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Word-level distributions and structural factors codetermine GOOSE fronting

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ABSTRACT

We analyse dynamic formant data from a corpus of Derby English spanning three generations, focusing on the relationship between yod-dropping and GOOSE (/uː/)-fronting. Derby English exhibits a stable but variable pattern of yod-dropping in post-coronal position (e.g. *new* [njuː]~[nuː]), and an ongoing process of /uː/-fronting. The degree of /uː/-fronting is highest in words which categorically include yod (e.g. *cube*) and lower in words which never show a yod (e.g. *noodle*). Words with variable yod-dropping exhibit intermediate degrees of fronting. The degree of fronting in variable words is partly determined by how frequent the lexical item is: frequent words undergo more fronting than infrequent words. Although this result can be attributed to increased coarticulation with yod in frequent forms, it also affects tokens where the yod is absent. We suggest that these results provide evidence for phonetic coherence at the level of the word as well as phoneme and allophone categories.

Keywords: GOOSE fronting; sound change; word-specific representations; lexical frequency

1. INTRODUCTION

Fronting of GOOSE has been observed in Englishes world-wide (e.g. in the UK [12], US [1, 10, 16], South Africa [17], Australia [7], and New Zealand [8]). The vowel often transcribed phonemically as /uː/ is rarely of a back phonetic quality for native speakers. The fronting process results in a range of variants from [ʉː] to [yː], with variable degrees of diphthongisation and unrounding also possible [12]. GOOSE fronting is spreading rapidly in many locations. Unusually for a change in progress, variants generally display little or no social-indexical marking [10]. That is, social and stylistic differences appear to play little role in promoting the change. Instead, the fronting of GOOSE is usually attributed to a phonetic process of coarticulation with preceding coronal or palatal consonants [16, 13].

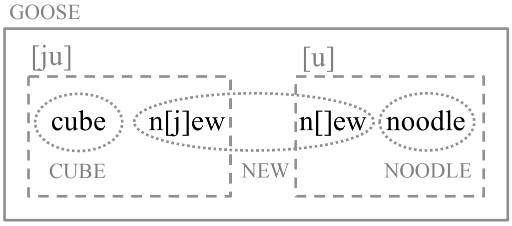
In many dialects (including most British varieties), GOOSE words fall into two classes based on whether the vowel is preceded by a yod (/j/) or not (e.g. *noodle* /nuːdl̩/ vs. *cube* /kjuːb/). The examples of GOOSE in these classes derive historically from different monophthongs and diphthongs, mainly Middle English /oː/, /iu/ and /ɛu/. GOOSE words containing /j/ are subject to variation in most dialects of present-day English. The /j/ may undergo a process of 'coalescence' with adjacent consonants (thus *issue* may be /ɪsjuː/ or /ɪʃuː/), or deletion. The latter process is often referred to as *yod-dropping* (i.e. *new* may be /njuː/ or /nuː/).

Deletion varies markedly across dialects, particularly in stressed positions [20]. Historical /j/ was lost earliest after palatals, /r/ and /l/ (*chew, rude, blue*), and is now almost universally absent in these contexts [20]. Most contemporary British and North American dialects show variation according to preceding context. RP has variable loss after /θ s z l/ (*enthuse, suit, azure, lewd*), but /j/ is generally retained after /n t d/. In North America, /j/ deletion extends to most coronal contexts (thus deletion is the norm in *news, tuna, duty*). Some dialects, notably those of East Anglia, have radical loss of /j/ in all clusters, including after labials and velars (*beauty, cute*). In unstressed positions /j/ is more likely retained (thus /j/ deletion in *news* but not *annual*; [20]). Other dialects, including the one on which we focus here, Derby, show considerable variation in /j/ deletion after coronals.

The fronting of GOOSE and the presence or absence of /j/ are not independent of each other. As noted above, GOOSE fronting is widely attributed to coarticulation with preceding segments: the back tongue position for /uː/ fronts as a result of the front articulation of coronals and /j/, and the high F2 locus of these sounds attracts the lower F2 of the vowel ([13, 16]). This, of course, only explains GOOSE fronting in words where the /uː/ is in a fronting context, but not in words such as *spoon* or *goose*, where the preceding consonant does not involve a front lingual articulation. Labov [16] and Harrington *et al* [13] suggest that these words participate in GOOSE fronting due to the 'binding force of the phoneme' [16], which links words like *coop* and *cube* at an abstract level.

In this paper we analyse dynamic formant data from a diachronic corpus of Derby English, showing that 'binding forces' exist not only at the level of the phoneme but also at the level of individual words [5, 6, 14]. Derby English is relatively unusual in having both a fronting process affecting GOOSE, and

Figure 1: An outline of different possible patterns of fronting in Derby English.



variable yod dropping after the coronal stops /t/, /d/, /n/. Thus, while most words are still consistently yod-ful (e.g. *cube*) or yod-less (e.g. *noodle*), a few words can pattern with both classes (e.g. *n*[j]*ew*/*n*[]*ew*). This provides an opportunity to compare the relative importance of different representational levels (phonemes, allophones and word-level representations) in phonetically gradual changes. Based on Labov's claim about the binding force of the phoneme, we would expect the entire GOOSE lexical set to be fronting *en masse*. However, the coarticulatory effects of yod and other environments (e.g. the backing influence of a following /l/) may lead to different levels of fronting in different contexts. Moreover, if we assume that word-level representations can influence phonetic realisation and sound change (e.g. [14]), it is possible that different lexical items will show different levels of fronting based on how frequently the yod appears in them. Thus, we may expect to see a contrast between *cube* words (yod always present), *new* words (yod variably present) and *noodle* words (yod never present). Figure 1 provides a visual outline of these predictions, which are also summarised below:

H1: GOOSE-fronting is progressing in parallel both in yod-ful and yod-less environments (*coherence at the phoneme level*; cf. the solid box in Figure 1);
H2: GOOSE tokens preceded by yod will show more fronting than ones that are not preceded by yod (*allophonic conditioning*; cf. the dashed boxes in Figure 1);
H3: Words with variable yod-dropping will show intermediate degrees of fronting, and behave as a coherent group (*coherence at the word level;* cf. the dotted circles in Figure 1).

2. METHODS

2.1. Materials

Our data come from a spoken corpus of Derby English consisting of recordings made in 1995 and 2010. The recordings contain dyadic conversations between local residents, and isolated words read from a list. The corpus spans roughly three generations with an overall 45 speakers (17 male, 28 female). The structure of the corpus is outlined in Table 1. The older speakers in the 1995 data set were aged 50–80 years old at the time of the recording, while the middle/younger speakers in both data sets were aged 14–27 years. The recordings were forced aligned using the LaBB-CaT software package [11] and a slightly modified version of the Penn Aligner [21].

Table 1: The structure of the Derby corpus.

Recorded	Age	Female	Male
1995	Older	10	9
1995	Middle	8	2
2010	Younger	9	7

Table 2: The structure of the data set.

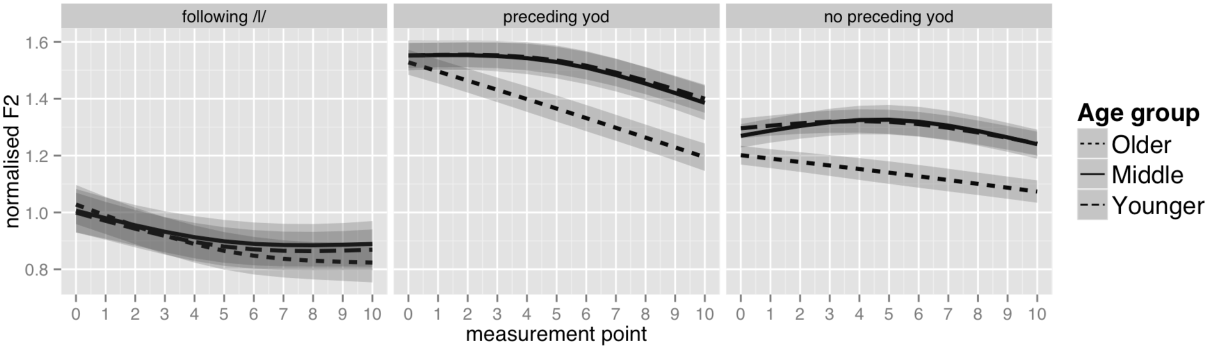
Class	Types #	Yod-ful #	Yod-less #
CUBE	77	507	–
NEW	37	190	229
NOODLE	217	–	2725
overall:	331	697	2954

2.2. Data processing

Using automatic methods, we extracted all GOOSE words from the recordings. We then manually discarded high-frequency function words (e.g. *do*, *to*) and problematic tokens (e.g. overlapping speech, wrong lexical set, reduced vowel). This left 3651 tokens, spread across all the relevant groups outlined in Figure 1 and Hypotheses 1–3. Table 2 shows the number of word types and tokens in each group.

We then used a program called *Formant Editor* [19] to extract, inspect and manually correct F2 trajectories for the /(j)uː/ sequences in each word. *Formant Editor* relies on *Praat* [4] to obtain first pass formant readings, and then allows the user to correct alignment and measurement errors by hand. Each F2 trajectory consists of 11 measurements taken at regular intervals. In yod-ful words, the yod was also included in the trajectory, since there is no natural boundary between the glide and the vowel. The first and second authors each listened separately to all tokens of variably yod-ful words and determined whether a yod was present or not based on auditory judgment and visual inspection of the spectrogram. Disagreements were resolved by discussing problematic tokens together. All formant trajectories were normalised in *R* [18] using Watt &

Figure 2: The fronting of GOOSE over time as shown by normalised F2 trajectories predicted by a mixed effects model including an interaction between age and context.



Fabricius' [9] vowel extrinsic method implemented in the *vowels* package [15] (we extracted additional TRAP and FLEECE tokens from the recordings for the purposes of normalisation). As a result, all findings are presented on a normalised scale, where a unit of one corresponds roughly to the difference in F2 between a fully front /i/ and a fully back /u/.

2.3. Data analysis

All results and figures are based on linear mixed effects regression models fitted using the *lme4* package in *R* [3, 18]. In order to take the dynamic nature of our dependent measures into account, all models share the following general structure. The outcome variable is normalised F2, while the predictor variables include a restricted cubic spline-based transformation of the measurement point (i.e. how far into the trajectory the measurement was taken), and interactions between this and other relevant variables. In practice, this means that the F2 trajectories predicted by the model can vary flexibly in terms of their shape depending on the values of the predictor variables, and they can include non-linearities. All models include random intercepts for words and speakers. Random slopes for measurement point and the main treatment variables were also included whenever possible (although the maximal random slope structure recommended in [2] could often not be reached due to non-convergence). The details of the individual models are described in the results section.

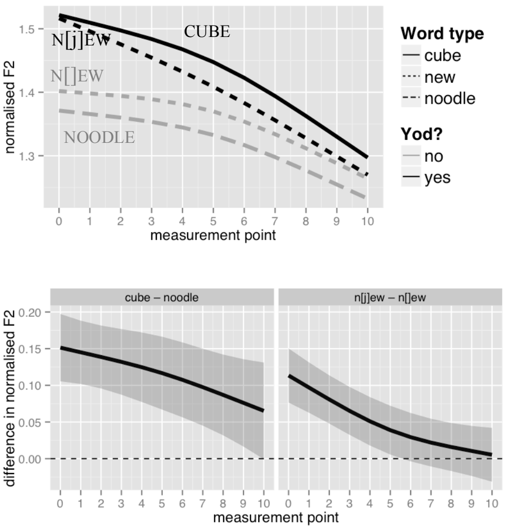
3. RESULTS

In order to see whether GOOSE has fronted in Derby English, we ran a mixed effects regression model with age, phonetic context and their interaction as the main predictor variables. Age was coded as a categorical variable with three values: *older*, *middle* and *younger*, which correspond to the three rows in Table 1. Three relevant phonetic contexts were distinguished: *following* /l/ (*school*), *preceding yod* (*cube*) and *no preceding yod* (*noodle*). Words with variable yod (*new*) were not included in this model. Figure 2 shows the main predictions of the model: each panel represents a different context, and each line a different age group. The bands around the lines are 95% confidence intervals. Non-overlapping confidence intervals indicate significant differences (this implication does not hold the other way round: lines with overlapping confidence intervals may still be significantly different).

The preceding yod and no preceding yod contexts (the two rightmost panels) both show significant differences between the oldest age group and the rest of the speakers, but no significant differences between the middle and the younger age groups. No age effect is observed in the pre-/l/ environment, where the vowel remains fully back for all age groups. The preceding yod context shows a higher degree of fronting than the no preceding yod context, which is partly due to the inclusion of the yod in the trajectories. However, we also see significant differences in the second half of the trajectories, which means that the difference is not simply due to the presence of the /j/. These results indicate that these two contexts are fronting in parallel (H1), that certain contexts do not display any degree of fronting (*contra* H1), and that fronting is subject to a certain degree of allophonic conditioning (H2).

To investigate H3, we constructed a second regression model, this time including (i) *cube*-type words, (ii) *new*-type words and (iii) all *noodle*-type words where the vowel is preceded by a coronal stop /t, d, n/ (to ensure comparability with *new*-type words). The model fit separate curves through *cube*, *noodle* and *n*[]*ew*/*n*[j]*ew* words. The top panel in Figure 3 shows model predictions for each of these groups. Consistently yod-ful/yod-less words (*cube* vs. *noodle*) display significant differences throughout the entire trajectory (cf. bottom left panel). Variable words show intermediate degrees of

Figure 3: Fronting as a function of word type and the presence / absence of yod. Top panel: model predictions; bottom panels: confidence intervals for differences between groups.



fronting, and the yod-ful vs. yod-less variants only differ significantly at the beginning of the trajectory (cf. bottom right panel; this difference is due to the preceding glide in the *n*[j]*ew* group). This indicates that *new*-type words behave as a coherent group, in line with H3.

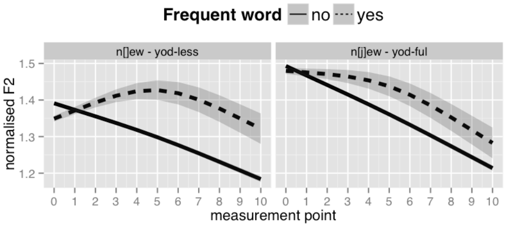
Variable yod-dropping words display a further interesting pattern. We ran a third regression model with the following predictors: log-transformed lexical frequency (based on our own data set), the presence/absence of yod, and their interaction. This model only included variable words that occurred at least three times in the data set. The results are shown in Figure 4 (where the dashed line represents the upper quartile and the solid line the lower quartile of frequency values within the *new* class). Frequent words display a higher degree of fronting than infrequent words, regardless of the presence or absence of yod. As we will see in the next section, this finding can also be linked to H3.

4. DISCUSSION AND CONCLUSIONS

Let us summarise the main findings of the previous section. GOOSE has undergone fronting in Derby English in all environments, except before /l/. This change is led by yod-ful words and it has progressed in parallel in yod-ful and yod-less words. Words with a variable pattern of yod-dropping (e.g. *new*) show intermediate degrees of fronting, and behave distinctly from *cube* and *noodle*-type words. Finally, variable yod-dropping words that are frequent show a higher degree of fronting than their infrequent counterparts.

All our hypotheses receive some degree of support from these findings. First, the parallel fronting of GOOSE after yod and in other environments suggests that phonemes can change as a coherent unit (H1). However, this coherence can be broken under certain circumstances, as shown by the absence of fronting before /l/, which is likely due to coarticulation with the following velarised /l/. While the phonetic basis of this phenomenon is straightforward, it is not clear why a fault line within the phoneme GOOSE should occur between pre-/l/ and other environments as opposed to, say, yod-ful and yod-less environments. The different behaviour of these three types of environments (cf. Figure 2) also shows that the phonetic context can play a crucial role in gradual changes (H2).

Figure 4: Fronting as a function of word frequency. Left: *new* tokens where the yod is absent; Right: *new* tokens where the yod is present.



Perhaps the most interesting patterns are those shown in Figures 3 and 4. Although the phonetic contexts in *n*[]*ew* and *n*[j]*ew* are identical to those in *noodle* and *cube*, respectively, their formant trajectories do not show the same degree of separation. The phonetic coherence of this group and their intermediate position provide evidence that words have a certain degree of autonomy during sound change. The vowels of invariant *cube* and *noodle*/*coop*-type words are consistently in the same favouring/neutral/inhibiting environments, while the vowel of *new*-type words is variably exposed to the fronting bias. If word-level representations are autonomous, the fronting effects of yod will accrue faster in the representation of invariably yod-ful words (*cube*) than they will in the representation of variably yod-ful words (*new*) (cf. [5, 6]). This explains the differences observed in our data. Word-level representations can also help us understand the frequency-related pattern shown in Figure 4. Frequent words often undergo lenition and coarticulatory changes faster than infrequent words [5]. Therefore, it is not surprising to see that variable but frequent words with a surface yod (*n*[j]*ew*) show more fronting. However, this effect is also present in yod-less variants. This finding can be attributed to the 'binding force' of word-level representations: although these variants do not contain the biasing environment themselves, they move together with yod-less tokens that represent the same word.

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