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Dentalisation as regional indicator in General South African English: An acoustic analysis of /z/, /d/ and /t/

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Abstract: Drawing on Bekker's (2007) study on the dentalisation of /s/ among young middle-class females from Johannesburg, this research aims to test whether the other traditionally alveolar oral obstruents, namely /z/, /d/ and /t/, are similarly fronted. The speech of two groups, one consisting of five females from prestigious private schools in Johannesburg and the other consisting of five females from similar schools in Cape Town, was recorded and the data analysed acoustically. For /z/, a spectral moments analysis was employed (Jongman, Wayland & Wong, 2000), which examined four parameters: centre of gravity, standard deviation, skewness and kurtosis. For /d/ and /t/, a metric established by Jongman, Blumstein and Lahiri (1984) was used, one which involves calculating the ratio of the root mean square (rms) amplitude at the onset of voicing against the rms amplitude of the stop burst. Results support the hypothesis that /z/ is dentalised by Johannesburg speakers, but do not support a similar hypothesis for /d/ and /t/.

Introduction

The dentalisation of what are traditionally alveolar consonants is relatively rare in English, or alternatively under-researched (Bekker, 2007). This paper reports on research conducted to test the hypothesis that /z/, /d/ and /t/ are fronted (i.e. dentalised) by some speakers of General South African English (GenSAE). More specifically, it aims to provide evidence for the hypothesis that this phenomenon is particularly prevalent in the speech of relatively wealthy young white females from the northern suburbs of Johannesburg (NSJ).

Impressionistically, one of the features of the speech of affluent Jewish people (especially females) from NSJ appears to be the dentalisation of /s/. Bekker's (2007) research provides acoustic evidence for the additional impression that the said feature has spread (or is spreading) to the non-Jewish speech community of NSJ. In short, his study confirms a noticeable tendency among young white non-Jewish females from NSJ to dentalise /s/ in comparison with similar individuals from elsewhere in the country. Dentalisation of /s/ appears therefore to have become, among other things, a regional indicator. Because of the social status of the Jewish population in Johannesburg, it may also be tentatively argued that the adoption of this feature by the non-Jewish population, and particularly by females within this population, indicates that this feature is or was a prestige variant.

Given the impressionistic observation of dentalised /s/ in Jewish speech, and the evidence provided by Bekker (2007) that dentalised /s/ is found among non-Jewish speakers from the same region, it is reasonable to question whether the same pattern might not be present among the other alveolar obstruents. Indeed, impressionistically, or at least stereotypically, it does seem to be the case that in Jewish speech, the other alveolar consonants, /z/, /d/ and /t/, are fronted; at the very least, there is some noticeable difference in articulation. This research aims therefore, in parallel with Bekker (2007), to examine whether, as with /s/, the articulation of the other alveolar consonants is significantly dentalised in the speech of non-Jewish females from NSJ i.e. whether there is acoustic evidence for dentalisation as a regional indicator[1].

The hypothesis, then, is that the alveolar consonants /d/, /z/ and /t/ are more fronted in the speech of young female GenSAE speakers from NSJ than in the speech of a similar group from Cape Town. If this hypothesis is confirmed then dentalisation in GenSAE is, in all likelihood, a regional indicator and, more speculatively, perhaps a prestige variant as well.

Literature review

This research brings together sociolinguistics and acoustic analysis. The general sociolinguistic background to the research is dealt with first, followed by a more detailed review of the relevant acoustic phonetics literature.

Sociolinguistic considerations

While it is increasingly difficult in the modern South African context to attempt to define the different sub-dialects of SAE in terms of the racial profile of their speakers, it is still correct to claim that, loosely speaking, GenSAE is the lect of SAE that is traditionally spoken by relatively affluent L1-English white people in South Africa. GenSAE needs to be distinguished on the one hand from other traditional ethnolects of SAE (such as South African Indian English) and on the other hand from other sociolects such as Cultivated SAE and Broad SAE, the first having a near-RP pronunciation but barely used among the young any longer; the latter a less-prestigious, possibly Afrikaans-influenced, sociolect. GenSAE is the commonly accepted local standard. Despite examining what is in all-likelihood a prestige variant, this paper will not be focused on Cultivated SAE, mainly because of its decreasing use. Instead, it is focused on identifying dentalisation as an indicator of region (and perhaps prestige) within GenSAE.

Prestige, in its sociolinguistic guise, deals with the assessment of a speech variant (whether positively or negatively) on the basis of social norms (Mesthrie *et al*., 2000). For instance, Labov's (1966) well-known study on the prevalence of postvocalic /r/ in various sociolects in New York showed that the frequency with which this /r/ was pronounced was clearly linked to the social class of the speaker concerned: *mutatis mutandis*, the higher the social class, the more frequent the incidence of postvocalic /r/. It should be stressed, however, that prestige is not always associated with the higher social classes. A common distinction is made in the literature between prestige linked positively to social status (overt prestige) as opposed to the kind of prestige carried mainly by working class dialects (covert prestige). The notion of a prestige variant, as used in this paper, implies overt prestige.

As shown in Labov (1966), as well as in subsequent variationist literature, the correlation between the use of certain speech variants and class is cross-cut by a number of other social variables. These include gender and style. Beginning with the former, the difference between typical male and female behaviour in speech has been well documented in various studies, such as in Cheshire (1978), which demonstrated that females were more likely than males to tend towards the standard or prestigious variant. Given that this research is focused on providing evidence for what might be a prestige variant, it made sense to focus on eliciting the speech of female subjects.

On the topic of style, it is again well known that the less self-conscious the speech, the less the use of incoming prestige variants. In the context of Labov's (1966) New York study, generally the more formal the style (e.g. word lists), the greater the use of postvocalic /r/. While the current study certainly does not attempt to use the full extent of the stylistic range (i.e. from word lists to near-to-naturalistic speech) it was hoped that the hypothesised prestige nature of dentalisation might be captured by the use of two different (although both relatively formal) styles i.e. word lists and read passages.

The identification of dentalisation as a prestige variant is, however, not the main focus of the study, which is rather to determine whether or not the relevant articulatory fronting is correlated with regional provenance, thus perhaps indexing regional identity. Historically, certain areas of Johannesburg (and particularly the speakers of Jewish descent[2] living in these areas) have long been associated with wealth and social prestige. These areas, often known collectively as the northern suburbs, are also associated in the popular consciousness with a particular way of speaking and it is ultimately this manner of speaking that the study is focused on. It should be

added that while this 'accent' is often associated exclusively with the local Jewish female population it is, in the experience of the authors, becoming more commonly associated with the region rather than with a particular ethnic group. Thus, given that the main focus of this study relates to region and not ethnicity, it was felt best to elicit speech from non-Jewish participants.

In summary, therefore, it was decided to elicit the speech of affluent, young, white, non-Jewish females from the northern suburbs of Johannesburg as well as the speech of a control group from another region of South Africa, and to test in this manner whether a dental or denti-alveolar place of articulation (i.e. fronting) is a regional variant of GenSAE.

Acoustic correlates of /z/

Fricatives are produced as a result of a narrow constriction in the oral cavity, which creates turbulence in the air flowing through the constriction (Jongman *et al*., 2000). According to Jongman *et al*. (2000), the place of articulation determines the acoustic properties of the resulting sound because of the changing size and shape of the oral cavity anterior to the place of articulation. Using a Fast Fourier Transform (FFT) spectrum, which measures the amplitude of the various frequency components of a sound, it is possible to isolate a difference in place of articulation by using a number of variables.

The first of these variables is the peak of the FFT spectrum. According to Jongman *et al*. (2000), the post-alveolar fricatives [ʃ, ʒ] have a lower spectral peak than the alveolar fricatives [s, z], due to the smaller oral cavity anterior to the point of constriction in the case of the alveolar fricatives. It follows that a dental or denti-alveolar fricative, with a smaller oral cavity anterior to the point of constriction than the alveolar equivalent, should have a higher spectral peak than the latter. Unfortunately, this variable is not entirely reliable, given that it may be affected by the size of a speaker's vocal tract[3], and the phonetic environment of the sound in question. For this reason, this variable was discarded in favour of the spectral moments analysis devised by Jongman *et al*. (2000), which is the analysis of four statistical operations on the spectrum: the centre of gravity, the degree of variance, skewness and kurtosis.

The *centre of gravity* (COG) is the average point of energy concentration in terms of frequency. It is important to note that this is not the frequency at which the highest-amplitude peak occurs, but rather the frequency around which there is the greatest concentration of energy. The study conducted by Jongman *et al*. (2000) revealed that post-alveolar fricatives have a lower centre of gravity than alveolar fricatives. It therefore follows that dentalised fricatives should have a higher centre of gravity than their alveolar equivalents.

The degree of *variance* (or standard deviation) is the level of concentration of acoustic energy around the COG. According to Jongman *et al*. (2000), post-alveolar fricatives have a higher degree of variance than alveolar fricatives, and it may therefore be expected that dentalised fricatives will have a lower degree of variance than alveolar fricatives.

Skewness examines the distribution of energy between the higher and lower frequencies. Negative skewness shows that acoustic energy is concentrated in the higher frequencies, while positive skewness indicates that acoustic energy is concentrated in the lower frequencies. Conflicting results have been achieved with respect to the difference between [s] and [ʃ] in this regard (Jongman *et al*., 2000). The most that can be hypothesised, therefore, is that dentalised fricatives display a *different* degree of skewness from alveolar fricatives.

Kurtosis is a measure of the degree of peakedness of the spectrum. A spectrum with flatter, less defined spectral peaks displays a lower kurtosis than a spectrum with high, well-defined peaks. According to Jongman *et al*. (2000), alveolar fricatives display a higher kurtosis than post-alveolar fricatives. It may therefore be predicted that dentalised fricatives should display a higher level of kurtosis than alveolar fricatives.

Acoustic correlates of /d/ and /t/

Schatz (1954) suggests that the perception of stop consonants is dependent on their phonetic contexts, and not merely on the sounds themselves i.e. the identification of stop consonants depends not solely on their own frequency patterns, but also on those of the following vowel.

Based on this, Delattre, Liberman and Cooper (1955) suggest that there is a consistent relationship between any particular stop consonant and the transition (i.e. the frequency shift) of the second formant of the following vowel, discernible by an examination of that region of the spectrogram in which the consonant leads into the vowel. The study by Delattre *et al*. (1955) specifically examined the transition of the second formant of the vowel from the onset of voicing after the release of the plosive to the nucleus of the vowel. The transitions following the voiced alveolar plosive [d] all showed a distinct difference from those following the other voiced plosives [b, g]. This suggests that a similar approach might be appropriate for the analysis of different phonetic realisations of the same phoneme e.g. English [d] vs. [d̪]. There has, however, been little or no research done specifically on the difference in formant transitions between alveolars and dentals. There is therefore no basis in the literature for determining whether any differences arising from the current analysis are indicative of dentalisation or some other phenomena. A more precise metric was required.

The research by Jongman *et al*. (1984) on the acoustic properties of dental and alveolar stop consonants attempted to find an acoustic property which could distinguish between dental and alveolar stop consonants. Using data from Malayalam, which makes a phonemic contrast between dental and alveolar stop consonants, Jongman *et al*. (1984) found that the amplitude of the small burst of sound after the release of the oral closure could be used to classify a significantly high proportion of the stops. Because the amplitude of a burst by itself may be influenced by the size of the speaker's vocal tract, as well as by the loudness at which the word is said, the rms amplitude[4] of the burst was normalised against the rms amplitude of the onset of the vowel following the burst i.e. for each token, the rms amplitude of the first two pulses of voicing in the vowel was divided by the rms amplitude of the burst. Jongman *et al*. (1984) found that by using a ratio of 5 as a cut-off point to distinguish between dental and alveolar stops (with dental stops having a ratio of greater than 5, and alveolar stops having a ratio of less than 5), they were able to correctly classify more than 86% of the recorded stops.

In order to determine whether this ratio is truly indicative of an invariant acoustic property, data from Dutch, which has dental stops according to Jongman *et al*. (1984), and from American English, which has alveolar stops, were then analysed. The metric was far less accurate in classifying these data. The stops of some subjects could be classified accurately, but for other subjects, only approximately 66% could be classified using a ratio of 5 as a cut-off point. This inaccuracy could be attributed to the fact that neither Dutch nor American English makes a phonemic distinction between dental and alveolar stops, which could result in the stops being less distinctly dental or alveolar than those in a language which does make this distinction, such as Malayalam. With respect to the GenSAE data therefore it makes sense to abandon the notion of a cut-off but to retain the use of the ratio metric as a continuum indicative of place of articulation i.e. a lower ratio indicates a more alveolar place of articulation, while higher ratios indicate a degree of fronting.

Research methodology

Two groups, each consisting of five subjects, were chosen: a test group from Johannesburg, and a control group from Cape Town. Since the aim of the research was to determine whether dentalisation has become a regional indicator of the NSJ, none of the subjects was of Jewish descent. Although GenSAE is spoken by members of various race groups, non-white speakers are more likely to have varying linguistic influences (such as education in another language or variety, or parents who speak another language or variety), and for this reason it was decided to focus the study on white participants. All participants were therefore white females and English L1 speakers, with English L1 parents. Seven out of the ten subjects were born in the relevant region and had lived in that region for their entire lives before coming to Rhodes University. Three of the ten subjects had moved into the relevant regions before the age of ten. None had spent an appreciable amount of time away from home e.g. in a foreign English-speaking country such as the USA. All of the subjects had attended prestigious private schools (and so may be safely assumed to be middle- or upper-middle class) and, at the time of recording, were first-year students at Rhodes University.

Cape Town was selected as the best region from which to draw the control group because of the number of girls from Johannesburg who attend private schools in other parts of the country,

especially KwaZulu-Natal and the Eastern Cape, and the resulting influence of the Johannesburg accent on girls from these schools.

Each subject was recorded using an AKG C1000 condenser microphone, a Behringer 1604 mixing console, an ESI WaveTerminal sound card and Wavelab 5 software. A sampling frequency of 44.1 kHz and a quantisation rate of 16 bits were used. Subjects were required to read word lists and short passages of text (see Appendix); as mentioned above the use of two styles was employed in the hope of capturing preliminary evidence for the prestige nature of dentalisation.

The word lists and texts included words designed to elicit the consonant /z/ in both word-initial and word-final position, and the consonants /d/ and /t/ in word-initial position. It was not possible to include /d/ and /t/ in word-final position since the metric requires that the rms amplitude of the burst be normalised against the rms amplitude of a vowel *following* the burst, perhaps related to the fact that stop consonants are sometimes unreleased in word-final position. The word list was presented in the form of flash-cards so as to prevent the subjects from reading them with a list intonation. Altogether 10 tokens of /z/ in each phonetic context (i.e. word-initial and word-final) and each formal style were recorded for each subject, resulting in 40 tokens of /z/ for each subject. Ten tokens of /d/ and /t/ respectively were recorded for each speaker in each formal style, resulting in 20 tokens of /d/ and /t/ each for each subject.

A Fast Fourier Transform was computed for the whole duration of each token of /z/, and each spectrum was measured for its COG, standard deviation, skewness and kurtosis. Forty tokens were analysed for eight out of the ten subjects (20 from word lists and 20 from text passages), and 39 for the remaining two, due to one subject omitting the token *Zulu* from a text, and the low quality of the recording of the token *tease* in another subject's interview. Altogether, 199 tokens for each region and 398 tokens overall were analysed.

For each token of /t/, it was decided to calculate the rms amplitude of the first 40 ms of the burst; according to Jongman *et al*. (1984) this time period is sufficient to capture all the relevant spectral information. The rms amplitude of the first two pulses of voicing in the vowel, measured from the peak of the first pulse to the peak of the third pulse, was also calculated, and the ratio of the rms amplitude of the vowel to the rms amplitude of the burst ascertained. Twenty tokens were analysed for each subject (10 from word lists, and 10 from short passages of text), yielding 100 tokens for each region and 200 overall.

The burst duration of /d/ varied from 7 ms to 32 ms and, given this large variation, it was decided to calculate the rms amplitude of the entire burst in each case, given that the size of the Hamming window is taken into consideration when calculating the rms amplitude. The same method as was used with /t/ was used to calculate the rms amplitude of the onset of voicing, and again, ratios were calculated. Twenty tokens were analysed for 9 out of 10 subjects (10 tokens from word lists and 10 from short passages of text), and 19 for the remaining subject, due to the poor quality of the recording of the token *determined*. Ninety-nine tokens for Johannesburg and 100 for Cape Town were therefore analysed.

Results

The following two sections provide the results for the analysis of /z/, and of /t/ and /d/, respectively.

The analysis of /z/

The relevant means obtained on the basis of the analysis of /z/ as well as the results of a two-tailed t-test are provided in Table 1.

It is clear from Table 1 that, on average, the Johannesburg tokens display a higher COG, a lower degree of variance (standard deviation), and a different degree of skewness from the Cape Town tokens. These differences are also highly significant on a statistical level. While the difference in kurtosis is not statistically significant, with Johannesburg displaying only a slightly higher average than Cape Town, it is at least in the right direction. In general, therefore, the data provide compelling confirmatory evidence for the hypothesis that Johannesburg /z/ tends to be fronted.

This conclusion is also supported by another method of analysing the data, i.e. if one ranks each individual speaker on the basis of each of the parameters, as has been done in Tables 2 to 5.

Dentalisation is indicated by a higher COG and, as can be seen in Table 2, three of the five highest averages belong to Johannesburg speakers, while three of the five lowest averages belong to Cape Town speakers. There is an obvious trend towards a higher COG among Johannesburg speakers. On the other hand, a lower standard deviation suggests dentalisation and, in Table 3, four of the five lowest averages for standard deviation belong to Johannesburg speakers, while four of the five highest averages belong to Cape Town speakers. Next, the five speakers from Johannesburg all show a lower level of skewness than the five Cape Town speakers, as can be seen in Table 4. As expected, given that there did not appear to be a statistically significant difference for kurtosis, the rank scale for this variable appears to be random, as is clear from the data presented in Table 5.

The results therefore seem to indicate clearly that there is, on average, a higher level of dentalisation among Johannesburg speakers. However, in order to investigate the possibility of fronting as a prestige variant, the difference between the results for the word lists and texts must be examined. It was, in short, hoped that the word list data would, on average, show a higher COG, a lower degree of variance, a different degree of skewness and a higher level of kurtosis than the text-data, with a greater difference between the two styles in the results for Johannesburg than in those for Cape Town. The results were somewhat surprising. Table 6 shows the differences between the styles for

Table 1: Results for /z/: Spectral moments analysis means and *p*-values

	Cape Town	**Johannesburg**	***p*-value**
Centre of gravity	6584.50534 Hz	7906.09092 Hz	*p ≤ 0.0001*
Standard deviation	2664.571645 Hz	2273.8187 Hz	*p = 0.0006*
Skewness	0.806152	-0.4496775	*p ≤ 0.0001*
Kurtosis	5.572491	6.376668	p = 0.6067

Table 2: Results for /z/: Ranking of subjects in terms of average centre of gravity

Cape Town 5	5019.521 Hz
Cape Town 1	5618.003 Hz
Cape Town 4	5808.473 Hz
Johannesburg 2	6148.555 Hz
Johannesburg 4	7131.715 Hz
Cape Town 3	7886.693 Hz
Johannesburg 1	8004.772 Hz
Cape Town 2	8565.673 Hz
Johannesburg 5	8874.929 Hz
Johannesburg 3	9351.123 Hz

Table 3: Results for /z/: Ranking of subjects in terms of average standard deviation

Johannesburg 2	2058.294 Hz
Johannesburg 1	2084.249 Hz
Johannesburg 5	2102.776 Hz
Cape Town 2	2236.061 Hz
Johannesburg 4	2331.949 Hz
Cape Town 3	2460.846 Hz
Cape Town 4	2589.924 Hz
Johannesburg 3	2793.277 Hz
Cape Town 5	2896.306 Hz
Cape Town 1	3049.851 Hz

Cape Town, and Table 7 for Johannesburg. As can be seen, the results were tested for statistical significance.

As predicted, speakers from Cape Town showed a higher COG in the word lists than in the texts while those from Johannesburg showed, contrary to predictions, a higher COG in the texts than in the word lists; in both cases, however, the difference was not statistically significant. In addition, both groups showed a lower degree of variance in the word lists than in the texts, as well as a different degree of skewness, and a higher degree of kurtosis, as predicted. With the exception of the COG parameter, the results seem to give at least some indication that there is a higher degree of fronting in the word lists than in the texts, across both populations.

Table 4: Results for /z/: Ranking of subjects in terms of average skewness

Johannesburg 5	-1.06069
Johannesburg 3	-0.70465
Johannesburg 1	-0.54957
Johannesburg 4	-0.00619
Johannesburg 2	0.083811
Cape Town 2	0.363552
Cape Town 4	0.834434
Cape Town 5	0.899554
Cape Town 3	0.934789
Cape Town 1	1.00336

Table 5: Results for /z/: Ranking of subjects in terms of average kurtosis

Cape Town 5	1.8906776
Johannesburg 3	2.833614
Cape Town 4	3.7468397
Johannesburg 2	4.92437768
Cape Town 1	5.0986511
Cape Town 2	5.88884797
Johannesburg 4	6.087854
Johannesburg 1	6.523976
Cape Town 3	11.22559
Johannesburg 5	11.506299

Table 6: Results for /z/: The effect of style on Cape Town subjects

	Word lists	**Texts**	**Difference**	***p*-value**
Centre of gravity	6609.494 Hz	6559.264 Hz	50.231	0.8681
Standard deviation	2416.075 Hz	2875.376 Hz	459.301	0.0008
Skewness	1.168	0.441	0.727	0.0045
Kurtosis	7.246	3.882	3.365	0.1427

Table 7: Results for /z/: The effect of style on Johannesburg subjects

	Word lists	**Texts**	**Difference**	***p*-value**
Centre of gravity	7656.212 Hz	8158.494 Hz	502.282	0.091
Standard deviation	2207.355 Hz	2340.642 Hz	133.288	0.3157
Skewness	-0.282	-0.612	0.329816	0.1807
Kurtosis	8.086	4.652	3.433521	0.096

Interestingly enough, the Cape Town data show the only two statistically significant results as can be seen in Table 6, i.e. a significant difference between the two styles in terms of standard deviation and skewness. While one has to remain rather tentative in terms of one's interpretation of these results, there is some evidence here to suggest that while fronting is part of the NSJ vernacular and mainly indicative of regionality in this regard, it is, in the Cape Town context, a change-from-above in the classic Labovian sense, i.e. indexical of class and prestige and in all likelihood imported from another speech community (i.e. Johannesburg).

The analysis of /t/ and /d/

The average ratio obtained for each speaker, in rank order, may be found in Tables 8 and 9.

As can be seen, there is no obvious pattern across these two sets of data which clearly separates the two regional groups. This was reflected in the results of a two-tailed t-test which yielded a *p*-value of 0.71 for /d/, and a *p*-value of 0.20 for /t/. We also note that, except in two cases (Cape Town 1 and Johannesburg 2 in Table 8), all the ratios are less than 5, indicative of an alveolar place of articulation in terms of the metric provided by Jongman *et al*. (1984). In conclusion, the data show no evidence for the dentalisation of the traditionally alveolar plosives in the speech of the Johannesburg subjects. An analysis of the differences between word list and read-passage data also yielded no significant results.

Discussion and Conclusion

On the basis of the above results, there is little evidence to suggest that Johannesburg speakers dentalise /t/ and /d/ more than their Cape Town peers. There is, on the other hand, considerable evidence, from both this and Bekker's (2007) research, to support the hypothesis that both the traditionally alveolar fricatives (/s/ and /z/) are in fact dentalised. With respect to /z/ in particular, the data show a statistically significant difference between the two populations, and when the averages for each speaker were examined, there emerged a rank order which coincided with the predictions.

Table 8: Results for /d/: Average ratio for each speaker

Johannesburg 3	2.403745
Cape Town 5	2.761712
Cape Town 2	3.282659
Cape Town 3	3.484138
Johannesburg 4	3.811523
Johannesburg 1	4.181691
Cape Town 4	4.204513
Johannesburg 5	4.679329
Johannesburg 2	5.107945
Cape Town 1	5.47841

Table 9: Results for /t/: Average ratio for each speaker

Johannesburg 3	1.571154
Cape Town 3	2.253537
Johannesburg 5	2.556174
Johannesburg 4	2.578869
Cape Town 5	2.598109
Cape Town 2	2.814792
Cape Town 1	2.916052
Johannesburg 2	3.33341
Johannesburg 1	3.675057
Cape Town 4	4.084815

An examination of the differences between the Johannesburg word list and text-passage data shows that there is no statistically significant difference between the two styles. This would suggest that dentalisation of /z/ does not carry overt prestige in the Johannesburg context but remains a regional indicator. In the Cape Town data, however, there was a significant difference across the two styles with respect to two of the four variables, even though it appears that overall Cape Town speakers dentalise significantly less than Johannesburg speakers. What this suggests is that while dentalisation has 'settled down' as a regional indicator of the northern suburbs of Johannesburg, it is an incoming prestige variant in Cape Town. These remarks remain speculative, however, given the fact that both styles employed were formal ones and, as such, need to be supplemented in future research through the use of sociolinguistic techniques that elicit and analyse the full range of stylistic data.

Lastly, it should be mentioned that while the research was being conducted it was noted (impressionistically and based on inspection of the spectrograms) that speakers from Johannesburg displayed a strong tendency to devoice the voiced fricative /z/ in all positions.[5] Given that the lack of voicing would have affected the FFT spectrum, all the statistical operations performed on these spectra would, of course, have been affected as well. This is a significant point because, while all the data show that there is a significant difference in articulation between the two populations, it is at least conceivable that this difference could be based on the degree of devoicing of /z/, as opposed to the degree of dentalisation. Further research examining the degree and frequency of devoicing across the two populations is required in order to shed more light on this possibility.

Notes

[1] As in the case of /s/, if these sounds are found to be dentalised among non-Jewish speakers from Johannesburg, it is then reasonable to suspect that this is because dentalisation has spread from Jewish to non-Jewish speech. Furthermore, given the prestige of the Jewish community in Johannesburg, it would be reasonable to expect that such spread reflects the prestige nature of this feature. Note that nothing much rides on these impressionistic assumptions: the focus of the research is to provide empirical evidence for the existence of dentalisation in the speech of Johannesburg subjects. If confirmed, the postulated reasons why such dentalisation exists and what its social origins are remain speculative and require further research and confirmation.

[2] An alternative expression would be 'those of Eastern European descent', with the two groups often coinciding.

[3] This is especially problematic for the current study given that only ten subjects were recorded.

[4] The rms amplitude is 'the root of the mean of the sum of the squares of the amplitude value for each sample point ... divided by the window size' (Jongman *et al*., 1984: 1984).

[5] Word-final devoicing is, of course, a well-known phonetic phenomenon and thus not unexpected. The point to emphasise here is that the devoicing was evident in both word-*initial* and word-final position and that in both positions it was more prominent in the speech of the Johannesburg subjects than that of Cape Town subjects.

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Appendix A - Tokens recorded

Table 10: /z/

Word lists		**Texts**	
Word-initial	**Word-final**	**Word-initial**	**Word-final**
zig-zag	keys	xenophobes	year's
zest	nose	Zim	arose
zen	ladies	Zulu	fires
zeppelin	sneeze	zero	noise
zinc	eggs	zoom	tease
zeal	doze	zap	cheese
zany	shoes	zoo	has
zebra	eyes	zombie	buzz
zip	tyres	zodiac	rise
xylophone	choose	zone	says

Table 11: /d/ and /t/

/d/		**/t/**	
Word lists	**Texts**	**Word lists**	**Texts**
daddy	death	table	terrible
doll	dismayed	teaspoon	Ted
dinner	days	tuck	turn
dump	do	ticket	TV
deep	dog	toad	tiger
dip	dangle	tailor	teddy
dance	determined	tall	tiniest
dumb	difficult	teach	tacky
diary	director	turkey	title
digs	diamonds	temple	tell

Text 1: Last year's attacks on immigrants by xenophobes changed some people's opinions of South Africa. Much negative sentiment arose afterwards, because the attacks harked back to the terrible human rights abuses of Apartheid years. 'It's the people from Zim who are seen to be the problem,' said Thulani, a peaceful Zulu shop owner who witnessed the attacks. 'It was horrible – people lit fires and beat other people to death.' Ted Modikwe, a head policeman in Johannesburg, was dismayed by the attacks, which took place over a number of days. 'Everyone thought things like this were in the past. It's just not right – I can't believe that people would do something like this, or that people can hate each other so much. But now you turn on your TV, and what you see could make you sick. It's high time people started talking about the causes of this sort of problem. And the police need to adopt a zero-tolerance campaign when it comes to violence.'

Text 2: It's fun to see how my dogs and cats play with each other. My cat Shelley is a real tiger, and my dog Pooky is just a big teddy bear, but he still loves a good rough and tumble game with her. Shelley will zoom up to Pooky and butt her head into him, which starts a mad chase. Even more fun is to watch how Shelley will sit in wait for a mouse. She can sit still for ages, completely alert, listening for any small sounds. She can sense the tiniest noise, too. Sometimes I dangle some cheese somewhere to attract a mouse, just because it's fun to watch how she will tease it for a bit, and then she reaches out her paw and zap! She has the mouse. Of course, she will never actually eat what she drags inside. Between the mice, dogs and cats, it's like living in a tiny zoo sometimes.

Text 3: Lisa Hayley is a new actress who's creating a buzz. Her rise to fame has been slow because of her start in some tacky zombie movies, but she's determined to see her name in lights,

she says. The title of her new film, *Zodiac*, is a reference to a sinister series of killings by a notorious murderer, based on a true story. 'I'm excited to see how it turns out once it's complete! You know, they always cut so much out that it's difficult to tell while you're making it. But I understood that I just had to be a part of this right from the moment I met the director. And the script was fantastic – the second I got on set every day, it was just so easy to get right in the zone and forget everything else,' she says happily. Her one weakness? Diamonds. 'And I drink herbal tea constantly,' she laughs. And her future dreams? 'To live in Madrid. Such an amazing city.'