proportional data were tested for significant relationships using analyses of variance.

The conversational speech data was tested statistically for gender differences in the occurrence of consonant realisations, but a similar depth of phonetic analysis on environments was not done and remains a possible area of expansion in future study. The statistical analysis was done using ANOVA in R, version 2.5.1. The data was compared for speech style, and the issue of individual differences between speakers will be discussed briefly in Chapter 5.
3.4 Summary

The results of the analysis will be presented in Chapter 4. General findings on the range of consonant variation will be presented first, then specific findings on gender correlations with consonant variation, speech style and phonetic environments will be presented.

In Chapter 5, a discussion of the findings will be made with reference to previous findings on consonant variation, especially in Australian English. Findings on gender variation in sociophonetics will also be compared to the results of the present study.

Finally, the conclusions of the study will be presented in Chapter 6.
Chapter 4: Results

This section will present the results of the analyses. It will report on the range of variants found in the Melbourne English corpus, and give an account of gender differences in the frequency of non-canonical stop realisations. There will be a focus on particular variants of /t/ found in the data. Observations on the relationships between phonetic environments, gender and variants that occur commonly in the controlled speech data will be reported. Finally, the results of variant correlations with speech style will be presented in relation to gender as well.

4.1 Range of Consonant Variation

A diverse range of non-canonical /p,t,k/ realisations were produced by the participants in this study, particularly in the connected speech data.

The different speech genres (wordlist, sentence list, spontaneous speech) yielded different distributions of consonant variants, with the highest proportion of variation occurring in the spontaneous speech corpus as might be expected through the findings of Loakes (2006), who studied male speech in Melbourne. Figure 7 shows a continuum of the variants found in both the controlled data and the conversational speech data. The continuum was drawn as an extension of Honeybone’s (2001) lenition trajectory, which classifies the most basic stages of consonant lenition. The ordering of the variants was decided through the consideration of the articulatory behaviour of each variant, with the level of articulatory ‘openness’ increasing towards the right of the continuum (Loakes, 2007, personal communication). The tapped variant, which only occurs as a realisation of /t/, has been excluded as Figure 7 displays a summary of the types of articulations that were produced for all three phonemically voiceless stops. This study would, however, place the tapped variant between the affricate and approximant on the continuum because tapping involves a completely closed phase that suggests a leftward placement on the continuum. However it is also classed as a 'momentary' articulation (e.g. Catford 1977) which
makes distinguishes it from the other obstruents. The affricated variant would probably fall left of the tap because it involves less of a divergence from the canonical stop in terms of manner of articulation.

Figure 7: Continuum of /p/, /t/ and /k/ consonant variants found in data

4.2 Gender Variation

Table 2 shows the gender differences in the frequency of frication across the range of voiceless stop consonants. The findings for the affricated /t/ data is collapsed under the category of fricated /t/ in this overall analysis. However, the affricate will be regarded as a separate variant and analysed again for frequency and phonetic environment later.

<table>
<thead>
<tr>
<th>Gender</th>
<th>/p/</th>
<th>/t/</th>
<th>/k/</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Wordlist Data</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>10 (27.8%)</td>
<td>16(38.1%)</td>
<td>7 (16.6%)</td>
</tr>
<tr>
<td>Female</td>
<td>1 (2.8%)</td>
<td>18(45.0%)</td>
<td>4 (9.52%)</td>
</tr>
<tr>
<td></td>
<td>Sentence Data</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>8 (22.2%)</td>
<td>7(17.5%)</td>
<td>10 (23.8%)</td>
</tr>
<tr>
<td>Female</td>
<td>3 (8.3%)</td>
<td>18(42.9%)</td>
<td>4 (9.52%)</td>
</tr>
<tr>
<td></td>
<td>Spontaneous Data</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>23 (25.3%)</td>
<td>92(25.3%)</td>
<td>45 (30.4%)</td>
</tr>
<tr>
<td>Female</td>
<td>6 (10.2%)</td>
<td>73(24.1%)</td>
<td>28 (23.5%)</td>
</tr>
</tbody>
</table>

Note: /t/ values include [tʰ] affricate as fricated variant

Table 2: Frequency of frication across gender and consonants

As can be seen from Table 2, the male speakers fricated /p/ and /k/ more frequently than female speakers in all speech types. Females produced fricated /t/ more than
male speakers in the controlled (wordlist and sentence) data, but had marginally fewer in the spontaneous speech.

There was no overall effect of speaker sex on the distribution of fricated variants (F=2.3; p>0.05), but there was a strong sex/phoneme category interaction (F=5.06; p<0.02) and a significant effect of phoneme category (F=7.31; p<0.01). The males produced fricated /p/ variants significantly more than females across the corpus in general.

<table>
<thead>
<tr>
<th>Speaker Gender</th>
<th>Canonical (% of total)</th>
<th>Affricated (% of total)</th>
<th>Fricated (% of total)</th>
<th>Tapped (% of total)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Wordlist</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>61.9%</td>
<td>21.4%</td>
<td>16.7%</td>
<td>0</td>
</tr>
<tr>
<td>Female</td>
<td>35.0%</td>
<td>32.5%</td>
<td>12.5%</td>
<td>5.0%</td>
</tr>
<tr>
<td><strong>Sentence Data</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>22.5%</td>
<td>7.5%</td>
<td>10%</td>
<td>27.5%</td>
</tr>
<tr>
<td>Female</td>
<td>33.3%</td>
<td>26.2%</td>
<td>21.4%</td>
<td>4.76%</td>
</tr>
<tr>
<td><strong>Conversational Data</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>23.8%</td>
<td>9.1%</td>
<td>15.9%</td>
<td>14.0%</td>
</tr>
<tr>
<td>Female</td>
<td>26.7%</td>
<td>9.24%</td>
<td>14.9%</td>
<td>12.2%</td>
</tr>
</tbody>
</table>

Table 3: /t/ distribution with affricate and fricated variants separate

Table 3 focuses on the consonant /t/ and presents a finer distribution of variants within the consonant’s realizations for both sexes, with the affricate [tʰ] treated as a separate variant. /t/ is given closer attention than the other consonant because it seems to be behaving differently from /k/ and /p/, which have clear male speaker correlations. Also, the frequency of other variation (taps, glottalized tokens, affricates) is high compared to the other consonants as seen through Figure 8 in a sample bar chart of the variants in the sentence data.
Figure 8: Gender differences in range of /t/ variation in sentence list

The analysis found that the proportion of affricate variants as a percentage of the /t/ tokens that are called ‘fricated’ in this analysis is substantial for both sexes. For example, 72.2% of the male speakers’ realisations termed ‘fricated’ in the male speakers’ wordlist utterances were the affricate [tʰ]. 56.3% of female speakers’ fricated wordlist utterances were affricates. The connected speech data showed similarly high proportions of the affricated variants in the ‘fricated’ tokens shown in Table 3.

Gender is clearly an important variable in the frequency of affricated tokens. In the wordlist, the male speakers produce more affricated variants than fricated variants. The female speakers produce more affricates than fricatives in all the speech styles. The greatest gender-related difference is found in the sentence list, where female speakers produce 26.2% of their total tokens as affricates, and males only affricate 7.5% of the time. There is a substantial gender difference in proportion of 18.7%. With affricated variants being clearly marked for gender, it is important also to keep in mind that they show a tendency to occur in different phonetic environments from the fricated /t/s. This will be further discussed in a later section on phonetic environment.
Table 4 shows the frequency and distribution of glottal variants across the speaker sexes:

<table>
<thead>
<tr>
<th>Gender</th>
<th>/p/ (%)</th>
<th>/t/ (%)</th>
<th>/k/ (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Wordlist Data</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>0</td>
<td>0%</td>
<td>7.14%</td>
</tr>
<tr>
<td>Female</td>
<td>0</td>
<td>15%</td>
<td>4.76%</td>
</tr>
<tr>
<td><strong>Sentence Data</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>0</td>
<td>37.5%</td>
<td>9.52%</td>
</tr>
<tr>
<td>Female</td>
<td>0</td>
<td>14.3%</td>
<td>4.76%</td>
</tr>
<tr>
<td><strong>Conversational Data</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>1.1%</td>
<td>22.7%</td>
<td>14.2%</td>
</tr>
<tr>
<td>Female</td>
<td>1.69%</td>
<td>23.8%</td>
<td>4.2%</td>
</tr>
</tbody>
</table>

Table 4: Frequency of glottal variants sorted by speaker sex and speech genre

It can be seen from Table 4 that for /t/, males produced a higher percentage of glottalized variants than females in the sentence data, but females had a higher proportion in the wordlist and spontaneous data. There is negligible gender correlation for /t/-glottalization. For the consonant /k/, males produced a higher frequency of glottalized variants than female speakers in all contexts, suggesting that /k/ glottalization is marked for gender. Realisations of /p/ did not yield many glottalized variants, and did not show any gender correlations in the corpus.

With regard to the continuum in Figure 7, the male speakers are found to produce more ‘open’ variants that are further away from the canonical stop in the stops studied.
4.3 Phonetic Environment- Prosody and Position

4.3.1 Controlled Speech Data

Table 5 below essentially shows the prosodic environments of the number of fricated (and affricated for /t/) variants that occurred within the controlled data. The results for the wordlist and the sentence list have been combined because of the very small numbers of occurrences in some variants. Tokens which occur in connected speech will be clearly identified through the ‘initial intervocalic’ and ‘final intervocalic’ phonetic environments. The table also presents the proportionate percentages of occurrence of the variants in various phonetic environments over the total amount of times that variant occurred for each speaker sex. It shows the word-level positioning where each variant occurred, whether it occurred in an intervocalic position, whether the variant occurred in a stressed or unstressed syllable and whether it occurred at the syllable onset or coda. The results for the affricate [tʰ] have been presented separately from the ‘pure’ fricated tokens in the analysis of phonetic environment.

<table>
<thead>
<tr>
<th>Gender</th>
<th>Variant</th>
<th>Phonetic Envt (Word-level)</th>
<th>intervocalic</th>
<th>Syllable position</th>
<th>Percentage of tokens</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Controlled Data /p/</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>Fricated</td>
<td>Initial</td>
<td>Stressed onset</td>
<td>1/18 5.56%</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Initial</td>
<td>√</td>
<td>Stressed onset</td>
<td>2/18 11.1%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Final</td>
<td></td>
<td>5/18 27.8%</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Medial</td>
<td>√</td>
<td>Unstressed onset</td>
<td>10/18 55.6%</td>
</tr>
<tr>
<td>Female</td>
<td>Fricated</td>
<td>Medial</td>
<td>√</td>
<td>Unstressed onset</td>
<td>2/4 50%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Medial</td>
<td></td>
<td>2/4 50%</td>
<td></td>
</tr>
<tr>
<td><strong>Controlled Data /t/</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>Fricated</td>
<td>Medial</td>
<td>√</td>
<td>Unstressed onset</td>
<td>8/10 80%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Final</td>
<td></td>
<td>2/10 20%</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>Fricated</td>
<td>medial</td>
<td>√</td>
<td>Unstressed onset</td>
<td>10/11 90.9%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Final</td>
<td></td>
<td>1/11 9.1%</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>Affricat</td>
<td>Medial</td>
<td>√</td>
<td>Unstressed</td>
<td>7/12 58.3%</td>
</tr>
</tbody>
</table>
Table 5: Frequency of fricated variants in various phonetic environments (shaded areas highlight unusual environments for consonant reduction)

Both males and females produced a majority of fricated and affricated tokens in the unstressed syllable onset word-medial intervocalic position which has been noted in earlier studies as a common site of lenition (Shockey, 2003; Tollfree, 2001).

However, as can be seen from Table 5, males generally had more variance in prosodic environment for all the fricated variants except fricated /t/. The male speakers produced more fricated/affricated tokens occurring in word-final position than females as a whole. The female speakers’ data exhibited a narrow range of environments in which frication of plosives occurred. A majority of female fricated/affricated tokens occurred in the unstressed syllable onset word-medial intervocalic position, and a smaller percentage of syllable-coda word-final fricated variants occurred for /t/ and /k/, which is another expected site of consonant weakening (Tollfree, 2001). The female speakers also produced 2 of 4 fricated /p/ tokens in the word Aspen across a fricative-stop cluster [sp] which could have been progressive coarticulation with the preceding voiceless fricative.
A few sites of unexpected variation according to prosodic context are worthy of note. For the male speakers, 16.7% (3/18) of their fricat ed /p/ tokens occurred in word-initial stressed syllable onset position. Also in the affricates [tʰ], both male and female speakers produced these tokens in word-initial stressed syllable onset position. For the female speakers up to 50% of their affricated tokens were produced in this environment, which has been cited as unusual for consonant variation of this type (Shockey, 2003: 34). These issues will be further elaborated upon in the discussion section.

4.4 Other Variants

This section provides a brief summary of the findings for some of the other variants that were yielded from the controlled data.

4.4.1 Glottals

Glottalized /k/ and /t/ tokens are noted as they form a relatively high proportion of the speakers’ realizations. As mentioned above, only 2 /p/ tokens were glottalized, and are therefore excluded from the discussion.

For glottal /k/, males produced 61.5% in word-medial syllable-onset position and 38.5% in word-final coda position. Female speakers produced all their glottalized /k/ variants in word-medial syllable-onset position.

In the wordlist, males did not produce any glottalized /t/ variants, whereas for the female speakers, 15% of their /t/ realisations were glottalized. Of these, 66.7% were in final position and 33.3% were word-medial.

In the sentence list, male speakers glottalized 37.5% of their /t/ variants, and females 14.3%. Of the male speakers’ glottal variants, 60% occurred in final position and 40% in medial intervocalic position. For the female speakers, half of their glottal variants occurred in word-final position and the other half was word-medial. It should be noted
that all the word-medial glottalized /t/ tokens produced by both sexes occurred exclusively in the word *Britain* [briʔ’n]. Because of the glottalization causing the second syllable to become a syllabic nasal, the glottal stop occurs in stressed syllable coda position instead of unstressed syllable onset (as with a canonical pronunciation of /t/).

### 4.4.2 Taps

Male speakers produced no taps in their wordlist data, and females produced 5% tapped variants. Of the 5%, all occurred in a unstressed syllable onset word-medial intervocalic position (as in the word *bitter*), as might be expected (Fukaya et.al., 2005). In the sentence data, males produced 27.5% tapped variants and females produced 4.76% with all being in unstressed syllable onset word-medial intervocalic position (as in the sentence *They’re from one of her suitors*).

### 4.5 Speech Style

In this section, the findings for speech style will be presented in relation to speaker gender. The statistics referenced are presented in Tables 2, 3 and 4 above.

There were a number of observations in terms of speech style. As mentioned previously, speakers of both sexes tended to produce a smaller percentage of consonant variance in the wordlist as compared to the connected speech data. This is not surprising as connected speech has commonly been found to yield more consonant variation than cited speech (Ohala, 1996; Shockey, 2003). More specifically, female speakers had a clear increase of fricated /p/ tokens from wordlist to sentence list, with the highest number in conversational data. In terms of /k/ fricated tokens, female speakers had the same number in the word and sentence lists, and then increased quite sharply in the conversational data with a percentage difference of 14%.

For the male speakers, speech style appeared to be less significant in terms of the /p/ data. The proportionate distribution of fricated /p/ tokens was sporadic across the speech
styles. However in /k/, there is a clear pattern of increase from wordlist to sentence list, then conversational speech. The increase from wordlist to sentence list is larger than from the sentence data to spontaneous speech data.

The /t/ variants yielded interesting results in relation to speech style. While considering affricated variants as part of the fricative /t/ data, the male speakers’ percentage drops from wordlist (38.1%) to sentence list data (17.5%) with a fairly large percentage difference of 20.6%. The proportion increases in the conversational speech to 25.3%. The highest proportion of fricated /t/s is found in the wordlist (38.1%), showing a trend that is opposite to the general increase over wordlist to conversational data for the consonant /k/. For the female speakers, the biggest percentage of fricated variants occurring in the wordlist, a slight drop in the sentence list and the lowest percentage of fricated variants (including affricates) found in the conversational speech. A pattern of decrease from wordlist to connected sentence list and conversational speech is seen for females.

With the affricate numbers extracted from the ‘fricated’ token data, the male speakers still produce a similar pattern, with the greatest number of fricated variants in the wordlist (16.7%), a drop of 6.7% in the sentence list and an increase in the conversational speech. For the female speakers, however, the wordlist shows the lowest percentage of fricated variants, and there is an increase in the sentence data which shows the highest number of fricated variants. The conversational data produces 14.9% of variants, less than the sentence list and more than the wordlist.

Looking only at the numbers for the affricated variants, male speakers produce the most affricated variants in the wordlist, and fairly low numbers in the sentence data (7.5%) and spontaneous speech (9.1%). The female speakers however, show an interesting pattern which is similar to the combined fricative data (fricated + affricated) where the highest percentage is found in the wordlist (32.5%), secondly in the sentence data (26.2%) and the smallest percentage found in the spontaneous data (9.24%). These findings will be discussed in Chapter 5. The results in this section are summarized in Table 6 in the next chapter.
Detailed analysis of the conversational data was not covered given the scope of this thesis. Future study into these aspects may prove to be fruitful to the study of gender and consonant variation.
Chapter 5: Discussion

**Summary of Gender-related Findings**

<table>
<thead>
<tr>
<th>Range of variants</th>
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<tbody>
<tr>
<td>• Range of variation is greater for males than females</td>
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<tr>
<td>• Range of variation is greater in connected speech than in read wordlist data</td>
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</tbody>
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<table>
<thead>
<tr>
<th>Gender differences in the frequency of variants</th>
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<tbody>
<tr>
<td>• Males produced fricated /k/ and /p/ more than females in all speech styles</td>
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<tr>
<td>• Females produced affricated /t/ more than males in all speech styles</td>
</tr>
<tr>
<td>• In controlled speech, females produced more fricated /t/s than males and marginally less than males in conversational speech</td>
</tr>
<tr>
<td>• Males produced more glottalized variants of /k/ than females in all speech styles</td>
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<th>Relationship between phonetic environments, gender and variants</th>
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<tr>
<td>• Majority of fricated and affricated tokens in the unstressed syllable onset word-medial intervocalic position</td>
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<tr>
<td>• Male speakers had more /t/ fricated/affricated tokens occurring in word-final position than females</td>
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<tr>
<td>• Unpredicted phonetic environment found for /t/ affricate data for both sexes: stressed syllable onset word-initial position</td>
</tr>
<tr>
<td>• Unexpectedly strong phonetic environment for occurrence of fricated /p/ for males: stressed syllable onset word-initial position</td>
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<th>Speech style &amp; Gender</th>
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<tr>
<td>• For /k/ and /p/, female speakers had increased frequency of frication from wordlist to sentence list to conversational speech</td>
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<tr>
<td>• Male speakers had a similar pattern of increase only for frication of /k/</td>
</tr>
<tr>
<td>• Clear pattern of decrease for female speakers in fricated (+affricated) /t/ from wordlist across to sentence and then conversational speech</td>
</tr>
<tr>
<td>• Females had a decrease of affricated /t/ from wordlist to sentence to spontaneous speech</td>
</tr>
</tbody>
</table>

Table 6: Summary of findings
In this chapter, the results that were presented in the previous chapter will be discussed more specifically. Also, the findings in this study will be considered against those of previous studies. The discussion aims to account for some of the patterns found and to suggest hypotheses in areas which require testing by further research. The research questions of this thesis will also be addressed.

5.1 Consonant Variation

With the range of consonant variants found in this study, Ohala’s (1996) analogy of the growing speech variant menagerie appears to apply to Melbourne English as well. A diversity of up to ten variants was found for the consonants, with the most occurring for /t/ production and the fewest occurring for /p/ production. These are presented in the continuum in the previous section. It is worth noting that certain speakers exhibited more examples of non-canonical variants than others. These include:

- the voiced stop
- affricated variant
- approximant
- spirantized stop
- fricated stop
- pre-glottalized stop
- post-glottalized stop
- glottalized stop
- fully deleted stop

Some of the sub-categories of variants were collapsed into broader categories, following the example of Docherty et.al. (2006). For example, spirantized consonants, which showed different acoustic characteristics from the purely fricated variant, were classified as fricated for the analysis given their related phonetic similarity. Pre-glottalized and post-glottalized variants were also categorized as ‘glottal variants’. Although approximated variants, voiced variants and deleted variants were not
analysed in this study, they also contribute to the notable diversity in this sample of young Australian English speech.

Speakers also tended to have different frequencies of variants even within the same gender group, thus accounting for the importance of speaker-specific study (Loakes & McDougall, 2007). This study has found that in the collected corpus of young Melbourne English speakers’ controlled and spontaneous speech, the variable of gender has proven to be significant in a number of features.

As found through the analysis of the data, the dominance of fricated, affricated and glottal variants is noticeable. Some of these variants, like the fricated token for example, were picked up only recently by Australian English studies (Tollfree, 2001; Loakes & McDougall, 2004).

Both speaker sexes participated in exhibiting the range of variation, but male speakers were found to have more diversity within the same speech style, and even the repetitions of the same token in the controlled data. Overall, the results of this study show that consonant variation does not occur uniformly across all the consonants, or both speaker sexes. The patterns that emerged from the findings do not show consistency across the three voiceless stops /p, t, k/, which is a similar finding of previous work on stop consonant production (Loakes & McDougall, 2007).

5.2 Gender Variation

The focus of this study is largely based on the first research question on whether gender variation is evident in voiceless stop production in Melbourne English.

From the data, the frication of consonants /k/ and /p/ appeared to be marked for male speech, as male speakers tended to fricate /p/ and /k/ more than females in all speech styles. Frication of /t/ was noticeably higher for female speakers in the cited speech data, but males showed a slightly higher frequency in the spontaneous data. Therefore the conclusion can be drawn that female speakers in this Melbourne English corpus
fricate /t/ more frequently in cited speech than males. The percentage difference of 1.2% in the spontaneous speech is too small to claim a significant gender difference.

The affrication of /t/ showed interesting results. The female speakers were found to produce the affricated /t/ significantly more than the male speakers across all speech styles. This finding is supported by statements made by previous research in Sydney English that /t/ affrication is associated more with female speakers (Horvath, 1985; Haslerud; 1995). Interestingly, the pure frication of /t/ (excluding affrication) did not have a similarly straightforward relationship with speaker sex.

In Docherty et.al.’s (2006) study of spontaneous New Zealand English, it was found that female speakers tended towards higher numbers of released forms than males. At the same time, they found that the frequency of fricated phrase-final /t/ stops corresponded with the release of canonical stops. Like the current study, they classify spirantized and affricated tokens under the category of ‘fricated’ /t/. With the clear correspondence of the ‘highly salient, fricated release’ (Docherty et.al., 2006: 383) and released aspirated /t/, both their findings and those in the current study suggest that female speakers are more likely than male speakers to produce /t/s with the aspirated quality of released stops, fricatives and affricates.

Trudgill (1986) noticed in his study that female speakers produced more strongly released word-final stops and suggests that they are prestigious, standard forms in American English. In light of these findings, Labov’s (1990) principle that women tend to produce prestige forms more frequently than men can also be said to apply to this Melbourne English data.

The fricated variant and affricated variant of /t/ are considered to be the ‘prestige’ form because of their association with greater aspiration as in the released stop (Tollfree, 2001, Horvath, 1985). This study thus supports the idea that affricated variants are an extremely aspirated variant of the released /t/ (Horvath, 1985).

In terms of the tapped variants, which are considered to be a reduced and therefore less ‘standard’ and ‘prestige’ forms (Byrd, 1994), males produced a higher frequency
in the connected speech data (both sentence and spontaneous data), but none in the wordlist. The greatest difference was found in the sentence list, with males producing more taps than females. Therefore, in terms of the connected speech data, it can be said that the tapped variant is marked for male speech, which agrees with Loakes & McDougall’s (2007) findings of Melburnian males in the same age group. Speech rate is also a likely factor in the frequency of taps that should be considered. The majority of taps occurred in the connected speech data for both speaker sexes, where speech rate is more variable and presumably faster than in careful read speech of the wordlist. This may account perhaps for the increased incidence of taps, and should be explored in further research.

Glottal variants appeared to have little gender correlation as far as /t/ is concerned, but were marked as a male feature in /k/ for all speech styles. This was the most apparent in the spontaneous speech data, perhaps because of the higher levels of coarticulation in the production of natural speech. Females showed fairly low numbers of glottalized variants in both /p/ and /k/ but had quite a high percentage in /t/, whereby they unexpectedly glottalized more in the wordlist and spontaneous data than men. Glottalization of /p/ did not show any significant results for both sexes, mainly because its frequencies were so low in both speaker sexes.

Given the previous association of released tokens as the ‘standard’ form that females are theorized to lean toward (Labov, 1990; Byrd, 1994), glottalized /t/s would be presumed to be produced more by males than females. However, similarly unexpected results are found by Byrd’s (1994) American English study whereby women tended to glottalize /t/ more than men in all word-positions. This could be explained by Byrd’s (1994) suggestion that glottalization is used as a devoicing mechanism by women to achieve a breathier vocal quality (than males), which is a marker of female speech.

Scholars like Milroy, Milroy, Hartley & Walshaw (1994) have argued against the generalization that females tend to use prestige forms. Through a study of glottalized /t/s in urban British English, they found that middle class women were spreading the previously considered low social class use of it in word-medial and final environments. From these varied findings, it can be said that females and the ‘prestige
variant’ relationship does not hold true in all circumstances. Research suggests that conformity with social membership in their social communities (Wenger, 1988; Eckert et.al., 1999) has also been found to be influential in terms of phonetic choices made, especially for females.

Having stated the debate, it is possible that female speakers in this study may be producing released-sounding /t/ as a prestige marker. However, the current study has not tested for speaker-awareness of these markers, and so the correlation is left open for future research verification. Labov’s (1990) second principle, which suggests that females tend to lead in new innovative forms, is also difficult to study within the scope of this study. It would be interesting to find out if the features that have been marked ‘female’ in this study do go on to influence language change.

5.3 Speech Style & Speaker Sex

Definite differences were found in the three speech styles, with different levels of frequencies of specific variants occurring across the board for both sexes. Female speakers’ frequencies of frication of /k/ and /p/ had a clear upward trend from the wordlist across to the conversational data. This was also true for male speakers’ /k/ frication. These results are not surprising, as it has already been found that connected speech, especially in a casual, unscripted style causes higher levels of lenition than citation speech (Shockey, 2003).

In the fricated and affricated /t/ findings, a converse trend was found from /k/ and /p/. The frequency of both frication and affrication had a decreasing trend for female speakers from wordlist across to spontaneous speech. No clear trend was found for the males. Again, this points to the likelihood of /t/ frication and affrication being marked for feminine speech. Also, it lends to the postulation that /t/ is a consonant that has different sociophonetic functions from /k/ and /p/. The consonant /t/ will be discussed in further detail below in the section on phonetic environment.
5.4 Phonetic Environment & Speaker Sex

In addressing the third research question, interesting findings were obtained, especially in the /t/ data. Only the controlled data (wordlist and sentence list) was analysed specifically for the aspect of phonetic environment. As an overall observation, male speakers had more variation than females.

Previous research has shown that the lenition of consonants tends to happen in weak phonetic environments such as in unstressed syllables in intervocalic position for example (Shockey & Gibbon, 1993). This is supported by the current study in that the majority of tapped, fricated and affricated /t/ tokens occurred in the unstressed syllable onset word-medial intervocalic position. Similar findings were made by Loakes & McDougall (2007) who found that the environments in which frication of /k/ and /p/ occurred most frequently were intervocically and following a stressed vowel. In the present study, a substantial amount of the fricated and glottalized /t/ variants also appeared in the syllable coda word-final position. This is not surprising as that is another frequent site of reduction (Honeybone, 2001, Tollfree, 2001).

However, according to previous studies, consonants which occur in syllable-initial positions and word-initial and stressed position ‘tend not to undergo assimilations and lenitions seen in other positions’ (Keating, Wright & Zhang, 2001: 5, Honeybone, 2001) because consonants have generally been found to be longer and produced with more strength in that position. Shockey (2003) claims that the onsets of syllables are environments that are less susceptible to consonant variation than syllable codas. Particularly in English, sonority is stronger in word-initial than word-final position. Unstressed syllables have a higher tendency to be undershot than stressed syllables because they are prosodically weak (ibid: p.28, Tollfree, 2001; Honeybone, 2001). Stress is also an important factor affecting consonant variation and ‘onsets of syllables immediately following a stressed syllable are vulnerable, especially if they are a single plosive (not part of a cluster), even more if they are alveolar plosive’ (Shockey, 2003: 34).
As presented in the previous chapter, the results in this research have shown the fricated and affricated variants of /t/ to appear in word-initial stressed contexts. Tollfree (2001) points out that ‘[p]losive [t] is usually the only realisation of /t/ in word-initial position in AusE’ (Tollfree, 2001: 47) except in the case of intervocalic word-initial tapping. The findings of this study therefore make a case for fricated and affricated /t/ being governed by a process other than lenition, given that these are occurring in prosodically strong contexts, where we would expect canonical variants of the stops to occur (Keating et. al., 1999).

In this study, the role of affricated /t/ variants requires careful consideration. As mentioned by previous studies, the frication of /t/ appears to have sociophonetic correlations that are different from /k/ and /p/ (Horvath, 1985; Tollfree, 2001; Loakes, 2006). Previous researchers have made a similar proposition that affrication is a process that does not seem to share the characteristics of lenition as other processes like frication (Foley, 1977; Hyman, 1999).

However, Honeybone (2001) in looking at Liverpool English, argues for affrication as a type of weakening under the criteria that it tends to occur in environments where lenition is common. In fact, he claims that frication of consonants tends to occur in these similar environments, which has proven true in this study. However, this does not account for the occurrence of affrication in this study in strong word-initial, stressed-syllable onset environments where lenition has been claimed to be inhibited (Honeybone, 2001). It seems likely that /t/ affrication in this study of Melbourne English speech is not a process of lenition, and in fact might be a process of consonant strengthening where speakers are aiming to produce more perceptually salient speech sounds through frication and affrication. This is a postulation that may be productive for future Australian English research to confirm.

The data also showed /p/ to be fricated by male speakers in stressed syllable-onset word-initial position. Loakes & McDougall (2007) found in their studies of individual differences between young male Melbourne English speakers that /k/ and /p/ were produced in unexpected phonetic environments such as word-initially and before a stressed vowel.
The glottalized variants did not show particular correlations to speaker sex. However, an interesting observation was made for /t/ glottal variants. For both speaker sexes occurred mainly in word-final, unstressed syllable-coda position, except for the word *Britain* where male speakers produced 40% in word-medial position for that word, and female speakers 50%. It appears that uniquely for the word *Britain*, this study’s findings would apparently disagree with Tollfree’s (2001) findings that glottalized /t/s do not appear in word-medial intervocalic position. However, she points out that it occurs commonly before syllabic nasals, which is what happens when the /t/ in *Britain* is glottalized.

An important point to make would be that speech rate has been considered to be an important prosodic factor in consonant variation that should be taken into account when studying sociophonetic variability (Docherty, 2007). Although this has not been a focus of the current study, the analysis of phonetic environment was done on cited speech data which serves as a control for prosody between speakers. It would, however, be useful to look at speech rate more closely in further research into the spontaneous speech data. As the spontaneous speech occurred impressionistically at a faster speech than the cited speech, it can be speculated that speech rate effects are indeed present in the two types of speech, as suggested previously for the tapped /t/ variant.

### 5.5 Further Considerations

A few interesting findings were made when individual variation was looked at briefly in the unusual production of the word *Britain*. Both the male speakers produced the word *Britain* with fricated variants in the wordlist, but both produced the same word with a glottal stop as the /t/ realization in all the sentence list readings in the sentence ‘He’s been living in Britain for ten years’. One of the female speakers, GP, produced the wordlist readings of the word with 2 instances of the glottal stop and then switched to the fricated variant the third time she read it. However, in her sentence list readings, all three instances of the words were pronounced with a glottal stop. The second female speaker ER produced all the /t/ stops in both the wordlist and sentence
list readings with the fricated variant. Although individual variation was not an area that this study included within its scope, it would be very beneficial to look at unique differences as the speakers did exhibit fairly different phonetic behaviour even within repetitions of the same word.
Chapter 6: Conclusion

In this study, gender has been examined in relation to Melbourne English consonant variation. A number of new findings about gender correlations with stop consonant variation have been discussed and compared with previous findings. The research questions on gender, speech style and phonetic environment have been addressed with auditory and acoustic analysis as the primary methodology. Interesting results have been found especially in the areas of stop frication, affrication and gender marking, which adds new findings to the knowledge pool on consonant variation and sociophonetics in Australian English.

Scholars have suggested that more work needs to be done to include experimental analysis to support sociolinguistic hypotheses. Shockey (2003) mentions that only a ‘patchy picture is beginning to build up’ (p.109) about the production and perception of reduction in connected speech. Also, there seems to only have been minimal response to Byrd’s (1994) recommendation for the comparative study of spontaneous speech corpuses with read speech. According to Foulkes & Docherty (2005), language markers can carry important social information that would be invaluable in aiding the development of a deeper understanding of spoken communication. At the same time, the study of social factors in relation to consonant variation can lend understanding to sociophonetic features that mark human speech production. The present study has investigated into the social factor of gender and found new gender speech markers in its results.

The study of consonant variation is important to the growing areas of natural speech synthesis and speech recognition, whereby more natural sounding speech can be synthesized with the informed inclusion of reduction processes found in spontaneous speech, and machines can be configured to pick up the actual patterns that occur in real speech. It can also be helpful to speech pathology and even in helping second language learners to pick up natural sounding speech (Lavoie, 2002: 52). Dressler (1975: 219) points out that connected speech rules ‘are one of the most important
parts of phonology in its application to... the teaching of foreign languages, where fast speech phonology has previously been neglected’.

The focus on consonants can also lend a greater depth of understanding into the relationship between vowels and consonants. Lavoie (2002) cites the theoretical usefulness of being able to tell if vowels and consonants fit similar patterns of reduction, and may eventually lead to other re-considerations about current theories of speech production (p.52). Research such as this study can also be used to inform the area of speech perception, which will increase knowledge of languages’ acceptable phoneme inventories.

This study embarked on the investigation of a phonetic feature in Melbourne English to see if the largely socially-constructed category of gender has particular relationships with it. The interesting correlations uncovered contributes to the knowledge of the range of consonants in the Melbourne variety of English, the current sociolinguistic knowledge available on gender as well as speech style differences and the role of phonetic environment in consonant variation. As stated by Foulkes & Docherty (2005), ‘[v]ariability is one of the defining characteristic of human speech’ (2005: 1). This thesis has found that Melbourne English voiceless stop consonant production is, indeed, highly varied, and also distinctly gendered.
References


Trudgill, P., 1972, ‘Sex, covert prestige and linguistic change in the urban British English of Norwich’, Language in Society 1, 179-195.


Appendix A: Corpus Materials

Part 1. Word List

Instruction: Please number and say each word 3 times, pausing between each repetition.

Example: “Number one. Clock. Clock. Clock.”

1. clock
2. blacksmith
3. back
4. turkey
5. architect
6. cool
7. bitter
8. transit
9. bought
10. suitor
11. Britain
12. tarnish
13. shopping
14. Pete
15. rope
16. dipper
17. Aspen
18. pale
Part 2. Sentence List

Instruction: Please number and say each sentence 3 times, pausing between each repetition.

1. Watch the blacksmith at work.
2. The clock on the wall is new.
3. I’ll call you back.
4. We’re having turkey tonight.
5. I’ll get the architect on the job.
6. Tarnish happens because of oxidation
7. That’s a bitter lemon.
8. We were in transit for hours.
10. They’re from one of her suitors.
11. He’s been living in Britain for ten years.
12. He paled as he caught sight of her.
13. We spent the day shopping for his present.
14. Pete was playing the guitar
15. The only thing we need is a rope.
16. Use that dipper by the well.
17. He came to Aspen as a young man.
18. Cool down before you hurt yourself.

Part 3. Discussion

1. Have you ever travelled overseas? Where to? Think back on memorable travelling experiences and what you enjoyed most about them. Where in the world might you like to travel to in the future?

2. Talk about the course you are doing now. Why did you choose it? What do you enjoy the most about it? What do you like least? If given the choice, would you choose to be studying something different?
3. What are some of the things you remember while you were growing up? What are some of your memories of your favourite experiences? Can you remember activities you used to enjoy? What do you remember about your primary school experience?