2017

Co-occurrence of /t/ Variants in Young Vermont Speakers

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Honors Thesis
2016-2017

ABSTRACT: Despite the social perception that Vermont's rural dialect is dying, /t/ glottalization has been found to be a highly robust feature, especially among adolescent and younger speakers (Roberts 2006). Naturally, this leads to questions as to the current status and future projections of the feature. In a study of Vermont speakers (Bellavance and Roberts 2016), aspiration following glottalization ([ʔʰ]) was found in the speech of all fourth graders. It is with these observations that this study sought answers to fine-tuned questions regarding Vermont glottalization. The informal interviews of 30 speakers were analyzed. The speakers comprised five females and five males of three age groups: kindergarten, fourth grade, and high school. 11,954 tokens were perceptually coded for seven variants of /t/: glottal stop replacement, glottal reinforcement, flap, deletion, aspirated /t/, creak, and aspiration following replacement.

A quantitative analysis of the data for replacement variants, using Rbrul (Johnson 2009), revealed the following: significant differences ($p<.05$) were found for word position, preceding segment, following segment, and grammatical status. The social factors, age and gender, were not significant. Results from the model show the fourth grade age group with the highest proportion of [ʔʰ] occurrence. Although this is not surprising given initial observations, the finding goes against the expected age group for language innovation (high school). Results from the study raise questions as to the allophonic status of [ʔʰ] as well as its usage among age groups. Additionally, anecdotal evidence raises questions regarding stance qualities of [ʔʰ] in high school speakers.

INTRODUCTION

In a poster presented at the American Dialect Society annual conference (Bellavance and Roberts 2016) concerning glottalization (closure of the glottis during the articulation of a sound) patterns in Vermont families, the researchers found high amounts of aspiration following glottal stop production among all three fourth grade speakers. This finding was especially peculiar, given that it does not follow general lenition accounts (c.f. Wells 1990). Specifically, aspiration (an effortful speech production) does not, according to the literature on and knowledge of glottalization, follow glottal stop replacement (a less effortful production of /t/). It is thus interesting and contradictory to find an effortful feature that contains no (known) additional information following a "lenited" feature. Additionally, Bellavance and Roberts found proportions of glottal stop production among fourth grade speakers to be higher than high school speakers. This finding is contradictory to those found by Roberts (2006). Although differing

amounts of data may explain this discrepancy, it is nonetheless worthy of further investigation.

This thesis seeks to find more definitive answers regarding the current status and projected future of the Vermont dialect. It is unlikely that this aspiration is constrained to the three fourth grade speakers analyzed during the previous study, and is instead likely to be present in many more speakers, at least of that age group. Because this aspiration is contrary to a general lenition account and has not been previously documented in any studies regarding glottal stop replacement, this thesis will serve as the first in the field to question with what patterns, if any, the feature aligns. It is along this line of investigation that this thesis will also explore the co-occurrence of seven variants of /t/ (ways of producing /t/) with particular emphasis on glottal stop replacement with aspiration and creak (laryngealization). By determining the environments in which these /t/ variants occur, this study will help to further our understanding of the Vermont dialect specifically, and glottalization broadly. Thus, the research questions for the current study are as follows: Do all fourth grade speakers aspirate following glottal stop replacement? If so, what are the constraining environments? Do kindergarten and high school speakers aspirate /ʔ/? If so, what are the constraining environments? Finally, how do glottal stop with aspiration, glottal stop without aspiration, and creak co-occur in these speakers?

In addition to expanding upon evidence against reports of dialect leveling in Vermont, this thesis will provide further insight regarding the area's most robust feature (i.e. glottalization). The two major ways in which this will be

accomplished are the examination of glottal stop aspiration and the determination of the co-occurrence of seven /t/ variants (outlined in the methodology). Aspiration following glottal stop replacement has not previously been documented in sociolinguistic literature and is contrary to phonological lenition rules (c.f. Wells 1990). Thus, this study gives serious investigation to a feature that could be present in Vermont speech, child speech, American dialects, or any combination of these. Additionally, investigation of the co-occurrence of the specified /t/ variants will further our understanding of how this stigmatized feature behaves. The thesis foundationally lies in dialectology, but can be associated with a multitude of subfields (e.g., phonetics, phonology, child speech). It is therefore highly relevant and could provide significant insights into how Vermont speech is developing and how glottalization patterns across the nation could be functioning.

BACKGROUND

Increased immigration and emigration within the past few decades, as well as increased tourism and economically dependent relations, have helped to shape a shift in the Vermont dialect (Roberts 2006). Additionally, overt stigmatization and stereotyping often reduce original dialectal features (Hazen 2008). Both of these factors foster the social perception, as well as the empirical reality, that Vermont is "losing" its traditional rural dialect. However, glottalization in Vermont has rapidly become a socially salient and robust feature of the Vermont dialect, especially in younger generations. In her 2006 study, Roberts analyzed the glottalization patterns of 47 participants with ages ranging from 3 to 80 years old. The five variants (ways

of producing /t/) coded for the phoneme /t/ were glottal replacement, glottal reinforcement, flap, aspirated /t/, and deletion. Roberts (2006) found that while glottal reinforcement in word-final or word-medial positions following vowels and liquids is a prevalent feature of American English, glottal stop replacement in such environments seems to be a distinct dialectal feature. It is not only important to note her finding that glottalization is, in fact, a robust feature of the Vermont dialect, but it is also intriguing to see that this glottalization differed in nature between age groups.

Leveling, the decrease of local features to match those of the surrounding regions, is a key indicator of dialectal change in a community that is moving from greater to lesser isolation (Kerswill 2000). This disappearance, or change, of certain linguistic characteristics has recently been found in the Vermont dialect (Roberts 2006). The study of language change in Vermont relied on the speech of generations of speakers, a traditional method in dialect variation research (Weinreich, Labov & Herzog 1968). Analyzing the speech of children of varying ages can also be useful, as each age can provide data for a specific stage in the dialect shift as well as a stage of individual language acquisition (Kerswill 2000). This is largely due to the sharp increase in socialization outside the family that children engage in upon entering school. Although leveling has been present in the Vermont dialect over the past few decades, this increase in glottalization, especially in children, indicates a shift in the opposite direction: increase in a non-standard feature (Roberts 2006). In order to understand dialect shift more fully, it is

necessary that micro-level studies be conducted to expand the findings of larger group studies, such as Roberts (2006) and Kerswill (2000).

Phonological and morphological studies regarding /t/ lenition (weakening of the /t/ phoneme, usually to a glottal stop) have provided an array of results. Clearly, /t/ lenition does not occur when it occupies the onset of the tonic syllable (e.g., *ten*, *retain*) (Harris & Kaye 1990). Additionally, the second /t/ in a word can only be lenited if the first is also lenited (Harris & Kaye 1990). Glottalization in American English is generally favored word-finally rather than word-internally, and utterance-finally (Redi & Shattuck-Hufnagel 2001), especially before front vowels and stressed syllables (Eddington & Taylor 2009, Eddington & Channer 2010, Pierrehumbert & Talkin 1992). Glottalization in English has been found to occur before sonorant consonants, and not fricatives or stops (Pierrehumbert & Frisch 1997). Results from logistic regression of the speech of fifteen Vermont speakers (Bellavance and Roberts 2016) showed similar conclusions for word position and preceding segment. Specifically, word-final glottal stop replacement was significantly more likely than word-initial. Deleted nasal probability was highest, implying a preceding vowel. Preceding syllable stress was not included, but following stress was coded for and not found to be significant. Following pause has been found to be highly favorable for glottalization of /t/ in Vermont, whereas following obstruent is among the least favorable environments (Roberts 2006; Bellavance and Roberts 2016).

Variation of /t/ production other than glottal stop replacement has also been found. /p/, /t/, and /k/ have been found to be accompanied by aspiration

when they are syllable initial, but as having little or none elsewhere (e.g., *plum pie* vs. *plump eye*, *attack* vs. *at ease*) (Wells 1990). However, pre-aspiration in /t/ has been found in Newcastle speakers (Foulkes, Docherty & Watt 1999). Laryngealization of /t/ has also been cited in British English varieties (e.g., Foulkes, Docherty & Watt 1999; Foulkes & Docherty 2005).

METHODS

Professor Julie Roberts recorded the spontaneous speech of children and adults born and raised in northern Vermont during informal interviews for her paper, "As Old Becomes New: Glottalization in Vermont" (2006). The children and young adults were of three distinct age groups: kindergarten, fourth grade, and high school. However, some of the interviews initially recorded for Roberts' study had not yet been analyzed. Roberts generously shared these recordings from her earlier work with me and afforded me the opportunity to conduct a study (Bellavance and Roberts 2016) in which I explored familial glottalization patterns. In the current study, similar procedures were followed to analyze the speech of 23 additional speakers, for a total of 30 speakers: 10 kindergarteners, 10 fourth graders, and 10 high school students.

All tapes were converted to digital files using a Zoom H2 Handy Portable Stereo Recorder. Audacity was then used to listen to the digital files. Tokens with word-medial or word-final /t/ were impressionistically coded (Roberts 2006; Eddington & Channer 2010) as to the variant produced as well as the independent variables. Following segments of /t/, /d/, /θ/, and /ð/ were excluded. In line with Roberts (2006) and Bellavance and Roberts (2016), all instances of ambiguity

between glottal stop and glottal reinforcement were coded as glottal reinforcement, as the latter is the more common variant in American English (see following paragraphs for a detailed explanation of the variable). All data were then tested for significance using Rbrul (Johnson 2009), a menu-based front end interface that facilitates mixed-effects modeling in R (Johnson 2014). Logistic regression followed by a post hoc step-up/step-down comparison was applied to the data, given that multivariate analysis of spontaneous speech is the most relevant method (Roberts 2006; Cedergren and Sankoff 1974; Sankoff and Labov 1979). Following this, crosstabulations were generated through Rbrul (Johnson 2009) to give proportions for the variants according to various combinations of the independent variables. For a visual investigation as well as a reliability check, at least five randomly selected tokens of each variant were analyzed using spectrograms in Praat (Boersma and Weenink 2014).

The dependent variable (/t/) was coded for seven possible variants: glottal stop replacement without aspiration, glottal stop replacement with aspiration, glottal reinforcement, flap, aspirated (realized) /t/, deletion, and creak for each sound position (Roberts 2006). To clarify, creak is considered to be perceived laryngealization during a deletion, and therefore containing a following segment. Instances of laryngealization with a following pause was coded as a glottal stop replacement or glottal reinforcement. Aspiration following glottal stop replacement was, at times, difficult to code. Ingressive aspiration was not included. The egressive aspiration that was included was oral and relatively short in duration. That is, obvious sighing and nasal egressive sounds were not coded.

The study included four independent linguistic variables. These are: position (medial or final), preceding segment (consonant, vowel, /l/, /ɹ/, nasal, or deleted nasal), following segment (front consonant, middle consonant, back consonant, front vowel, central vowel, back vowel, liquid, /n/, /m/, /ŋ/, glide, or pause), and grammatical status (monomorpheme, regular past tense verb, semi-weak past tense verb, irregular past tense verb, one syllable negative contraction, or two syllable negative contraction). The study included two independent social variables: age (kindergarten, fourth grade, or high school) and gender (male or female).

RESULTS AND DISCUSSION

PROBABILITIES (MODEL): For the sake of simplicity, the dependent variable used for the model (glottal stop replacement, creak, and glottal stop replacement with following aspiration) will be referred to as "replacement." Table 1 outlines the combined variants, with proportions and the total number of tokens for each. Table 2 is a summary of the model, where light gray shading indicates non-significance and dark gray shading indicates interactions. Word position, preceding segment, following segment, and grammatical status were found to be significant. Proportions are given for age and gender.

Table 1 Dependent Variants Combined for Model

Dependent Variant	*Proportion of Tokens*	*N*
Glottal stop replacement	0.109	1306
Creak	0.025	301
Glottal stop replacement with aspiration	0.020	240

Table 2 Logistic Regression Analysis of /t/ Replacement

Input probability		0.004		
Total N		11954		
Overall Probability		0.155		
Degrees of Freedom		18		
Log Likelihood		-4090.307		
		Factor Weight	*Proportion of Application Value*	*N*
Position	*p< 6.16e-68*			
	Final	0.712	0.185	9501
	Medial	0.288	0.035	2453
Preceding Segment	*p< 3.17e-219*			
	Deleted Nasal	0.973	0.265	1023
	Oral Sonorant	0.854	0.197	7941
	Nasal	0.221	0.005	1281
	Obstruent	0.016	0.001	1709
Following Segment	*p< 1.93e-39*			
	Back & Front Vowel	0.696	0.172	2979
	Pause	0.679	0.236	1661
	Liquid & Glide	0.626	0.150	2551
	Back Obstruent	0.579	0.160	999
	Front & Mid Obstruent	0.518	0.134	1573
	Central Vowel	0.509	0.116	933
	/m/	0.452	0.113	397
	/n/	0.298	0.052	707
	/ŋ/	0.187	0.006	154
Grammatical Status	*p< 4.63e-30*			
	Monomorpheme	0.749	0.167	9789
	Irregular Past Tense Verb	0.694	0.242	240
	Semi-Weak Past Tense Verb	0.620	0.110	346
	Negative Contraction	0.329	0.103	1159
	Regular Past Tense Verb	0.156	0.002	420
Speaker (random)		n/a	n/a	n/a
Age				
	Fourth Grade	n/a	0.181	5666
	Kindergarten	n/a	0.142	591
	High School	n/a	0.130	5697
Gender				
	Female	n/a	0.171	6496
	Male	n/a	0.135	5458

Word position results for glottal stop replacement in Vermont has been mixed (Roberts 2006, Bellavance and Roberts 2016). Roberts' (2006) model of

glottal stop replacement did not find position to be significant; however, frequencies between word-medial and word-final were found to be fairly close. Conversely, Bellavance and Roberts (2016) found position to be both significant and have large differences in the probabilities, with word-final as the more favorable position. In the current study, the high favorability of the word-final position was expected, given initial impressions of the pre-pausal nature of [ʔʰ] and the larger number of tokens for the final position.

While deleted nasal was coded separately from oral sonorant, it is important to note that a deleted nasal almost always implies a preceding (nasalized) vowel.[1] While we would not expect /t/ to undergo replacement with a preceding nasal, the ordering of the phonological rules allows for replacement to occur. Nasalization of the vowel, followed by deletion of /n/, and, finally, glottal

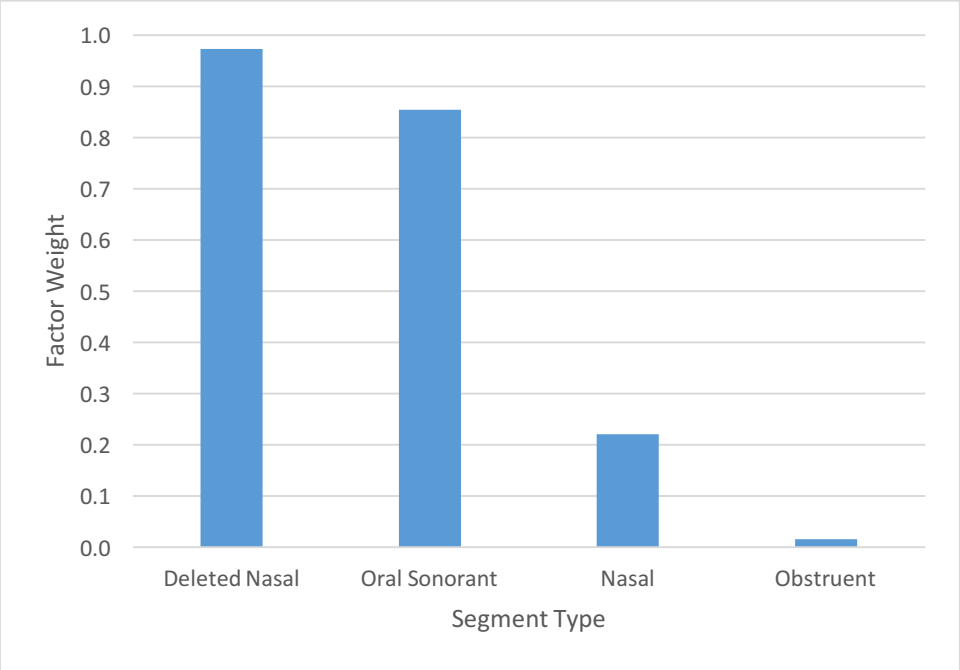

Figure 1 Effect of Preceding Segment on Replacement

[1] However, combining preceding oral sonorant and preceding deleted nasal resulted in a worse fit.

replacement of /t/, produces the preceding deleted nasal in the surface realization. Thus, words with a deleted preceding nasal will condition similarly to those with a preceding oral sonorant. Preceding oral segment as a favorable environment for replacement has been shown to be true in Vermont speech (Roberts 2006, Bellavance and Roberts 2016). This seems appropriate, as glottal reinforcement would be the natural choice for glottalization with preceding articulatory contact.

The most favorable following segment, combined back and front vowel, aligned neither with Roberts (2016) nor Roberts (2006), whose models predict following vowel to be fairly unfavorable. However, the unexpected results from the current model may be explained by the interaction between following back and front vowel and following pause. With the results of preceding segment, following segment, and word position combined, we can begin to postulate a fuller picture of favorable environments. We can consider a preceding deleted nasal and a preceding oral sonorant to both be realized as an oral sonorant. Adding this highly favorable preceding segment to the most favorable following segment, combined back and front vowel, leaves us with the most favorable environment for replacement as intervocalic and cross-word boundary. This supports Roberts' (2006) conclusion that the intervocalic, cross-boundary environment does, in fact, allow for both glottalization and flap allophones in at least one variety of American English. The higher favorability of glides and liquids compared to those of obstruents and central vowels is surprising, but the statistical interactions noted for pause and back obstruent may be contributing to

this result. Further, the number of tokens for following liquid and glide is greater than both obstruents and central vowel.

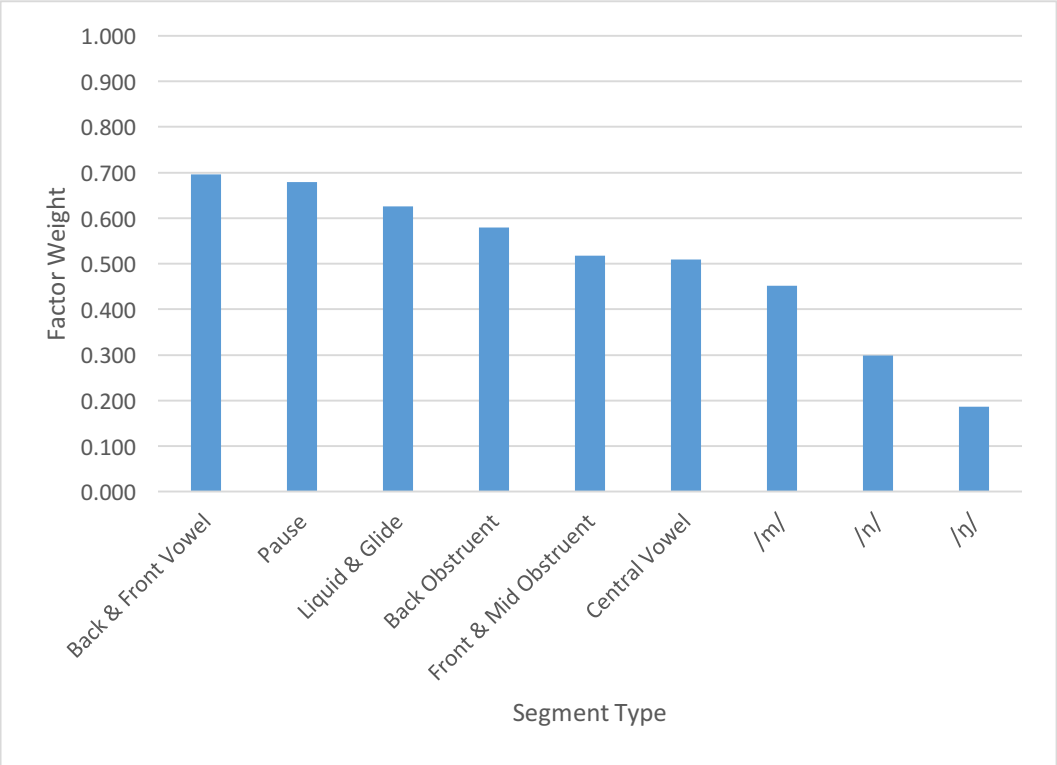

Figure 2 Effect of Following Segment on Replacement

Monomorphemes presented the highest favorability within the grammatical status variable. Negative contraction produced a relatively low favorability, which is not surprising given the preceding nasal (which, of course, would align well with glottal reinforcement). The interaction between the irregular past tense verb and the monomorpheme is most likely due to the small number of tokens of the former.

The principal catalyst for the study was to investigate aspiration following glottal stop replacement ([ʔʰ]) in the speech of several fourth graders. However, age was not significant. This contrasts with Roberts (2006), in which age was significant, with high school speakers having the highest probability of occurrence.

Gender was not significant, similar to Roberts (2016) and Eddington & Channer (2010). However, gender has been significant in other glottalization studies (cf. Eddington & Taylor 2009; Mees 1987; Milroy et al. 1994; Roberts 2006).

PROPORTIONS (CROSSTABULATIONS): Crosstabulations revealed [ʔʰ] to be overwhelmingly prepausal (as we would expect), however, there were several tokens that were not utterance-final (see Table 3). A few of these tokens were especially unusual, given that they were followed by a sibilant. In Figure 5, we can observe a small release of the glottal stop before the /s/ of [stʌdis]. A clearer depiction of [ʔʰ] can be seen in Figure 4, where the release has a longer duration. Overall, however, the variant is phonetically acting as expected.

Preceding vowel and /ɹ/ were similar proportionally for this variant. The proportions of the preceding segment variants for [ʔʰ] align well with the model, except for preceding deleted nasal. [ʔʰ] occurred almost exclusively in monomorpheme words, with the exception of two-syllable negative contraction words.

As was suspected from previous anecdotal findings, speakers in the fourth grade and kindergarten age groups produced the highest proportions of [ʔʰ]. In isolation, this finding could lend evidence to the variant as being based in 1) age grading due to language acquisition or 2) dialectal innovation, either separately or simultaneously. However, the first explanation is most likely false due to the increase in the usage of the variant between kindergarten and fourth grade. Thus, the second explanation is the more probable hypothesis and we can conclude that

there may be a change in progress being led by speakers younger than we would expect.

The difference between creak and glottal stop replacement may be based on perception alone (e.g., Schleef 2013). As is depicted in Figure 3, the distinction between creak and replacement is by no means clear. Ladefoged and Maddieson (1996) argue that true glottal occlusion (what we perceive as replacement) only

Table 3 Proportions of Aspiration Following Glottal Stop Replacement ([ʔʰ])

	Independent Variable	*Proportion*
Position		
	Final	0.025
	Medial	0.001
Preceding Segment		
	Vowel	0.030
	/ɹ/	0.029
	Deleted Nasal	0.007
	Obstruent	0.000
	/l/	0.000
	Nasal	0.000
Following Segment		
	Pause	0.138
	Mid Obstruent	0.005
	Central Vowel	0.002
	Front Vowel	0.001
	Front Obstruent	0.001
	Back Obstruent	0.001
	Liquid	0.001
	Back Vowel	0.000
	Glide	0.000
	/m/	0.000
	/n/	0.000
	/ŋ/	0.000
Grammatical Status		
	Monomorpheme	0.024
	Two-Syllable Negative Contraction	0.004
	One-Syllable Negative Contraction	0.000
	Irregular Past Tense Verb	0.000
	Semi-Weak Past Tense Verb	0.000
	Regular Past Tense Verb	0.000
Age		
	Fourth Grade	0.032
	Kindergarten	0.030
	High School	0.008
Gender		
	Female	0.021
	Male	0.019

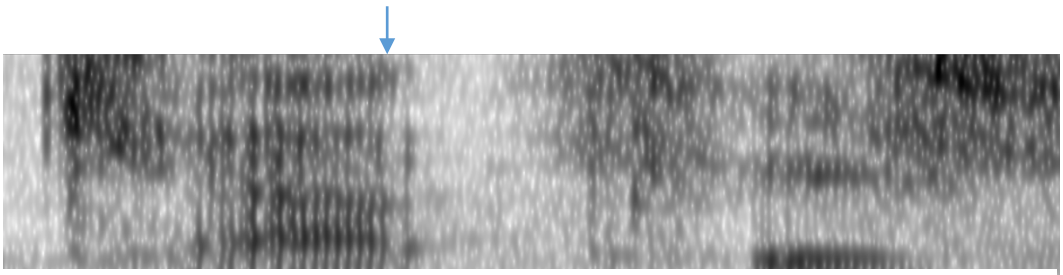

Figure 3 Spectrogram of "catfish" [kæfɪʃ]. Arrow indicates laryngealization of /t/ following laryngealized /æ/.

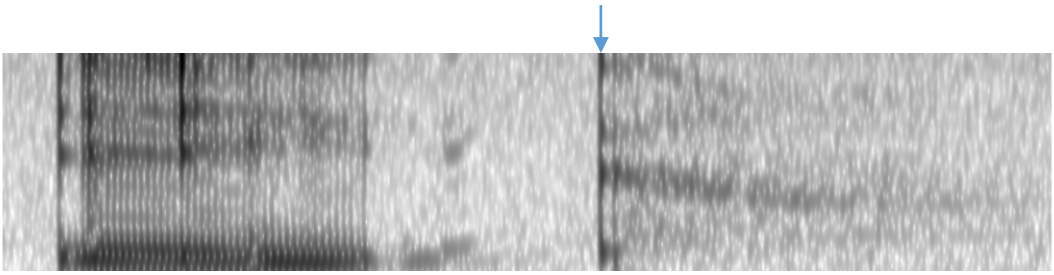

Figure 4 Spectrogram of "eight" [eʔʰ]. Arrow indicates glottal closure (followed by aspiration).

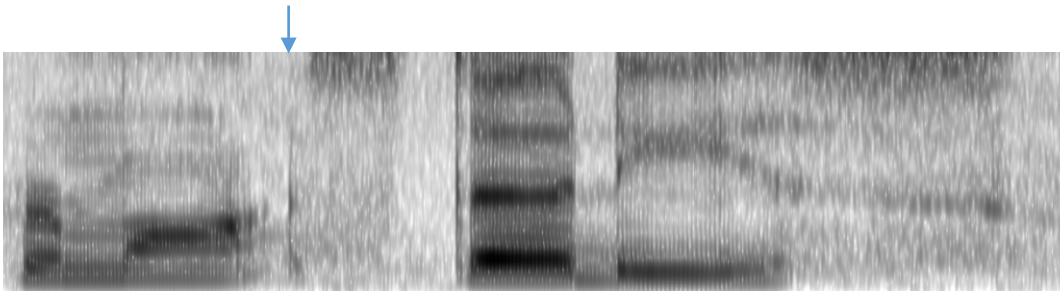

Figure 5 Spectrogram of "Vermont studies" [vɚmɔ̃ʔʰ stʌɹis]. Arrow indicates glottal closure (followed by brief aspiration).

occurs in gemination, and the glottal replacement we perceive is closer to laryngealization (Foulkes & Docherty 2005). The multiple striations in Figure 4 (coded as [ʔʰ]) may lend evidence to this argument. However, tokens in this study that were coded as glottal stop replacement or aspiration following replacement often had no creak in the surrounding environment (an example to the contrary can be seen in Figure 3). Further, the perceived variant of the hearer, especially with a highly stigmatized variant such as creak, could be valuable in arguing for a distinction to be kept between the two. Thus, we are led to the question: how do creak as an allophone and creak as aspect intersect? Further study as to the social perception of closure across the laryngeal continuum could prove insightful.

Anecdotal evidence of high school speakers' usage of [ʔʰ] revealed that the variant, when present, often occurred during topics of conversation that were emotionally charged. Two of which included stances on vegetarianism and gay rights, and another was during a discussion of the speaker's experience with foster homes. However, no such sociolinguistic information was apparent for fourth grade and kindergarten speakers.

SUMMARY

As was suspected at the outset of the study, more than three fourth grade speakers utilized aspiration following glottal stop replacement. However, the social factors coded for replacement (age and gender) were not significant.

This variant appears to follow similar phonological patterns to replacement, although is more restricted in regard to word position. Crosstabulations revealed that the variant proportionally occurred more often word-finally. Additionally, replacement overall has a higher probability of occurrence word-finally. Deleted nasal was found to be the most favorable preceding segment for replacement, which may indicate corpus effects for tokens ending in [nt]. Following pause was found to be a highly favorable environment for the following segment, which aligns well with the favorability of the word-final position. The interaction between following back and front vowel and following pause may be explained by the fact that both medial and final word positions were included in the model. Although the following segment has been an area of interest in glottalization studies, a following vowel would most likely indicate flap, rather than glottalization. It may be useful to consider that exemplar

theory could account for the high probability of a following vowel. That is, glottalized /t/s occur in words that are normally followed by non-sonorant segments, and thus retain their replacement even when followed by segments that would normally condition for flap (Eddington & Channer 2010). Monomorphemes were found to favor replacement more than other grammatical status variants.

Anecdotal evidence for the sociolinguistic usage of the variant in the high school speakers may indicate a shift in the type of usage of the variant between age groups. This may be due to acquisition, or change in, stance in speech. Further research as to the sociolinguistic qualities of the variant should be pursued.

ACKNOWLEDGEMENTS

I would first and foremost like to thank my thesis advisor, Professor Julie Roberts. The opportunity to conduct research under her on Vermont vowels during my sophomore year was an invaluable gift. I am ever grateful for her patience while walking through my confusion and unlikely hypotheses during our meetings. The time, effort, and knowledge she has given me, and the welcoming manner in which she gave them, are in no way unnoticed. Without Julie, this thesis would not have been possible. I would also like to thank Professor Maeve Eberhardt for her consistent affirmation and kindness, and her willingness to help in any way. Thank you to Professor Toni Cook for her clear instruction on phonology and her constant availability to teach. Thank you also to Professor Alec Ewald for agreeing to chair my defense and taking the time to do so. Thanks are due to Alan

Howard for his patience with my attempts to understand software statistics. I would also like to thank my friends and family for their undying support and love. I am grateful to the UVM Office of Undergraduate Research and the UVM Humanities Center for affording me the opportunity to begin this work with a Summer Research Award. Finally, thank you to the UVM Linguistics Department and the UVM Honors College for the opportunity to conduct an Honors Thesis.

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