Don't Glottal Stop Me Now: A Comparative Study of /t/-glottaling in Edinburgh English in the 1970s

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This paper analyses the speech of Edinburgh speakers from a range of ages and socioeconomic backgrounds: established middle class (EMC), new middle class (NMC), and working class (WC). Findings were compared to previous studies, particularly Titheridge (2020), which examines the same data set collected in 1975. The results show that /t/-glottaling significantly correlates with social class but not age. The following phoneme and position of /t/ within the word were shown to be significant predictors of /t/-glottaling. Evidence of an interaction between the following phoneme and the speakers' social class was found, which could suggest that NMC has a different ordering hierarchy of the aforementioned factors from WC and EMC.

1 Introduction

Glottal replacement of /t/ has spread rapidly throughout the U.K. and become a distinct feature of Scottish English, particularly prevalent in working class speech (Stuart-Smith 1999). Although once considered a "lazy sound" (Smith and Holmes-Elliott 2017:327), research has shown that /t/-glottaling has become increasingly common in RP, Northern English, and Scottish English (Milroy et al. 1994, Macaulay 1977, Stuart-Smith 1999, Fabricius 2002, Marshall 2003, Schleef 2013). The rapid spread of /t/-glottaling and its strong social class conditioning makes this variant especially interesting to study. In the present paper, I investigate linguistic and social constraints for predicting /t/-glottaling in male native Edinburgh English speakers from interview recordings conducted by Esling in 1975 (Esling 1978). Investigating this data from the 1970s gives us some insight into when the change could have begun in Edinburgh. I compare findings to previous literature and expand on Titheridge's (2020) recent work, which investigates the same data set. This study considers the social class and age of the speaker, as well as position of /t/ within a word and the following phoneme, to examine which constraints have the strongest effect on rates of glottal /t/.

Similar to previous research, the internal constraints of the following phoneme and position of /t/ within the word were the strongest predictors for /t/-glottaling (Schleef 2013, Smith and Holmes-Elliott 2017, Miller 2019). Additionally, social class was found to predict glottaling, my results showing that WC speakers use the glottal variant the most frequently, which is in line with previous studies (Stuart-Smith 1999, Fabricius 2002, Schleef 2013, Smith and Holmes-Elliott 2017). Similar to Titheridge (2020), this study also found a different ordering hierarchy of the following phonological environment most and least favourable to /t/-glottaling than most studies (Stuart-Smith 1999, Schleef 2013). Notably, a number of different ordering hierarchies have been reported in Scotland (Romaine 1975, Macaulay 1977, Reid 1978, Stuart-Smith 1999), which makes this variable particularly worthy of investigation.

This paper examines whether the internal constraints are consistent across the three social classes and finds an interaction effect between the following phonological environment and the speaker's socioeconomic status. My results, for the most part, are in line with previous research, except that age was not an accurate predictor of the glottal variant. Thus, this paper does not find the dramatic increase from older to younger speakers which has been accounted for in earlier studies (Stuart-Smith 1999, Fabricius 2002, Schleef 2013, Smith and Holmes-Elliott 2017). This paper's operationalisation of age into three groups and its closer investigation of speakers' individual variation builds on Titheridge (2020). Titheridge (2020) assesses that her grouping of the speakers' ages into two cohorts was potentially a "faulty re-operationalisation [of age]" (Titheridge 2020:36). However, this paper can support Titheridge's evaluation that age is not a significant predictor of /t/-glottaling in this data set from 1975, which gives us some insight into when the change could have begun in Edinburgh. Finally, this paper carefully suggests that NMC speakers show a different ordering of constraints from both the WC and EMC, which supports Dickson and Hall-Lew's (2017) finding that NMC speakers are separate from, rather than in between, the EMC and WC.

2 Literature Review

T-glottaling is one of the most widely studied sociolinguistic phenomena in the U.K., and previous research suggests that it is an ongoing sound change (Stuart-Smith 1999, Fabricius 2002, Schleef 2013, Smith and Holmes-Elliott 2017). Its long history in Glasgow Urban Scots has sparked a debate of whether /t/-glottaling may have its

origins in Scottish English, rather than London, as was formerly believed (Stuart-Smith 1999, Fabricius 2002, Schleef 2013). I will first consider the history and spread of /t/-glottaling in Scottish English, before examining what linguistic and social constraints have been found to predict the variant.

2.1 Scottish English /t/-glottaling

According to Schleef (2013:203), /t/-glottaling has been used in Edinburgh for at least 100 years. Although stigmatized in many parts of the U.K. and once considered an "ugly and also a lazy sound" (Smith and Holmes-Elliott 2017:327), new research suggests that glottal /t/ is slowly losing this reputation (Fabricius 2002). Schleef (2013) concluded that /t/-glottaling in word-final position is stable, and its change is nearing completion in Edinburgh, while in other parts of the U.K. this change is still ongoing (Fabricius 2002, Marshall 2003). Schleef (2013) found that younger speakers in Edinburgh use the glottal variant more frequently than younger speakers in London, which supports the idea that /t/-glottaling has a longer history in Scotland than England. Indeed, Stuart-Smith (1999) proposes that Glasgow may be the "original home of the glottal stop" (Stuart-Smith 1999:181).

2.2 Internal Constraints of /t/-glottaling

The use of /t/-glottaling can be predicted by the position of /t/ within the word and the following phonological context. Previous studies have found that /t/-glottaling occurs more frequently word-finally than word-medially (Schleef 2013, Smith and Holmes-Elliott 2017, Miller 2019). This pattern has also been attested for in urban Glasgow speech and RP (Macaulay 1977, Fabricius 2002).

This study examines /t/-realization in three different phonological contexts: pre-consonantal (PreC), prevocalic (PreV), and prepausal (PreP). Previous literature has found that /t/-glottaling is most likely to occur in PreC environments, while PreV environments disfavour the glottal variant (Schleef 2013, Smith and Holmes-Elliott 2017).

(1) PreC > PreP > PreV

The diffusion pattern seen in (1) is attested for in RP, London, and certain varieties of Northern English (Fabricius 2002, Schleef 2013, Smith and Holmes-Elliott 2017). Interestingly, a number of different diffusion patterns for /t/-glottaling have been reported in Scotland, as shown in Table 1.

Table 1: Relative frequency of [ʔ] according to phonological environment, as described by Stuart-Smith (1999:192)

Researcher	Romaine	Macaulay	Reid	Macaulay	Stuart-Smith
Location	**Edinburgh**	**Glasgow**	**Edinburgh**	**Ayr**	**Glasgow**
Year	**1975**	**1977**	**1978**	**1991**	**1999**
Most frequent	PreV	PreC	(PreC)		
↑	PreP	PreV	PreP	PreP	PreP
↓	PreC	PreP	PreV	PreV	PreV
Least frequent	(V_V)	(V_V)	(V_V)	(V_V)	(V_V)

It seems clear that the typical diffusion pattern put forward by Schleef (2013) of **PreC > PreP > PreV** does not hold true for many varieties of Scottish English. This variation in ordering hierarchies of the most and least favourable environments for glottal /t/ in Scottish English makes this variable particularly interesting to study. Johnston (1983, cited in Stuart-Smith 1999:185) notes that:

> [T]he range of variation in standard and vernacular varieties is not always organised along a linear continuum. Historically, the varieties of the middle and working classes in Glasgow are derived from two distinct, yet related sources. […] Working class speech continues urban Scots, which has shown T-glottalling for at least a century. Middle class speech, typically Scottish Standard English, has no recorded history of T-glottalling beyond what is assumed for other standard varieties of English. However, given that Glasgow is a traditional dialect area, continuing two once distinct linguistic systems, it is not impossible that while appearing quantitatively continuous, T-glottalling may in fact be qualitatively discrete for speakers of working- and middle-class backgrounds respectively.

This suggests that /t/-glottaling could have developed separately in urban Glasgow Scots and Scottish Standard English (SSE). Indeed, Schleef supports this idea, his results suggesting that /t/-glottaling has a longer history in Scotland than other parts of the U.K. (Schleef 2013). Importantly, Johnston (1983) points out that WC speech is more influenced by Scots and middle-class speech is typically more influenced by SSE, which is a variety of English similar to Standard Southern British English or RP, spoken with a Scottish accent (Stuart-Smith 1999). McClure (2002) explains that the standard and the vernacular are not always ordered along a linear continuum, and that few Scottish English speakers exclusively use Scots or exclusively Standard English. However, it is worthy to note that there is no evidence to suggest that SSE has a history of /t/-glottaling beyond what is assumed for RP (Stuart-Smith 1999). This paper will not attempt to cover the complex linguistic history of Scotland and the current linguistic situation, but it is important to note that these separate influences of SSE and Scots could explain why there does not appear to be a standard ordering of constraints and why so many different diffusion patterns have been found in Scotland.

2.3 External Constraints of /t/-glottaling

Previous studies have found gender, style, social class, and age to be significant predictors for /t/-glottaling (Stuart-Smith 1999, Fabricius 2002, Schleef 2013, Smith and Holmes-Elliott 2017). As all of the speakers analysed in this study are male, and the data consists of casual interviews, I will only consider the speakers' social class and age.

According to previous research, variation in glottal replacement of /t/ is socially stratified in Scottish English, with the highest rates of /t/-glottaling occurring among speakers of lower socioeconomic status (Stuart-Smith 1999, Milroy at al. 1994). The strong evidence for glottal /t/'s social class conditioning makes this variant interesting to study. The use of alveolar /t/ is prestige-driven, while the glottal variant is considered non-standard and low-prestige, and has been used consistently by working class speakers in Glasgow, its use increasing over time (Stuart-Smith 1999, Miller 2019). Notably, Dickson and Hall-Lew (2017) have analysed the relationship between class mobility and realizations of sociophonetic variables. Their findings provided evidence that NMC speakers present different sociophonetic patterns from the WC and EMC (Dickson and Hall-Lew 2017). This paper investigates whether there are significant interaction effects between social class and the patterning of linguistic constraints.

Age of the speaker has been shown to be another significant predictor for /t/-glottaling (Stuart-Smith 1999, Marshall 2003, Schleef 2013, Smith and Holmes-Elliot 2017). Previous studies have indicated an increase in the use of glottal /t/ in each new generation (Stuart-Smith 1999, Marshall 2003, Smith and Holmes-Elliot 2017). This pattern holds true for varieties of Scottish English as well, where Marshall (2003) found that the feature is increasingly used by younger speakers. Schleef (2013) concluded that /t/-glottaling is more common in adolescents in Edinburgh than in London (Schleef 2013). Furthermore, Smith and Holmes-Elliott's (2017) investigation of /t/-glottaling in Buckie showed a rapid change across generations, with younger speakers glottaling 90% of tokens compared to 38% of older speakers (Smith and Holmes-Elliott 2017:342). Smith and Holmes-Elliott (2017) and Stuart-Smith (1999) indicate a rapid change in progress in certain varieties of Scottish English. This rapid spread of /t/-glottaling makes it particularly worthy of investigation, especially from data collected in the 1970s, to shed light on when this rapid change could have begun in Edinburgh.

3 Methodology

3.1 Data and Participants

This study focuses on the internal and external constraints of /t/-glottaling in a sample of male native Edinburgh English speakers. The data was collected as part of a collaborative project on /t/ variation in Edinburgh speech, in which 29 undergraduate students at Edinburgh University coded 13 of the interviews conducted by John Esling in 1975 (Esling 1978), aided by pre-existing transcripts. Inter-rater reliability checks were performed for each speaker, with at least two coders double-coding at least 10% of all tokens. The initial rates of agreement ranged from 0% to 100%. After reconciling differences through discussion between raters, the final rates of agreement were all at least 76%.

The dependent variable is the realization of /t/, whether it is glottal [ʔ] or alveolar [t]. The envelope of variation includes the phonological environments in Table 2.

Table 2: Envelope of variation

Word-medial	Word-final
Followed by a vowel	Followed by a vowel
Followed by a sonorant	Followed by a sonorant
	Followed by a non-/t/ consonant
	Followed by a pause

Each realization of /t/ was coded for and partially or fully double-coded for inter-rater reliability checks. All other variants of /t/ (taps [ɾ], deletions [ø], and 'other') were removed from the data, following Miller (2019). Taps and 'other' occurred very infrequently, both less than 4%. The deletions made up 21% of realizations of /t/, which is less frequent than the alveolar and glottal realizations. It may be worth investigating deleted realizations of /t/ in a separate study; however, they were not considered in this analysis.

The independent variables are the position of /t/ (word-medial or final) and the following phonological environment (consonant, vowel, or pause). Additionally, social class and age of the speaker have been shown to predict rates of /t/ glottaling. Esling's (1978) operationalisation of social class was based on the 1971 Census for Scotland, which he used to select two wards of the city: Pilton and Morningside. Pilton was classed as the least affluent and Morningside as the most affluent, according to criteria such as the percentage of owner-occupied households, age group distribution, and socioeconomic group distribution. He then classed each speaker into one of three groups, which were reclassified according to Dickson and Hall-Lew (2017) as EMC, NMC, and WC (Esling 1978).

Following Smith and Holmes-Elliott (2017), age was operationalised as three groups (younger, middle, and older). This operationalisation into three groups enabled a more compelling comparison to Titheridge (2020), which classed age into two cohorts. Smith and Holmes-Elliott's (2017) division of age into three groups facilitated finding generational differences. Limited by the smaller sample of 13 speakers (compared to Smith and Holmes-Elliott's 24) and to ensure that each group was of a similar size, five speakers were classed as younger, with ages ranging from 22 to 37, four speakers as middle, ranging from 38 to 46, and four speakers as older, ranging from 52 to 64, as shown in Table 3.

Table 3: Sample stratified by age and social class

	Younger (22–37)	Middle (38–46)	Older (52–64)
EMC	2	2	∅
NMC	2	1	1
WC	1	1	3

3.2 Statistical Analysis

To analyse which constraints are the most accurate predictors of /t/-glottaling, a mixed-effect logistic regression model was created in RStudio. The final model was generated using by-hand drop-one ANOVA comparisons, created by the lme4 package in RStudio, following Dickson and Hall-Lew (2017). The random effect of Speaker and Word was included to account for individual variation. All factors were tested for interaction effects, and interactions which were found to be significant were tested into the initial maximal model.

4 Results

4.1 Overall Distributions

Table 4 shows the overall distribution of all variants. Of the tokens, 75% were identified as alveolar or glottal, and following the example of previous studies, all other variants were excluded (Stuart-Smith 1999, Smith and Holmes-Elliott 2017, Miller 2019).

**Table 4:** Overall distribution of all variants

	Alveolar	**Deleted**	**Glottal**	**Other**	**Tap**
N	768	431	780	8	63
%	38	21	38	0	3

4.2 External Constraints

As discussed in Section 2, previous research has provided strong evidence for glottal /t/'s social stratification in Scottish English, with highest rates of /t/-glottaling occurring among speakers of lower socioeconomic status (Milroy at al. 1994, Stuart-Smith 1999, Fabricius 2002, Schleef 2013). Figure 1 demonstrates the same result, showing the dramatic increase of glottal use across the three social classes. EMC speakers exhibit rates of glottal replacement at 35%, compared to 70% of WC speakers.

Previous studies have indicated that the rate of /t/-glottaling accelerates in each generation, with younger speakers usually exhibiting the highest rates of the glottal variant (Schleef 2013, Smith and Holmes-Elliott 2017). Age of the speaker was analysed in Figure 2, which shows the distribution of glottal use across the three age groups, younger (22–37), middle (38–46), and older (52–64). The distribution of rates of glottal /t/ across the three groups is somewhat unexpected, with older speakers using the glottal most frequently at 61%. The middle age group uses the glottal least frequently, only 41%, and the younger speakers use glottal /t/ at a surprisingly low rate (54%). Previous findings of a dramatic increase in glottal replacement of /t/ in younger age cohorts cannot be attested for in Figure 2 (Stuart-Smith 1999, Fabricius 2002, Schleef 2013, Smith and Holmes-Elliott 2017), though it is not surprising when compared to Titheridge (2020), which also did not find a dramatic increase of glottal use in younger speakers. The possible reasons for this unusual finding will be discussed further in Section 5.

As the speaker will be entered into the mixed-effect model as a random factor, the effects of individual variation will be controlled. However, following Smith and Holmes-Elliot (2017) and Guy (1980), I also inspected the individual patterns at a descriptive level in Figure 3.
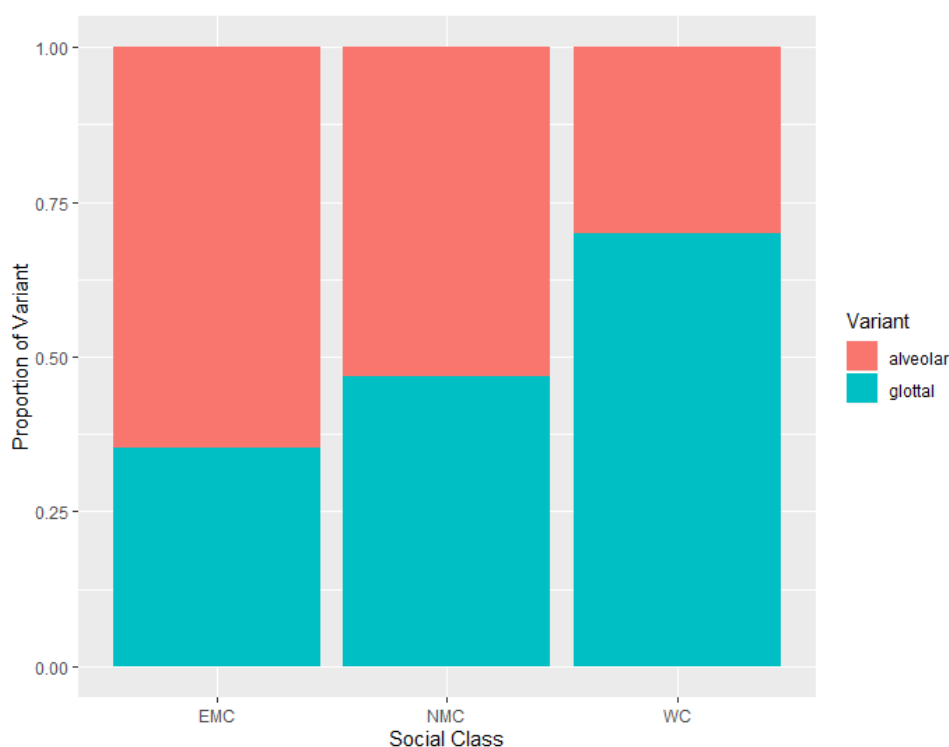
Figure 1: Overall distribution of glottal /t/ by social class.

Figure 2: Overall distribution of /t/-glottaling by age.
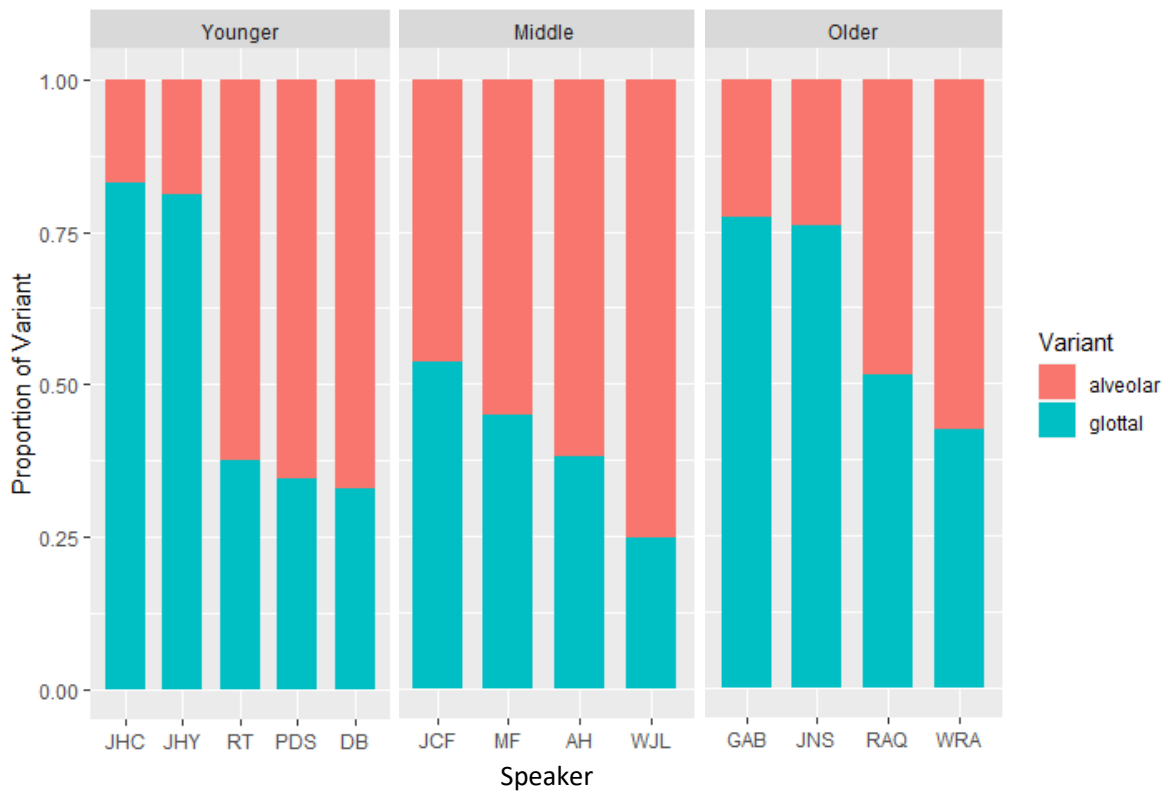
Figure 3: Proportion of glottal use by individual speaker.

Figure 3 shows the individual rates of variability, where I ordered the speakers from high to low across each age cohort. Ultimately, the three groups look relatively similar, and the figure shows a considerable amount of individual variation in each age group, and that all speakers use glottal replacement to some extent. The interspeaker variability increases from the older group to the younger group. Within the older age group, the range of the highest (GAB = 77%) to the lowest-rate user (WRA = 42%) is 35%. This is compared to the younger age

group, which has a range of 50% (JHC = 83%; DB = 33%). Additionally, the middle group appears to have the least interspeaker variability at 29% (JCF = 54%; WJL = 25%). This increase in interspeaker variability across age groups is not accounted for in other studies, such as Smith and Holmes-Elliot (2017), which found a decrease across generations. In their study, the interspeaker variability decreased from 66% in the older age group to 24% in the young cohort (Smith and Holmes-Elliott 2017:332). This difference between my results and Smith and Holmes-Elliot (2017) could be due to multiple factors, which will be discussed in Section 5.

Note too that two of our older speakers, JNS (64) and GAB (52), show relatively high rates of /t/-glottaling, around 80%. This could suggest that /t/-glottaling has been used in Edinburgh for a number of generations (Smith and Holmes-Elliott 2017). These findings are not altogether surprising when compared to Titheridge (2020), who also did not find a significant increase of glottal use in younger speakers. Having now considered the external constraints, I will examine the linguistic constraints of /t/-glottaling, and analyse whether our three social classes have similar orderings of internal constraints.

4.3 Internal Constraints

As discussed in Section 2, position of /t/ within the word (final or medial) and following phoneme (consonant, vowel, or pause) have been shown to predict rates of /t/-glottaling in previous research (Stuart-Smith 1999, Fabricius 2002, Schleef 2013).

Table 5: Overall distribution of /t/-glottaling by word position

Word Position	N	%
Final	595	67
Medial	185	28

Table 5 demonstrates that /t/-glottaling is most likely to occur in word-final contexts, with 67% of word-final /t/ being glottal, compared to 28% word-medially. This is in line with previous research, which has shown the word-final position to be the most favourable environment for the glottal variant (Stuart-Smith 1999, Fabricius 2002, Schleef 2013, Titheridge 2020). Previous studies have additionally shown that this pattern is consistent across the social classes, and that both EMC and WC speakers will have higher rates of /t/-glottaling word-finally than medially (Smith and Holmes-Elliott 2017).
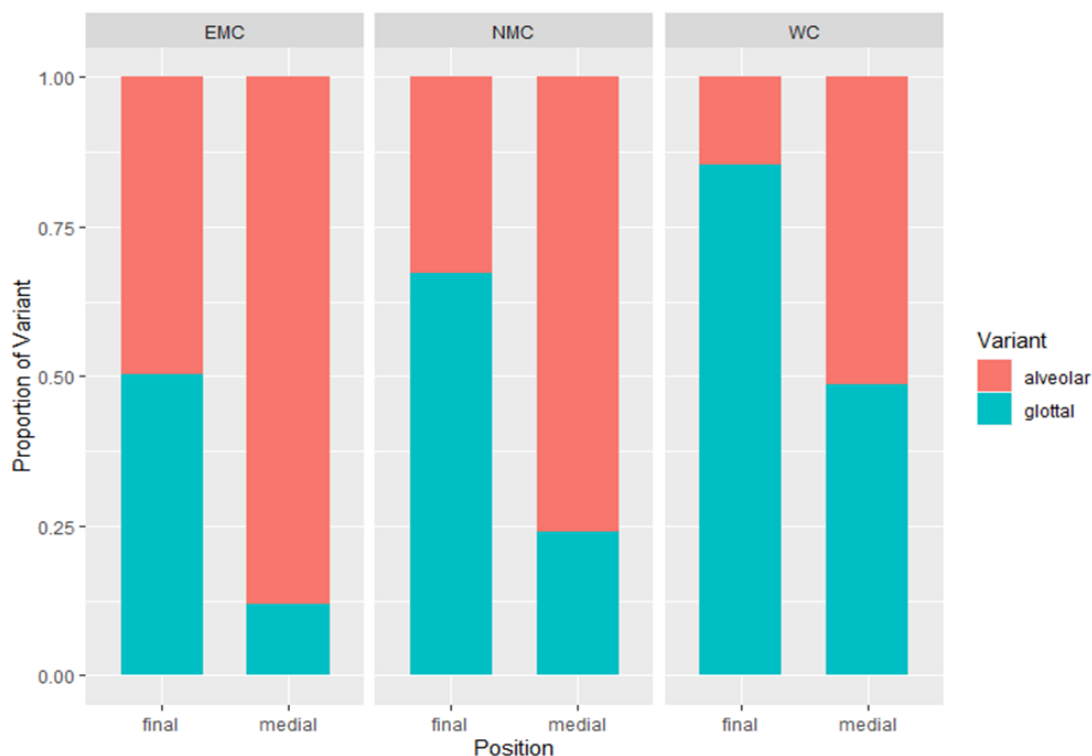
Figure 4: Distribution of /t/-glottaling by social class and word position.

Figure 4 shows that, across all social classes, glottal /t/ occurs more frequently in word-final positions. Additionally, we can see that WC speakers use the glottal variant more frequently word-medially and finally, compared to NMC and EMC speakers. WC speakers use the glottal variant around 85% word-finally, and almost 50% word-medially. In comparison, EMC speakers use the glottal variant around 50% word-finally, and less than 15% word-medially. This is not surprising when we consider previous research, which has shown /t/-glottaling to be the most prevalent in all positions among the working classes, particularly in Glasgow (Macaulay 1977, Stuart-Smith 1999).

The other internal constraint of /t/-glottaling examined is the following phonological context. Previous studies have concluded that the glottal variant is favoured in pre-consonantal environments (Stuart-Smith 1999, Fabricius 2002, Schleef 2013).

Table 6: Distribution of /t/-glottaling and following phoneme

Following phoneme	N	%
Consonant	359	71
Pause	87	52
Vowel	334	38

Table 6 demonstrates that PreC environments favour the glottal variant, with 71% of PreC contexts being glottal, compared to 38% in PreV contexts. This is in line with a previous study by Fabricius (2002), who also found that the glottal is used most frequently pre-consonantally (Fabricius 2002:133). Our results also appear to follow the typical diffusion pattern found by Schleef (2013) and accounted for in Titheridge (2020):

(1) PreC > PreP > PreV

(1) illustrates the typical pattern for predicting /t/-glottaling in many varieties of U.K. English (Schleef 2013). However, although this pattern is attested for in RP, London, and some varieties of Northern English, a number of different hierarchies have been reported in Scotland (see Stuart-Smith 1999). I examine whether the different social classes have the same diffusion pattern in Figure 5.
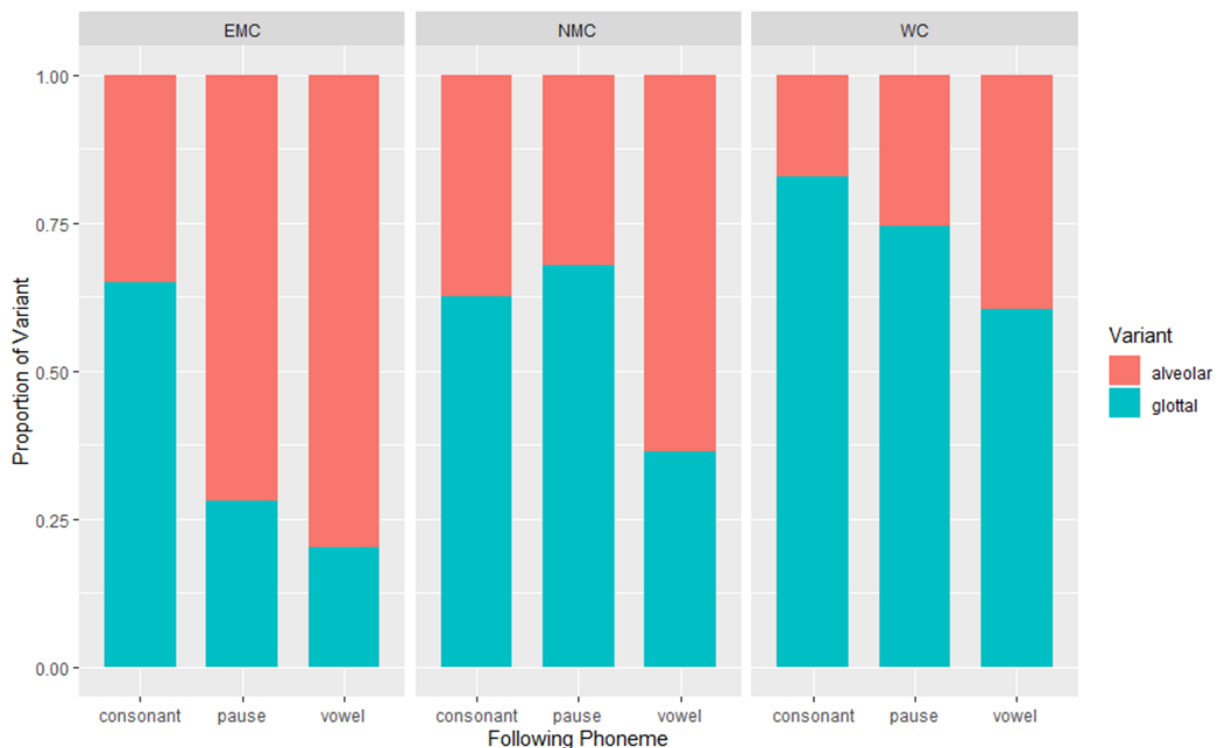
Figure 5: Use of glottal by social class and following phoneme.

Figure 5 illustrates that across all social classes, the PreV environment disfavours the glottal variant the most. EMC and WC speakers follow the typical diffusion pattern seen in (1), **PreC > PreP > PreV**, proposed by Schleef (2013) and Reid (1978) for Edinburgh English speakers. However, while these findings are in line with Schleef (2013) and Reid (1978), Figure 5 demonstrates a different ordering hierarchy from Romaine (1975), who found the following ordering hierarchy for Edinburgh English speakers:

(2) **PreV > PreP > PreC** > (V_V) (Romaine 1975, in Stuart-Smith 1999:192)

Based on Figure 5, I would tentatively suggest that my NMC speakers have a different ordering hierarchy, as they have higher rates of glottal /t/ in PreP contexts. Therefore, I would propose the following ordering:

(3) **PreP > PreC > PreV**

My proposition of the ordering hierarchy seen in (3) has not been accounted for in other studies. The implication of these results, and whether these findings are statistically significant, will be examined in Section 5.

4.4 Fixed-effect Logistic Regression Model

So far, the results have shown that WC speakers use the glottal /t/ more frequently than NMC and EMC speakers. Additionally, the glottal /t/ is more likely to occur word-finally than word-medially for all speakers, and most speakers use the glottal more frequently in PreC contexts. To analyse which constraints are accurate predictors of /t/-glottalling, a mixed-effect logistic regression model was created in RStudio. To test for interactions between the linguistic and social constraints, ANOVA comparisons were conducted, and the final model was created by the lme4 package in RStudio. The best-fit model retained Position, Following Phonological Environment, Social Class (SEC), and the interaction effect between Following Phonological Environment: Position and Following Phonological Environment: SEC.

Table 7: Best-fit mixed-effect logistic regression model of /t/-glottalling by internal and external constraints

Fixed effects	Levels	Estimate	Std.Error	z-Value	p-Value
(Intercept)		0.676	0.480	1.409	0.159
Position	Medial	-2.514	0.417	-6.034	< 0.001 ***
	Final	(reference level)			
FollowingPhon	Consonant	(reference level)			
	Pause	-2.561	0.386	-6.631	< 0.001 ***
	Vowel	-2.246	0.308	-7.292	< 0.001 ***
SEC	EMC	(reference level)			
	NMC	0.487	0.637	0.765	0.444 *
	WC	1.460	0.626	2.331	0.020 *
FollowingPhon:Position	Medial:Vowel	1.0539	0.424	2.484	0.013 *
FollowingPhon:SEC	Vowel:WC	1.448	0.453	3.195	0.001 **
Random effects	**Type**	**Variance**	**Std.Dev.**		
Speaker	Intercept	0.570	0.755		
Word	Intercept	2.480	1.575		
	Min.	**Median**	**Max**		
Scaled residuals	-6.532	0.122	3.377		

Table 7 illustrates which constraints predict /t/-glottalling, and shows that not all of the constraints analysed were statistically significant. As Figures 2 and 3 indicated, the speaker's age was not an accurate predictor for rates of /t/ glottalling, reflecting the results of Titheridge (2020).

Table 7 provides statistical evidence that position, following phoneme, and social class predict /t/-glottaling. Importantly, the data demonstrates two interaction effects: FollowingPhon:Position and FollowingPhon:SEC. The interaction between the following phonological environment and position has been found in other studies (Dickson and Hall-Lew 2017, Titheridge 2020). However, the interaction between the following phoneme and social class is a somewhat surprising interaction, the implications of which will be discussed further in Section 5.

Table 7 provides evidence that the internal constraints have the strongest effect on /t/-glottaling. The following phoneme is arguably the strongest factor for predicting glottal /t/, with PreV positions having a z-value of -7.292. The discovery that linguistic constraints have the greatest effect on /t/-glottaling is supported by previous research (Schleef 2013). Additionally, social class of the speaker predicts /t/-glottaling according to Table 6. WC has a z-value of 2.484, which provides statistical evidence that WC speakers use the glottal /t/ more frequently than EMC and NMC. Importantly, the interaction effect between the following phoneme and social class is not only statistically significant, but it is a stronger predictor for glottal /t/ than only the social class of the speaker (z = 3.195).

5 Discussion

Recent work in sociolinguistics shows that age and social class of the speaker, as well as the linguistic constraints of position of /t/ within a word and the following phoneme, can predict the use of the glottal variant. My results reflect similar findings, the only discrepancy being that this data does not account for a rapid increase of /t/-glottaling across the age groups. Additionally, my results present the possibility that the NMC speakers show a different diffusion pattern from previous studies.

The fact that age was not shown to be a significant predictor for /t/-glottaling in this data is not in line with earlier studies (Stuart-Smith 1999, Fabricius 2002, Schleef 2013, Smith and Holmes-Elliott 2017). Smith and Holmes-Elliott (2017), for example, found a dramatic increase in glottal use in younger speakers, 90% of whom opted for the glottal variant, compared to 38% of older speakers. In this data, however, younger and older speakers use the glottal variant at similar rates, with older speakers even /t/-glottaling at higher rates than younger speakers (Younger = 50%, Older = 61%). Although my operationalisation of age across three groups could have facilitated finding significant generational differences, my results, coupled with Titheridge (2020), indicate that age was simply not a significant predictor for glottal /t/ in the data. Additionally, this data displays considerable individual variation. For example, in the older age group, one speaker showed glottal replacement rates of 77%, while another speaker had a glottal replacement rate of 42%. This suggests that /t/ glottaling has been used in Edinburgh for a number of generations.

There could be multiple reasons for age not being a significant predictor of glottal /t/ in this data, such as that the data was collected in 1975, and the dramatic change in /t/ glottaling across generations is attested for in later studies (Schleef 2013, Smith and Holmes-Elliott 2017). This gives us some insight into when the spread of /t/-glottaling could have begun in Edinburgh. Possibly the change was already nearing completion in 1975 in Edinburgh. Smith and Holmes-Elliott (2017) note that glottal replacement of /t/ dates as far back as the mid-nineteenth century in parts of Scotland (Smith and Holmes-Elliott 2017:324). This presents the possibility that, unlike Buckie, /t/ glottaling is not a recent phenomenon in Edinburgh. Titheridge (2020:36) offers a similar interpretation of the data, noting that glottal /t/ "has a deeper history in Scotland than anywhere else in the British Isles". Thus, we must consider the possibility that, in the 1970s, age of the speaker no longer predicted rates of glottal /t/ in Edinburgh natives.

My finding that /t/-glottaling occurred more frequently word-finally than medially is in line with previous research (Macaulay 1977, Fabricius 2002, Titheridge 2020). I found that WC speakers use the glottal variant more consistently than NMC and EMC speakers in both positions. Additionally, my results suggested that PreC environments favour /t/-glottaling, while PreV environments disfavour it. This result is accounted for in previous research, such as Fabricius (2002) and Schleef (2013). However, as discussed in Section 2, different diffusion patterns have been found in Scotland (Macaulay 1977, Stuart-Smith 1999). This data for WC and EMC speakers reflected the diffusion pattern of previous research:

(1) **PreC > PreP > PreV**

Interestingly, my results illustrate the possibility of our NMC group having a different hierarchy for the following phonological context and /t/-glottaling. Figure 4 shows that the NMC speakers favour the glottal variant in PreP environments, and disfavour it in PreV contexts. I will tentatively put forth the following diffusion pattern for the NMC speakers:

(3) **PreP $\gtrsim$ PreC > PreV**

The ranking seen in (3) is most like that found by Stuart-Smith (1999). Her study found that /t/-glottaling was also favoured in PreP environments, and her results even suggested that the PreP glottal may be obligatory for some speakers (Stuart-Smith 1999). To expand on this idea, Fabricius (2002:133) has suggested that the PreP environments may become the next "widely accepted" context for the glottal variant. My findings that the NMC speakers exhibit speech patterns distinct from WC and EMC speakers supports Dickson and Hall-Lew's (2017:243) assessment that "social class does not pattern in a linear way". It appears that the different diffusion pattern we see in the NMC provides evidence that the NMC is not in between WC and EMC but a separate social group. Additionally, Titheridge (2020) accounts for the diffusion pattern's divergence from the standard by proposing a polygenetic hypothesis of glottal replacement (Titheridge 2020). This paper also supports this idea, and cautiously suggests that the variation of ordering hierarchies in Scottish English could be due to the SSE and Scots continuum, WC speech typically being more influenced by Scots and EMC more influenced by SSE (Johnston 1983). Thus, the same change of /t/ glottaling could have entered Edinburgh English from two different sources: Scots and SEE. As few Scottish English speakers use exclusively Scots or SEE, these separate influences could explain why there does not appear to be a standard ordering hierarchy in Scotland, and why our NMC speakers appear to have a different diffusion pattern than WC and EMC.

My regression model in Table 6 suggests that internal constraints are the strongest factors for predicting /t/-glottaling. This is consistent with previous studies, which concluded that the most prominent internal constraints of /t/-glottaling are the position of /t/ within the word and the following phonological environment (Fabricius 2002, Schleef 2013, Miller 2019). My results provide statistical evidence that the following phoneme is the strongest predictor for /t/-glottaling (z-value = -7.292).

6 Conclusion

The results, for the most part, reflect previous research that internal constraints are the strongest predictors for /t/-glottaling. Interestingly, while there are clear linguistic constraints of /t/-glottaling, namely the following phoneme and position of /t/ within the word, there are also external factors, such as the social class of the speaker, which predict the use of this variant more specifically. Additionally, my finding that WC speakers use the glottal variant most frequently is in line with earlier studies. This paper found that age is not a significant predictor for the glottal /t/, mirroring Titheridge (2020), which is at odds with previous research (Fabricius 2002, Schleef 2013, Smith and Holmes-Elliot 2017). This result is interpreted in light of the variant's deep history in Scotland. This paper cautiously suggests that /t/ glottaling is not a recent phenomenon in Edinburgh, and that the change might already have been complete in 1975, the date of collection for the data. Interestingly, my findings present the possibility that NMC speakers have a different diffusion pattern than has been found in previous research. This supports the idea that the NMC has a separate social identity from the WC and EMC, and indicates that Scottish varieties of English display a number of ordering hierarchies. This paper additionally supports a polygenetic hypothesis of glottal /t/ in Edinburgh, as Scottish English is influenced by both SSE and Scots (Johnston 1983). Further analysis of the ordering of internal constraints in Scottish English may shed more light on other potential interaction effects between speakers' socioeconomic status and the ordering of linguistic factors for glottal /t/.

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