VOWEL INSERTION IN SCOTTISH ENGLISH LIQUID+NASAL CLUSTERS: BOUNDARY DISPUTES AND DURATIONAL RELATIONS

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ABSTRACT

Published accounts of Scottish English vowel insertion in liquid+liquid and liquid+nasal coda clusters are limited to linguistic surveys. This paper aims to supplement the existent literature by describing the acoustic properties of the vowel and the conditioning environment for this process. The boundary dispute regarding whether the inserted vowel should be classified as phonetic or phonological has been assessed for Dutch schwa insertion in liquid+consonant clusters, but not yet for Scottish English vowel insertion. Duration, along with rate and distribution of application, were used to determine the status of the inserted vowel. Results indicate that the vowel aligns more closely with phonological epenthesis, varying in duration with respect to the duration of preceding vocalic and liquid segments and interacting with syllable structure and morphology.

Keywords: phonetics; vowel epenthesis; Scottish English; segment duration; morphophonology.

1. INTRODUCTION

In Scottish English, liquid+liquid and liquid+nasal coda clusters in monosyllabic, monomorphemic words are subject to vowel insertion. The term *Scottish English* is used to delineate a “bipolar linguistic continuum” [28] with Scottish Standard English on one end of the continuum and Broad Scots on the other [1, 8, 27]. In 1921, Grant & Dixon [13] noted that native speakers of Scottish English often perceive a vowel after coda /r/ before /l/ and /m/. Scobbie et al. [21], in an overview of the acquisition of Scottish English phonology, posits that the insertion of a vowel in monomorphemic words (i.e., *world, farm, film*) is a phonotactic requirement in “broader speech” and may be lexicalized in Scottish Standard English (p. 10). The most attention that this phenomenon has received within recency has come from Maguire [17], who utilized the unpublished version of the Linguistic Atlas of Scotland to better understand the distribution of epenthesis across various geographical regions. Maguire [17] determined that epenthesis in Scots is unlikely to be a diachronic process caused by language contact with Scottish Gaelic, and that a full synchronic analysis of the phenomenon need come from new sources. This is because data reported in both the unpublished and published versions of the Linguistic Atlas of Scotland, for instance, include very few tokens of these coda clusters, situated only within monosyllabic environments, that may altogether be confounded by “on the spot” transcriptions from over a dozen field linguists (p. 161).

The current language production study utilized patterns of distribution across varying morphophonological environments and durational information in the acoustics to determine whether vowel insertion in Scottish English is—as is described in survey literature reporting fieldworker perceptions—phonological epenthesis.

2. PHONETIC OR PHONOLOGICAL PROCESS

Whether or not a late inserted vowel is considered phonetic or phonological—an example of a *boundary dispute* [18]—has been assessed for Dutch schwa epenthesis in liquid+consonant clusters [22], but not yet for Scottish English vowel insertion. Vowels that are not considered epenthetic are regarded as phonetic, insofar as they surface due to articulatory constraints (i.e., as a result of the low amount of gestural overlap of adjacent segments [3]). Many languages have reported cases of phonetic vowel *excrescence* (e.g., Dutch [5], English [31], Gaelic [6]; for a review, see [14], p. 390). Vowel epenthesis, however, is the deliberate insertion of a vowel as a phonological repair strategy.

2.1. Motivations for phonological vowel epenthesis

Phonological vowel epenthesis may be triggered by a need to satisfy universal or language-specific sonority and syllable structure constraints. The Sonority Sequencing Principle (‘SSP’) asserts that the syllable nucleus has the maximum sonority value, with segments in onset position rising in sonority toward the nucleus and coda segments descending in sonority away from the nucleus [23]. Nasals are less sonorous than liquids, and therefore do not violate the SSP or the Sonority Dispersion Principle [7], which specifies that sonority in final demisyllables be *minimally* dispersed. Since liquids and nasals minimally differ in their sonority and liquid+liquid coda clusters form a sonority plateau, with *no* sonority dispersion, insertion is not easily predicted in these clusters by universal sonority restrictions.

Certain monomorphemic suffixes may trigger resyllabification, so that monosyllabic, monomorphemic words become bisyllabic, bimorphemic words. This occurs in cases where a nucleus is provided by a suffix that is either a vowel-initial or syllabic consonant. The second consonant of the coda cluster may then resyllabify from coda of the first syllable to onset of the second syllable. Suffixes that do not contain a viable syllable nuclei are expected to undergo vowel insertion if insertion is used to repair dispreferred coda clusters (e.g., *filmed* [fɪ.lV̲md]), but suffixes that do should block vowel insertion, as they trigger a resyllabification that breaks up the cluster with a syllable boundary (e.g., *filming* [fɪl.mɪŋ]).

2.2. Duration of epenthesized words

Since vowel epenthesis *adds* a vocalic segment to a sequence, an assumption might be that the duration of the word or syllable would be longer than that of unepenthesized variants. Acoustic studies have revealed that the duration of the coda cluster plus the preceding vowel is the same for epenthesized and unepenthesized variants [12], and that overall, word lengths for epenthesized variants are similar to unepenthesized variants [15], sometimes even shortening [10]. In Irish English, items that contain an epenthetic vowel undergo shortening of the preceding stressed vowel and first consonant of the coda cluster ('C1') [15]. Although Irish English does not have contrastive consonant length, Hickey [15] notes that it is possible to phonetically shorten a sonorant. For example, an alveolar [ɹ] can be shortened by becoming a derhoticized variant like a tapped [ɾ], while [l] and [n] can be shortened by producing a tap-like variety.

2.3. Speech rate extension

Speech rate has been used to distinguish whether a process of pre-nasal vowel nasalization in American English arises from physiological, mechanistic constraints or from phonological conditioning [25]. This process of nasalization in American English was compared with coarticulatory vowel nasalization in Spanish. The prediction was that phonetic phenomena should not adjust to speech rate as "they do not participate in the higher level reorganization of timing and durational factors and originate at a lower level" [26] (p. 306). Comparing the nasalized portion of the vowel across speech rates, Solé [25] hypothesized that the duration of vowel nasalization (contrasted with the duration of the oral portion) should vary with speech rate if nasalization was a deliberate phonological process. If the duration of nasalization was similar across different speech rates, then it could be classified as a phonetic, mechanical effect. This is based off of the assumption that the timing of velum lowering would occur relatively to the nasal consonant, regardless of speech rate. It was found that, in American English, velum lowering occurred with respect to the onset of the voicing of the vowel and not the onset of the following nasal consonant. Solé [25] concluded that the vowel is not nasalized as a result of anticipatory coarticulation, but is specified with the feature [+nasal], possibly motivated by the listener-oriented goal of ensuring stable perceptual distance across varying speech rates.

This line of reasoning may extend to vowel insertion. If the inserted vowel is an articulatory by-product of low degree of overlap between the gestural phases of the surrounding consonants, its duration should not vary with duration of the surrounding segments, but remain uniformly short. If the inserted vowel is epenthetic, however, we might expect a similar pattern to that of the American English pre-nasal vowel specified with the feature [+nasal]. The proportion of nasality varied with speech rate adjustments [25] and the duration of the epenthetic vowel should correlate with the duration of underlying segments within the word if it is deliberately inserted to break up a dispreferred consonant cluster or ensure that clusters with minimal sonority dispersion are made more perceptible.

3. METHODOLOGY

3.1. Participants

27 participants (M=10, F=17, Mean age=57, Range=21-93, SD=18.53) were recruited at The University of Edinburgh to participate in the current study. Participants were native Scottish English speakers born in the Central Belt region of Scotland, who had lived there for the past 10 years. Participants had normal hearing, normal-to-corrected vision, and were older than 18 years of age.

3.2. Stimuli

Stimuli included single words without carrier phrases to avoid coarticulation across connected speech. Experimental stimuli were words which contained the /lm/, /rm/, /ln/, /rn/, and /rl/ consonant clusters. Control items were words containing attested coda clusters that have not been reported to undergo vowel insertion in Scottish English, along with words containing onset consonant clusters. Each token was repeated twice in the experiment, and all tokens were randomized within two blocks.

In the first block of the experiment, 25 five-word sets (e.g., *farm, farms, farmed, farmer, farming)* were constructed, with a filler-to-experimental ratio of 1:1. Experimental items included: (i) monosyllabic, monomorphemic words, (ii) monosyllabic, bimorphemic words with consonant-initial suffixes (i.e., past tense [d] and plural [s]), and (iii) bisyllabic, bimorphemic words with vowel-initial suffixes (i.e., agentive [əɹ], comparative [əɹ], and [ɪŋ]).

In the second block of the experiment, participants read aloud from a list of 68 words with a filler-to-experimental ratio of 2:1. Words were Scottish place names, given names, and Scots slang. Clusters were situated within: (i) word-final position in monosyllabic (e.g., *culm*, 'soot') and bisyllabic items (e.g., *Dachalm,* place name) as coda clusters, and (ii) word-medial position in polysyllabic items (e.g., *Kilmer; contermashious,* 'contrary') as adjacent segments that do not form a coda cluster.

3.3. Recording apparatus

The hardware used in this experiment included a 2008 Macbook Pro laptop and a Samson Go Mic Portable USB Condenser Microphone using the Cardoid 10db setting. Recordings were made using *Audacity* v2.1.2 [29] at a sampling rate of 44100 Hz via one recording channel.

3.4. Procedure

Participants were seated in a soundproof booth with the experimenter in the adjacent room. Participants were instructed to read aloud from a word list presented on the computer monitor while being recorded with a desktop microphone. Words were presented visually one at a time via *PsychoPy* v1.84.2 [19]. Each word was displayed at the center of the screen for 1500 milliseconds ('msec') and then replaced by a fixation cross for an inter-stimulus interval of 250 msec. Text was displayed in a white font against a gray background. The two blocks of the experiment were counterbalanced and the presentation of stimuli was randomized across participants. In between blocks, participants were provided an automated break of 120 seconds and encouraged to drink water and rest. Sessions lasted about 50 minutes in total.

3.5. Acoustic measurements

Segment duration was marked for pronunciations with and without vowel insertion and those with an underlying vowel between the cluster (e.g., *forum*). Measurements were made by segmenting the .wav files for each speaker in *Praat* [4]. Files were resampled to 8000 Hz, forced aligned with the *Penn ForcedAligner* [32] using a custom pronunciation dictionary, and hand-corrected. Maximum formant values were set to 5000 Hz for males and 5500 Hz for females. An annotation tier was created for marking word boundaries and segment boundaries. Another tier was created to mark the presence or absence of vowel insertion in experimental items. Inserted vowels were detected by visual inspection of the spectrogram and waveform. The following visual cues were used: U-shaped curvature in the waveform, along with dark formants and vertical striations in the spectrogram.

4. RESULTS

Data were analyzed for 12 speakers (M = 6, F = 6, mean age = 58.91, Range = 21-93, SD = 17.99). Nonparametric tests were conducted, as segment duration has a non-normal distribution.

4.1. Rate and distribution of application

The rate of vowel insertion across suffixation type had the following pattern (from most insertion to least): monosyllabic, monomorphemic items (e.g., *farm*) > *-s* [s] > *-ed* [d] > *-er* [əɹ] > *-ing* [ɪŋ]. Monosyllabic words received the highest amount of insertion, while words containing the consonant-initial suffixes *-s* [s], and *-ed* [d] received more insertion than words containing the vowel-initial suffixes *-er* [əɹ] and *-ing* [ɪŋ]. This pattern is consistent across the /rm/, /rn/, /lm/, and /rl/ clusters, while no insertion was recorded for the /ln/ cluster. For example, the /lm/ cluster, which received the least amount of insertion, had the same distributional pattern as did the cluster with the most amount of vowel insertion, /rl/.

4.2. Durations

Mean duration of the vowel (msec) was compared for CVCVC words that contained an underlying vowel (e.g., *for<u>u</u>m*) against those that had an inserted vowel (e.g., *for<u>V</u>m*) between the consonant clusters of interest. The average duration was 95.52 msec for underlying vowels (N=771, SD=40.6, Range=20-281, SE=1.46) and 54.33 msec for inserted vowels (N=1462, SD=17.5, Range=17-160, SE=0.46). An independent Mann Whitney test revealed a significant difference between them (W=959790, p<.001).

4.3. Durational relations

Durations (msec) were collected for the first vowel ('V1') and second vowel ('V2') of each word. Separate Spearman's correlations were computed for the durations of V1 and V2 and for the durations of C1 and V2, both in words with an inserted V2 and an underlying V2. In words with insertion, V1 and V2 had a near-significant positive correlation (ρ=.0474, p=.0707) and C1 and V2 had a significantly positive correlation (ρ=.12, p<.0001). In words with underlying V2s, V1 and V2 had a near-significant positive correlation (ρ=.1914, p=.0757) and C1 and V2 had a significantly positive correlation (ρ=.18, p<.0001).

5. DISCUSSION AND CONCLUSION

Taken together, the acoustic data suggest that vowel insertion in Scottish English is more closely aligned with phonological epenthesis than phonetic excrescence.

Consistent with our expectations, epenthesis occurred most in monosyllabic, monomorphemic items (e.g., *film*), and more in words with consonant-initial suffixation than in words with vowel-initial suffixation. This demonstrates that insertion occurs most when the clusters are, in fact, coda clusters: in (i) monomorphemic, monosyllabic items (e.g., *farm, skoolm*), (ii) in monomorphemic, bisyllabic items where the cluster is word-final (e.g., *Dachalm*), and (iii) in monosyllabic, bimorphemic items (e.g., *farms*). In a small number of items, insertion occurred across syllable boundaries in word-medial polysyllabic slang words (e.g., *contermashious*) and in vowel-initial suffixed words (e.g., *farmer, filming*). This pattern has also been found in Irish English [24]. For speakers who epenthesized *farmer* and *farming*, an implicational hierarchy emerged in which they also epenthesized *farm, farms,* and *farmed*.

The average duration of the inserted V2 was 54.33 msec, whereas the average duration of the underlying V2 in a similar environment was 95.52 msec. Although the duration of the inserted V2 was significantly different from underlying V2s in similar positions, it was crucially half the length of the average underlying vowel duration. Much of the excrescent vowel literature finds that excrescence is much shorter than that. For example, Quilis [20] found that, excrescent duration in Spanish /Cɾ/ clusters, although more variable than is typical for excrescence (range 8-56 msec), has an average of 29 msec. Svarabhakti vowels may be as short as a fourth of the duration of the underlying vowel in a similar environment [2].

That the duration of excrescent vowels is short and often disappears at fast speech rates follows from the assumption that excrescent vowels result from the gestural phasing of two adjacent segments. Since fast speech rates can increase the degree to which the gestures for two adjacent segments overlap [9], and excrescent vowels surface as a result of *low* gestural overlap between adjacent segments, the observation that excrescent vowels disappear at fast speech rates is expected (although some exceptions exist: in Scots Gaelic, [6]; Moroccan Colloquial Arabic, [11]; and Dutch, [30]). By contrast, epenthetic vowels should not disappear at fast speech rates as their function is to repair illict phonological sequences, regardless of the timing of gestural phasing. The current experiment utilized Solé's work on the duration of the nasalized and oral portions of the vowel in [26] as a proxy for determining whether vowel insertion in Scottish English is a deliberate phonological process. The duration of the inserted vowel was approaching a significantly positive correlation (ρ=.0474, p=.0707) with the duration of the preceding V1. Although this correlation was non-significant, epenthesized variants patterned like unepenthesized variants, such that the duration of V1 and V2 in words containing an underlying V2 also only approached significance with a weak positive correlation (ρ=.1914, p=.0757).

Additional support for the treatment of the inserted vowel in Scottish English as epenthetic comes from durational observations recorded for Irish. Hickey [16] notes that words containing an epenthetic V2 have a shorter V1 duration than words containing an underlying V2, and that epenthetic V2s have similar intensity to that of the preceding V1, both of which were noted for the current dataset: (Mann-Whitney: W=4543000, p=4.796e-09) and (paired Wilcoxon: V=1019900, p<2.2e-16), respectively.

The current study used the distribution of insertion across varying morphophonological environments, duration of the inserted vowel, and the relationship between segment durations to determine whether the vowel should be considered phonetic excrescence or phonological epenthesis. We found that vowel insertion in Scottish English more closely aligns with deliberate, phonological epenthesis. Better understanding how acoustic information can resolve boundary disputes like the classification of a process as phonetic or phonological ultimately has potential to contribute to the phonetics-phonology interface.

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