

# Patterns of gender variation in the speech of primary school-aged children in Australian English: the case of /p t k/

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## Abstract

This paper examines the pattern of gender-specific variation of voiceless plosives /p t k/ in the speech of primary school-aged children (ages 5-12) in Australian English. While results are preliminary, findings at this stage show gender-specific variation of the voiceless plosives in the speech of primary school children, even in the youngest age group examined.

**Index Terms:** Australian English; sociophonetics; gender variation; plosives.

## 1. Introduction

Several studies of Australian English have focused on variation in the production of the voiceless plosives /p t k/ [1]–[4]. However, none of that research addresses phonetic variation in the speech of Australian English-speaking children. Studies of gender-specific variation of these plosives in the speech of children in other varieties of English predominantly focus on children who are still largely in the language acquisition phase [5]–[7]. Research has shown that the speech of children prior to school-age seems to reflect the features in the speech of their primary caregiver e.g. [6], [8]. Once children reach school age, their speech becomes more like that of their peers, and becomes more so as they move toward adolescence [9]. Adolescence marks the age at which speakers are considered to have reached a level of linguistic mastery, as well as the onset of puberty and the development of gender-specific differences in the vocal tract anatomy. The primary school years are therefore the transition period where children move from home-based care into wider society and into adolescence. Examining this age period could give us important insight into the development of gender-specific phonetic variation prior to adolescence.

This paper presents preliminary patterns of gender-specific variation of voiceless plosives /p t k/ in Australian English by primary school-aged children. In particular, instances of glottalisation, tapping, frication, and pre-aspiration were analysed, as studies of /p t k/ in adult speech in Australian and other varieties of English have found these variants to be particularly marked for gender.

Of the voiceless plosives set, variation of /t/ has received the most attention. Loakes and McDougall's [1] work on plosive frication notes that fricated /t/ appears very infrequently in the speech of their male participants, suggesting that their avoidance of this variant is due to its association with female speakers. This notion has been reinforced by studies of /t/ that include solely female participants by its greater frequency of use [2], [10]. The frication or affrication of /t/ is also noted to be a particularly female variant as it is in other varieties of English such as Tyneside English [11] and New Zealand English [12].

Pre-aspiration of /t/ has not been fully investigated in Australian English, however in other varieties of English pre-aspiration of /t/ is predominantly a female feature, especially for younger females [13], [14].

The glottalisation of /t/ is noted to be used by Australian English speakers [2], however it has been investigated to a lesser extent than other variants in terms of gender variation. One small-scale study [4] found a negligible gender correlation in its use: males produced more glottal /t/ in read speech, females produced more in word list data, and conversational data showed a relatively even production of glottalisation between the two genders. Other varieties of English that have investigated /t/ glottalisation have also found its use to vary between the sexes depending on context within an utterance or class status [15]–[17].

The tapped variant of /t/ is noted in Horvath's 1985 work on Sydney English to be 'clearly male', and associates a 'heavily aspirated' variant with female speakers [3, p. 104].

Studies in the variation of /p/ and /k/ are somewhat fewer in Australian English. Loakes and McDougall [1] found that frication of /p/ and /k/ by their male participants occurs at a much higher rate than /t/, with fricated /k/ appearing most often. This finding was reinforced by a smaller study [4] of /p/ and /k/ variation, where males were found to fricate at higher rate than females. These phonemes have received more attention in other varieties of English, where the frication of /p/ and /k/ is also reported as a predominantly male feature [14], [16], [17]. Similarly, the pre-aspiration of /p/ and /k/, while not investigated in Australian English, has been associated with female speakers in other varieties of English [16].

There is currently no research that addresses plosive variation in the speech of Australian English-speaking children. There have been some findings in other varieties of English that focus on gender variation of plosives, but mostly for children before the age of four years [5]–[7]. These studies have found that these children are beginning to show sensitivity to gendered variation of plosives. Docherty and colleagues [7] found that pre-aspiration appeared predominantly in the speech of girls in their study, reflecting the pattern of use in the speech of the adults in the community. Milroy and colleagues [18] found that children around 5 years of age are beginning to produce gender-based variation in the realisation of glottalised stops in British English.

The current study therefore aims to build upon our knowledge of children's sociophonetic development in the years between the language acquisition phase and adolescence, particularly in Australian English.

## 2. Method

### 2.1. Participants

The data presented here are preliminary, and represent a subset of a larger corpus collected by Casey Tait as part of a doctoral thesis on the acquisition of sociophonetic cues to gender in the speech of Australian English-speaking primary school-aged children.

The use of the different variants of /p t k/ are examined in the speech of 18 Australian English-speaking children from primary school in Yarrowonga, Victoria. Students from three year levels were recorded: Prep (ages 5-6), Year Three (ages 8-9), and Year Six (ages 11-12). This subset contains 3 boys and 3 girls from each year level, making a total of 9 girls and 9 boys. These particular year levels were selected in order to facilitate a developmental overview of the seven-year primary school period.

### 2.2. Recording

Speakers were recorded in same-sex and year level-matched dyads and were recorded on school grounds during school hours. The Year Six recordings took place at a separate campus to the Year Prep and Year Three recordings. All recordings were made using a Marantz Professional PMD661 solid state recorder and Shure SM-94 microphones at a sampling rate of 44.1kHz. Each speaker had a separate microphone placed in front of them on a boom stand. Microphones were placed at around 20-30cm from the speaker's mouth (or as close to this as was possible). The recording sessions lasted between 30-60 minutes and involved a mixture of spontaneous conversation and interactive games and activities.

### 2.3. Labelling

Each speaker's recording was broken down into shorter, manageable sections, transcribed, and then segmented and force-aligned using the WebMAUS-multiple automated alignment service [19]. Segment boundaries and consonant labels were manually adjusted using the *EMU speech database system* [20].

Fricated tokens were identified acoustically by an area of high frequency energy and lack of stop closure and release. An affricated variant of /t/ was also identified and considered here under the /t/ 'frication' category. These were auditorily distinct from a canonical released /t/ and were identified acoustically with a stop closure and a long period of aspiration that began with a short period of higher energy.

Pre-aspirated variants were identified by a period of fricative energy preceding the stop closure.

The glottalised variant of /t/ contained two realisations: the first (glottal /t/) was identified at areas where there were no formant transitions and the presence of creaky phonation on either side of the stop closure, while the second (laryngealised /t/) was identified by a lack of stop closure or release and the presence of fully laryngealised voicing throughout the segment.

Taps were identified acoustically by a short closure phase and a short period of voicing.

## 3. Results

### 3.1. Occurrence of variables

Table 1 shows the overall occurrence of the /p t k/ variables for boys and girls in each of the three year levels. Tokens were counted in four utterance environments: word-medial intervocalic, word-final intervocalic, word-final pre-consonantal, and word-final pre-pausal. On average, each girl produced around 8 minutes of speech from the four activities, while each boy produced around 14 minutes of speech. This accounts for the difference in the overall number of tokens between the boys and girls. Even though there is a large difference in the overall occurrence of each variable between the two gender groups, there are some patterns of gender-specific variation of these three voiceless plosives that are emerging.

Year Level	/t/ tokens		/p/ tokens		/k/ tokens	
	Boys	Girls	Boys	Girls	Boys	Girls
Prep	314	179	74	67	124	52
Three	514	281	115	32	258	82
Six	716	307	132	50	299	111
<b>Total</b>	<b>1544</b>	<b>767</b>	<b>321</b>	<b>149</b>	<b>681</b>	<b>245</b>

Table 1: Total token counts for /p t k/ for 18 speakers, broken down by sex and year level. Each speaker group contains 3 speakers.

### 3.2. /t/ variation

#### 3.2.1. Overall patterns of gender-specific /t/ variation

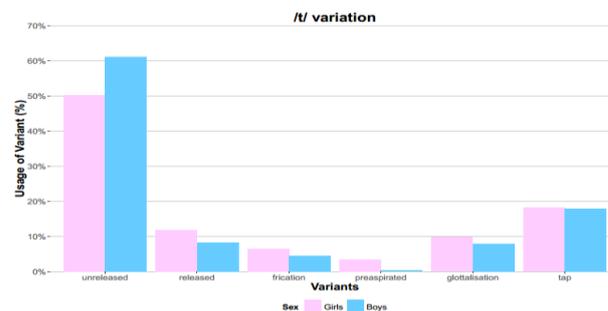


Figure 1: Rate of use for each /t/ variant by boys and girls overall (Boys n=9; Girls n=9).

Figure 1 shows the rate of use for each variant of /t/ for boys and girls overall. Both the fricated (including both the fully fricated and affricated realisations) and the pre-aspirated variants of /t/ appear in the girls' speech at a higher rate than boys, which is consistent with findings of these variants in adult speech. Glottalisation of /t/ (including both the glottal and laryngealised realisations) occurred at a higher rate in the speech of girls than boys overall. The tapped variant appeared at around the same rate for both boys and girls.

#### 3.2.2. Developmental patterns of /t/ variation

Figure 2 shows the rate of use for each /t/ variant by the six speaker groups examined. For the girls, there is a decrease in use of both the fricated and pre-aspirated variants of /t/ with an increase in age, but an increase in the use of both the glottalised and tapped variants with an increase in age. For the boys, there is a decrease in the use of the frication category of /t/ with an increase in age. An increase in the use of taps with

an increase in age is apparent, with both the Year Three and the Year Six groups using tapped /t/ at around the same rate. For the glottalisation of /t/, there is an increase in use from the Prep to the Year Three group, and then a decrease by the oldest age group. Pre-aspiration of /t/ appears very rarely in each of the boy speaker groups.

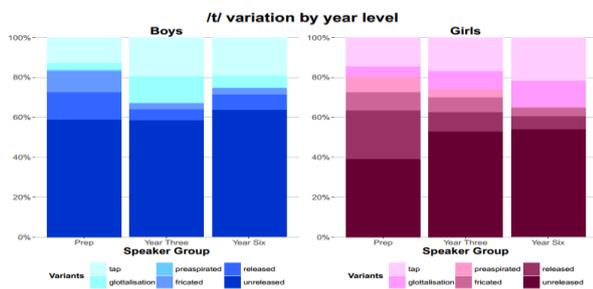


Figure 2: The rate of use for each /t/ variant by each speaker group. Each group includes 3 speakers.

### 3.3. /p/ variation

#### 3.3.1. Overall patterns of gender-specific /p/ variation

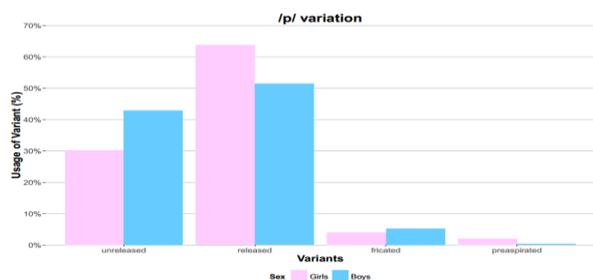


Figure 3: Rate of use for each /p/ variant by boys and girls overall (Boys n=9; Girls n=9).

Figure 3 shows the rate of use of each variant of /p/ by boys and girls overall. While there were considerably fewer tokens of /p/ produced overall compared to /t/ and /k/, there are still some gender-specific patterns emerging. The majority of /p/ tokens for both boys and girls are canonical released tokens of /p/, followed by an unreleased variant. The fricated variant of /p/ appears at a higher rate in the speech of boys than it does for girls. While the pre-aspirated variant of /p/ was relatively rare for both gender groups, it appeared more often in girls' speech than in boys' speech. Both of these findings are consistent with the use of these variants by adult speakers of both Australian English and other varieties of English.

#### 3.3.2. Developmental patterns of /p/ variation

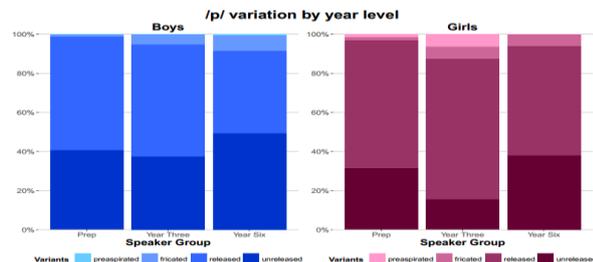


Figure 4: The rate of use for each /p/ variant by each speaker group. Each group includes 3 speakers.

Figure 4 shows the rate of use for each /p/ variant by the six speaker groups examined. For the fricated variant of /p/ there is an increase in use with an increase in age for boys. There is a similar pattern in its use for girls, with both the Year Three and Year Six age group produced a fricated /p/ at around the same rate. The pre-aspirated variant of /p/ increases in occurrence with an increase in age for girls from Prep to Year Three, but it does not appear at all in the speech of the oldest girls. For boys, the pre-aspirated variant only appears in the speech of the boys in the Year Six group, however it only makes up less than 1% of all of their /p/ tokens overall.

### 3.4. /k/ variation

#### 3.4.1. Overall patterns of gender-specific /k/ variation

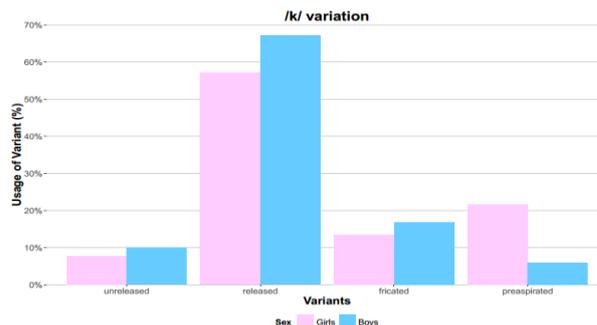


Figure 5: Rate of use for each /k/ variant by boys and girls overall (Boys n=9; Girls n=9).

Figure 5 shows the rate of use of each variant of /k/ by boys and girls overall. The majority of /k/ variants were released canonical tokens. Again, while there were considerably fewer tokens of /k/ produced by both gender groups in comparison to /t/, some gender specific patterns are apparent for this variable in the children's speech. The frication and pre-aspirated variants of /k/ patterned in a very similar way as the fricated and pre-aspirated variants of /p/: /k/ frication appeared at a higher rate in the speech of boys than in the speech of girls, while the pre-aspirated variant of /k/ is more preferred by girls overall than boys. Again, these findings are consistent with previous findings of the variation of /k/ in adult speech.

#### 3.4.2. Developmental patterns of /k/ variation

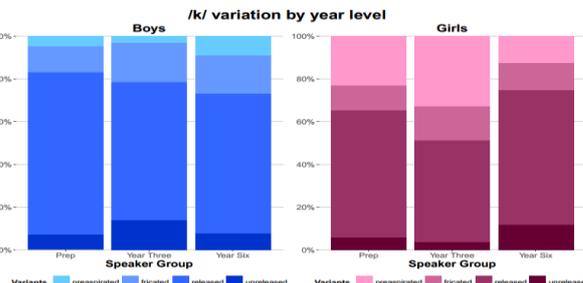


Figure 6: The rate of use for each /k/ variant by each speaker group. Each group includes 3 speakers.

Figure 6 shows the rate of use of each variant of /k/ by the six speaker groups examined. The frication of /k/ appears at a higher rate in the boys' speech in all three year levels, but for both gender groups there seems to be an overall increase in use with an increase in age. For girls, the pre-aspirated variant

of /k/ increases in occurrence from the Prep to the Year Three group, but a decrease in use occurs in the movement from the Year Three to the Year Six group. For boys, there is an overall pattern of increase in pre-aspirated /k/ with an increase in age, although it appears at a much lower rate than for girls at all year levels.

#### 4. Discussion

While the results are preliminary, patterns of variation of the voiceless plosives /p t k/ that correlate with gender are evident in the speech of primary school children in Australian English. Overall, girls are showing evidence of using variants that are largely associated with female speakers at a higher rate than boys. In particular, the pre-aspiration of all three of the voiceless plosives is highly preferred by girls, as well as the frication of /t/. Similarly, boys produced higher rates of male-correlated variants than girls, particularly the frication of /p/ and /k/. It is important to note that even speakers in the youngest age groups examined (ages 5-6 years) are producing variants that correlate with their gender.

Tollfree's evaluation of /t/ variation noted speakers' awareness of a formality hierarchy of /t/ variants [2, p. 60]. In particular, her speakers associated a fricated realisation with more formal or 'correct' speech, while they associated the tapped variant with more casual and laid back speech. For both boys and girls, there decrease in the use of fricated /t/ realisations, and an increase in the use of the tapped variant. The results reported here seem to suggest that children are becoming more aware of this formality hierarchy as they move toward adolescence.

It is also possible that the use of more 'casual' variants is associated with speech used in the community, or in regional areas of Victoria (or Australia) in general, and that children are becoming more aware of this association as they grow in age. This idea may be further extended when examining the variants used by the girls closest to adolescence. Overall, their use of variants patterns quite closely with boys in the same age group. For all female-correlated variants (i.e. pre-aspiration, /t/ frication), there is a decrease in their rate of use in comparison to girls in the younger age groups, while they employ the more male-correlated variants such as /p/ and /k/ frication at a similar rate as the Year Six boys.

The relationship between the variation of segmental features and social membership is well established in sociolinguistic theory (e.g. [21]). It may be possible that the use of more male-correlated, or possibly 'non-standard', phonetic variants and sociolinguistic variables could be a feature of the speech of the community. The analysis of further data and additional variables is planned for future work which may provide further insight into the patterns of plosive variation that have been revealed here. Furthermore, statistical significance testing is planned which may also provide further clarity in regards to the strength of each of the variables analysed. Mixed effects models may also reveal individual speaker differences that could be at play.

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