Intra-speaker phonetic micro-variation, and its relationship to phonetic and phonological change

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RÉSUMÉ
Ce travail se propose d'observer l'évolution en temps réel et en temps apparent de la quantité vocalique dans la variété d'anglais parlée à Glasgow au cours du XXème siècle à l'aide d'un corpus de production orale spontanée. Après avoir présenté les schémas de quantité vocalique caractéristiques de l'anglais écossais et de l'anglais d'Angleterre, puis présenté la situation de contact entre ces dialectes ainsi que l'évolution de la quantité en Écosse, cette étude se consacrera à la réalisation des voyelles /i/ et /u/ chez les femmes de Glasgow nées dans les années 1920, 1950, 1960 et 1990, et comparera les résultats obtenus aux conclusions d'une étude similaire consacrée aux hommes. Si le schéma écossais de longueur vocalique recule à Glasgow, nous verrons qu'il n'est pas remplacé par le modèle anglo-anglais. De plus, nous montrerons que le contexte prosodique joue un rôle dans l'évolution des règles de quantité. Enfin, nous remarquerons que l'érosion du modèle écossais semble plus marquée chez les femmes que chez les hommes.

ABSTRACT
The varieties of English spoken in Scotland have their own unique pattern of vowel duration, referred to as the Scottish Vowel Length Rule; this pattern differs from the one prevailing in most varieties of English. Considering the situation of permanent contact between Scotland and England, one could expect Scottish speakers to gradually adopt the Anglo-English pattern; several studies on the realisation of the SVLR have indicated this change is under way. However, the results of the single study to use a corpus of Glaswegian English were at odds with this expectation. This study, focused solely on male speakers, demonstrated that the erosion of the SVLR in Glaswegian English did not result in a move towards Anglo-English patterns. It also highlighted the influence of prosodic factors on the evolution of vowel length. Our work seeks to extend that study to comparable female speakers, testing the same real-time and apparent-time perspectives. Results show that the SVLR is weakening more strongly for women than for men, and that the Anglo-English durational pattern is not gaining ground in Glaswegian. Furthermore, this study confirms the importance of prosodic factors in sound change.

MOTS-CLÉS
Sociophonétique ; anglais écossais ; quantité vocalique ; changement phonétique ; dialectes en contact.

KEYWORDS
Sociophonetics; Scottish English; vowel length; sound change; dialects in contact.

1. Background

That language changes over time goes without saying. Diachronic variation has been extensively documented (Chambers 2013), and the role of social factors, including gender or social status, continues to be investigated (Eckert 2016), notably within the scope of historical sociolinguistics (Romaine 1982). Taking the example of the evolution of vowel quantity patterns in Scottish English, this study examines the potential linguistic influences and gender effect on sound change.

1.1 Vowel quantity in Scottish English

The quantity alternation pattern in Scottish English, and to some extent in mid-Ulster English, differs from all other varieties of English. The standard pattern, commonly called *Voicing Effect* (hereafter VE) or *low-level lengthening*, contrasts short and long vowels depending on the voicing of the next segment: a vowel followed by a voiceless consonant will be short and a vowel followed by a voiced segment will be long (House and Fairbanks 1953). The VE is generally described in this voiceless~voiced binary opposition in the core literature on this topic, and although Gimson (1972) did use items such as *do* and *bee* to illustrate lengthening contexts, morpheme boundary contexts have not been classified as inducing any kind of voicing effect (Roach 1991). Another feature of a VE environment is that it is not possible to produce minimal pairs contrasting vowel length alone, given that durational characteristics are dependent on the following segment.

Scottish English dialects feature a different pattern of vowel quantity, known as the *Scottish Vowel Length Rule* (SVLR), or *Aitken's Law*. Under this system, some vowels are long only before /**r**/, voiced fricatives and morpheme boundaries, and short in all other morphophonemic contexts (Aitken 1981). Aitken also notes that different dialects have different sets of vowels impacted by the SVLR, comprised of some or all of the following vowels: /**i ʉ e o a ɔ aɪ**/. This quantity opposition pattern is described as quasi-phonemic in the sense that the timing pattern induces minimal pairs such as *brood ~ brewed* or *need ~ kneed* (Wells 1982).

Followed by:	Voiceless consonant e.g. *beat, beef.*	Voiced plosive, nasal, lateral e.g. *beam, bead.*	Voiced fricative, /**r**/, morpheme boundary e.g. *breathe, bee.*
SVLR	**Short**	**Short**	**Long**
VE	**Short**	**Long**	**Long**

Table 1: Vowel length patterns

1.2 Previous studies on the SVLR

Based on the most standard interpretation of sociolinguistic theories, one could expect Scotland's specific linguistic patterns to weaken and fall into line with standardized accents. The political, economic, and cultural hegemony of England over Scotland and more specifically of the south of England over the rest of the United Kingdom should lead to all dialects of Britain levelling (gradually losing their marked variants) and shifting towards the dominant variety, at least according to the dialects in contact literature (Kerswill and Trudgill 2005). The London-centric British mass media is also believed to trigger new linguistic behaviours in their Scottish audience (Stuart-Smith 2006).

Several studies have documented the erosion of the SVLR. Working with seven Edinburgh-born children (two boys and five girls), Hewlett, Matthews and Scobbie (1999) investigated whether individual speakers could alternate between two quantity patterns. They found that the four children who had at least one parent from Scotland used the SVLR consistently, whereas the three children with English or Irish parents used the VE instead. Watt and Ingram (2000) used vowel duration patterns in Berwick-Upon-Tweed to assess whether the Berwick dialect was fundamentally Scottish or English. Vowel length was compared for all participants (four elderly and four teenagers, gender-balanced). All older speakers and one male teenager showed consistent SVLR, whereas the other three young speakers showed very little to no difference between segments before voiced fricatives (sign of either SVLR or VE) and voiced plosives (VE only). Scobbie (2005) investigated the SVLR at the other end of the country, with a gender-balanced corpus of 12 Shetland-born speakers aged 16 to 30. He found that people from a Shetland-only or Shetland-Scottish family demonstrated SVLR but those from a Shetland-England background did not. In 2015, Rathcke and Stuart-Smith scrutinized SVLR persistence in the Glasgow dialect, following the real and apparent time paradigm: SVLR-dependent vowel durations were measured for 16 speakers from two periods of time (in the 1970s and 2000s), with both young and middle-aged speakers for both decades of

recording (four age groups in total), all male. They discovered that the SVLR had substantially weakened over time for younger speakers, with those born most recently demonstrating a reduced length difference between short and long vowels. They also noted a substantial influence of the prosodic context in SVLR erosion. However, no substantial evidence of VE implementation was observed in their sample.

1.3 Gender difference and research questions

The first three studies gave preliminary support for the hypothesis that the SVLR would be fading and replaced by VE. However, the linguistic communities studied are not exactly representative of Scottish English as a whole, and receive far more Anglo-English input: Edinburgh is the Scottish city with the highest proportion of English-born residents (12% at the time of the 2011 census), Berwick-Upon-Tweed is actually in England, and the oil industry generated significant waves of migration from England to Shetland during the last century (Nicolson 1975).

The case of Glasgow is interesting: while most British regional varieties are moving towards a supra-regional standardised accent (Kerswill 2003), the Glaswegian dialect is considered to be the only shifting in its own way and retaining its most marked variants (see Griffiths for the MailOnline as an example of the 2015 press review on the matter). Moreover, Rathcke and Stuart-Smith's study focused on speakers within working class areas of Glasgow; this population could be described as a *close-knit* urban community, more prone to dialect maintenance (Milroy and Milroy 1985), especially considering that English accents are regarded in a more hostile way in such neighbourhoods (Stuart-Smith 1999).

Furthermore, research in patterns of linguistic change has shown that gender is a crucial element in linguistic innovation and diffusion. It is well established that women are likely to adopt new forms quicker than men (see related Principles in Labov 2001), potentially due to their lower social status (Schilling-Estes 1998); this pattern holds true in the close-grain contributions of the aforementioned studies. For those reasons, we thought that should Glasgow be following the same trend with regard to the VE pattern adoption, two predictions could be made: (a) a substantially slower implementation of the VE would occur in Glaswegian English due to lower Anglo-English influence, and (b) the trend would be detectable in female speakers earlier. Consequently, we proposed to take Rathcke and Stuart-Smith's study further, reduplicating it with female speakers to broaden our understanding of vowel quantity evolution over time in Glasgow, as well as investigate gender as a factor in linguistic change. We then asked the following:

- Has the SVLR been eroding more for female speakers than for their male counterparts?
- Is there any evidence of VE implementation in Glaswegian English?
- Is the vowel length alternation pattern as closely related to prosodic factors for women as it is for men?

2. Method

2.1 Corpus

Following the example of Rathcke and Stuart-Smith's work on male speakers, we also used the *Sounds of the City* corpus, a private collection of 142 recordings of Glaswegian English from the twentieth century onwards (Stuart-Smith *et al.* 2015). This corpus totals approximately 60 hours of spontaneous speech produced in diverse contexts (peer to peer conversations, oral history and sociolinguistic interviews, *etc.*). All recordings have been forced-aligned using HTK and are now accessible for academic researchers through a LaBB-CAT interface, which allows for orthographic and phonemic searches within the recordings (Fromont and Hay 2012). In order to facilitate optimal comparability with Rathcke and Stuart-Smith's work, the same age groups were selected for the present study: 70M, 70Y, 00M and 00Y, with the first two digits standing for the decade of recording (1970s or 2000s) and the letter for the age at the time of recording (Middle-aged or Young). We focused on the first three female speakers from each of those four groups, selected from the corpus' browsing interface in the order they appeared.

Accepted version

All twelve speakers have also been coded for the level of contact with Anglo-English varieties, since this might have influenced their adoption of the VE. Two speakers, both from the 70M group, mentioned regular stays in England, and were labelled as having a *high* level of contact with Anglo-English dialects. The presumption in a close-knit social group of this kind would be that speakers have very little contact with external varieties, therefore the remaining ten speakers were coded as *low.*

2.2 Segment selection and labelling

The SVLR is only active for the /**i ʉ aɪ**/ vowels in Glaswegian English (Scobbie *et al.* 1999). Following the documented evolutions in /**aɪ**/, both in quality and length (Scobbie and Stuart-Smith 2012), this study only looks at the first two vowels. Unlike Rathcke and Stuart-Smith, we did not include a third vowel acting as a control group; instead, in the interest of efficiency, we relied on their findings that only /**i**/ and /**ʉ**/ show quantity opposition patterns. Using a LaBB-CAT search, all lexically stressed realisations of /**i**/ and /**ʉ**/ were extracted for each of the twelve speakers, with the exceptions of: tokens followed by /**r**/ (see Lawson *et al.* 2011 for the effect of derhoticisation on vowel length); grammatical items likely to be reduced (*me, he, she, you, could, etc.*); items following special rules (e.g. proper nouns) and errors in transcription. The final number of tokens was 1594, with 638 tokens for /**i**/ and 956 for /**ʉ**/.

All 1594 soundfiles with their Textgrids were then analysed in Praat (Boersma and Weenink 2001), and HTK's automatic alignment was hand-corrected for each segment following Peterson and Lehiste's criteria (1960) to guarantee more precise durational measures (hereafter *durms*, token length in milliseconds). All tokens were also labelled for expected vowel length in the SVLR (*short* or *long*) and in the VE (*short*, *long* or *excluded* for morpheme boundaries). Coding was also added for other prosodic (within interpausal units) and linguistic factors likely to influence vowel duration: syllable position in phrase (*final* or *non-final*), prominence in phrase (*nucleus* or *non-nucleus*), type of word (*lexical* or *grammatical*), number of syllables in the word, number of segments in the syllable, and log-transformed lexical frequency of the word (obtained from the spoken half of the SCOTS corpus). Finally, global speech rate for each speaker (in syllables per second) was also retrieved from the corpus to account for non-phonemic individual variation in vowel length.

Factor	*Coded*	*Levels*	*Tokens*	*Factor*	*Coded*	*Levels*	*Tokens*
SVLR: expected realisation	*svlr*	*short*	1054	Type of word	*type*	*gram*	279
		long	540			*lex*	1315
VE: expected realisation	*VE*	*short*	545	Speaker age group	*group*	*70M*	475
		long	635			*70Y*	333
		excluded	414			*00M*	334
Position in phrase	*position*	*final*	285			*00Y*	452
		non-final	1309	Speaker degree of contact	*contact*	*high*	371
Prominence in phrase	*prom*	*nucleus*	373			*low*	1223
		non-nucleus	1221				

Factor	*Coded*	*Min – max*	*Factor*	*Coded*	*Min – max*
Segments/syll.	*nseg*	1 – 6	Lexical frequency	*lexfreq*	0 – 7.877
Syllabes/word	*nsyl*	1 – 5	Speech rate	*rate*	4.346 – 6.503

Table 2: Factors and tokens distribution

2.3 Statistical analysis

Our statistical analysis was conducted in R (version 3.2.2) with the *lme4* and *lmerTest* packages. Linear mixed effect modelling was performed to control the variation of *durms* depending on the following fixed factors: *svlr*, *VE*, *position*, *prominence*, *type*, *vowel*, *group*, *contact*, and all possible interactions between those factors. *nseg*, *nsyl* and *lexfreq* were treated as

covariates, while *speaker* and *word* were treated as random factors. Two separate models were run for *svlr* and *VE* to avoid collinearity. An analysis of variance was also run on speech rate with *group* as a predictor; the ANOVA model returned no significant difference in speech rate between groups. This factor was therefore not included in our main model.

3. Results

3.1 Raw data

As a preliminary analysis, values for token duration from raw data were obtained and contrasted for the different levels of each factor presented in table 2, in order to provide an initial interpretation of the accuracy of our method and of distribution across factors for segment duration. For instance, comparing token durations between SVLR-*short* and SVLR-*long* vowels demonstrates a substantial contrast both in their range and the distribution (see figure 1). Indeed, SVLR-*short* vowels have an average duration of 64.74ms, whereas SVLR-*long* vowels are on average 90.67ms in length (difference: 25.93ms). Contrast in duration distribution is less striking for the *VE* coding (average difference between VE-*short* and VE-*long* tokens: 8.49ms). It must be borne in mind that potential non-overlapping contexts are to be found in SVLR-*short* and VE-*long*; for instance, the vowel in a word such as *speed* would be short in Scottish English and long in Anglo-English.

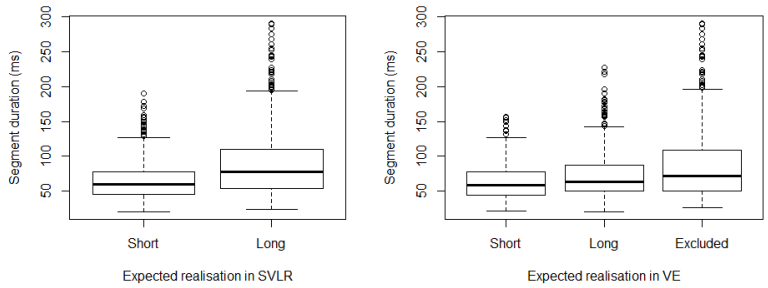

Figure 1: Vowel duration (raw) per predicted quantity pattern

Raw data also suggest that both prosodic factors (phrasal position and prominence) have a substantial influence on vowel duration in our dataset. Indeed, vowels in final position are on average 42.76ms longer than those in initial or median position (108.64ms against 65.88ms). As for prominence, vowels carrying the phrase's nuclear pitch accent are on average 28.83ms longer than the others (95.61ms against 66.78ms). Those two factors are not collinear, and can therefore be plotted in interaction for SVLR-*short* and SVLR-*long* vowels separately:

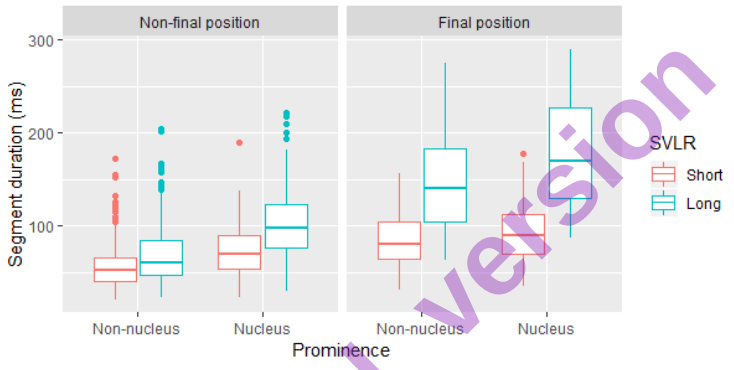

Figure 2: Vowel duration (raw) and prosodic factors

Beyond the SVLR/VE comparison, the raw data feature other durational contrasts. /**i**/ tokens are on average 12ms longer than /**u**/ tokens. Tokens in grammatical items are only 2ms longer than those in lexical items, but it must be kept in mind that function words were removed when defining our dataset; moreover, all remaining grammatical items (such as *who* or prepositions like *through*)

were /**ʉ**/ tokens. Finally, only two of the three covariates show the expected effect (figure 3). Plotting token distribution according to *nsyl* demonstrates that polysyllabic shortening is in operation: the more syllables in the word, the shorter the vocalic segment. Equally, the *nseg* figure shows the expected intra-syllabic compression pattern, with shorter vowel durations in more complex syllables. However, it was difficult to identify any trend in the distribution of token duration by lexical frequency.

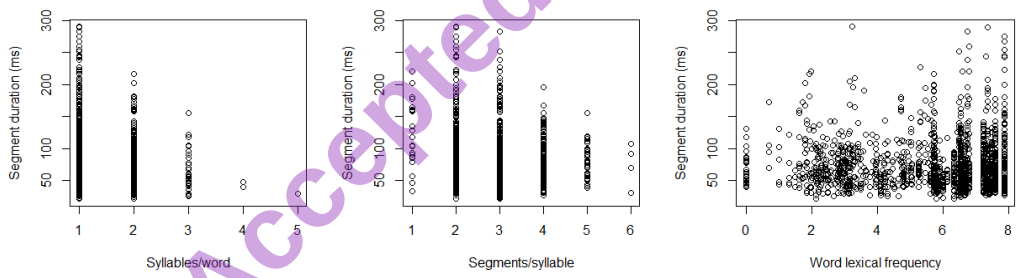

Figure 3: Vowel duration (raw) and covariates

3.2 Significant factors and interactions

Several factors were excluded during the statistical analysis and were therefore not considered relevant for the rest of this study: all the covariates (*nseg*, *nsyl*, *lexfreq*), *type*, and the interaction of both prosodic factors (*phrase:prom*), as well as *slvr:group:prom*. The factors *contact* and *group* were not significant in isolation, and were only kept in interaction with other factors. No interaction was found for *vowel*, meaning that all factors had the same effect on both /**i**/ and /**ʉ**/: thus, the SVLR should be examined as a whole, since there is no requirement to oppose factors by vowel.

All other factors were kept in the final model, most of them with high levels of significance (p-values < 0.005), including the interactions between *svlr:phrase*, *svlr:group*, *phrase:group*, *svlr:prom*, and *svlr:phrase:group*. Two interactions returned a lower level of significance: *contact:svlr* (p=0.0065) and *group:prom* (p=0.0467).

Several preliminary conclusions can be drawn at this stage: 1) the SVLR behaves differently depending on age group; 2) the SVLR behaves differently depending on prosodic context; 3) of the two prosodic contexts which have been annotated, phrase position seems to have a greater influence.

The similar model we ran for *VE* did not return any significant difference between VE-*short* and VE-*long* vowels. The only significant difference in estimates was between VE-*short* and VE-*excluded* – in other words, between tokens *always* short and *always* long in the SVLR, but not in the SVLR/VE non-overlapping contexts. There is therefore no visible implementation of the VE in our dataset.

3.3 Estimates

The level of significance for the interactions of *svlr:position* and *svlr:prominence* confirms the role that prosody plays in the SVLR: according to the estimates produced by the model, the difference between short and long vowels is substantially larger for segments in final position than for those in non-final position (91.4ms vs 16.7ms). Similarly, our analysis reports a greater difference between short and long vowels under the main pitch accent and non-nuclear segments (30.6ms vs 16.7ms).

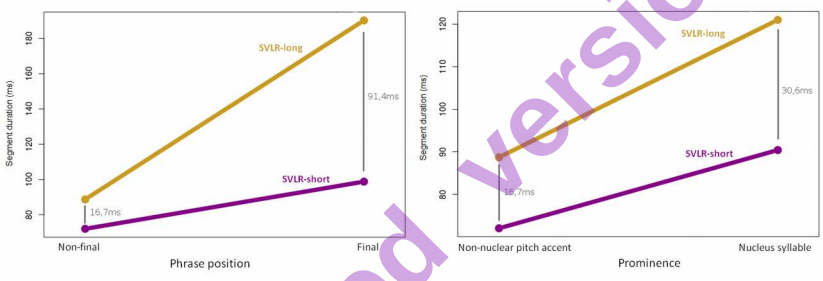

Figure 4: Vowel duration (estimates) and prosodic factors

The estimates for the *group:svlr* interaction demonstrate a highly significant difference between short and long vowels for all four age groups. The extent of those differences varies between age groups, and is due to variation in both short and long vowels. Estimated differences between *short* and *long* for each group are as follows: 70M – 69.4ms; 70Y – 44.3ms; 00M – 31.3ms; 00Y – 49.7ms. The difference in length over time between SVLR-*short* vowels was never significant; only long vowels demonstrate change, suggesting the duration of short vowels may be plateauing while longer vowels are shortening due to the SVLR erosion.

Estimates for the interactions of *group:position* and *group:prominence* also show a highly significant difference between the two levels of each factor for all four age groups. The effect of prosodic factors varies for each age group, both for short and long vowels; this could be due to an undocumented evolution of intonational patterns independent from changes in the SVLR.

3.4 Gender differences

Phrase position is the only prosodic factor considered in this study to display a significant influence on the SVLR over time (p-value for *svlr:group:position*=0e+00). This is in line with Rathcke and Stuart-Smith's findings. Contrasting the results of their study with ours enables direct comparison of the evolution of the SVLR over time between male and female speakers (figure 5).

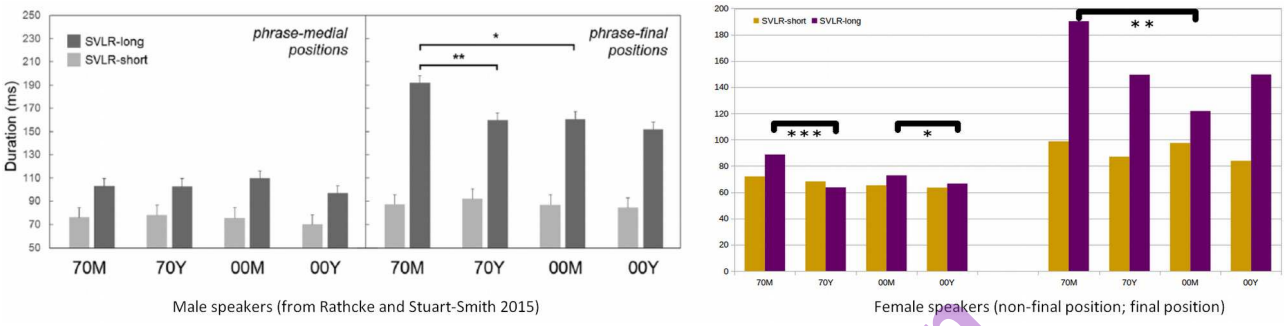

Figure 5: SVLR change over time for men and women. Stars indicate the degree of significance of difference in estimates between the two age groups at both ends of the brackets.

We find similarities between the two gender groups: the SVLR weakens over time, with long vowels shortening, particularly in phrase final position, and this shortening can be observed in real time in middle-aged speakers (70M-00M). However, this real-time difference is greater for women than for men. Our findings also differ from an apparent time perspective: the significant shortening between 70M-70Y in the male study is absent from our results, yet we see a significant weakening of the SVLR in apparent time in non-final positions for women for both decades of recordings. Amongst the cohort born the latest, a divergent behaviour is clear for the female speakers: there appears to be a reversal in the SVLR weakening trend in phrase-final position, with values for 00Y similar to 70Y. Finally, in our dataset, the three-way interaction of *svlr:group:prominence* is not significant, and neither is the interaction of both prosodic factors

together. This is at odds with Rathcke and Stuart-Smith's results; this might be because women use pitch differently, or due to a different labelling technique between the authors.

4. Conclusion and discussion

4.1 Summary

Our findings are broadly comparable to Rathcke and Stuart-Smith's, in that they demonstrate similar trends, albeit with a different amplitude and specifics. First and foremost, we find that the SVLR has undeniably been weakening across the twentieth century in Glasgow for female speakers. This erosion is substantially more radical for these speakers than for their male counterparts. This is consistent with the gender-specific theorised linguistic behaviours in sound change, since women appear to be ahead of men in reducing this quantity opposition pattern. The aforementioned reversal in the trend, observed in young female speakers, was also found in studies on the same corpus focusing on change in other phonetic features such as voice onset time (Stuart-Smith *et al.* 2015). This global reversal in young women's speech could foreshadow a new reinforcement of the SVLR and indeed of vernacular Glaswegian English in this linguistic community (Stuart-Smith, in press); collecting additional data for the 2010s decade will provide further insight on this question.

However, no evidence of VE implementation was found in female speakers as a group. This suggests that the Glasgow accent remains distinctive from other Scottish dialects. Its unique behaviour as a British accent was predicted in earlier literature (Scobbie *et al.* 1999).

Finally, our study corroborates the role of prosodic factors for change in vowel duration patterns. The fact that segments in the intonational tail undergo the greatest shortening in the SVLR suggests a potential hierarchy of prosodic positions in sound change, with segments in the strongest prosodic contexts more affected by change.

4.2 Discussion: the contact situation

Despite the very low impact of the degree of contact with Anglo-English in our dataset overall (p-value for *contact* in isolation= 0.8197), the interaction between *contact* and *svlr* was considered significant (p=0.0065). This indicates that the two speakers with a high level of contact demonstrated a divergent quantity alternation pattern. Both belonged to the 70M group, and produced longer SVLR-*short* vowels and shorter SVLR-*long* vowels. This difference is particularly striking given the 70M group produced the longest SVLR-*long* vowels of all age groups.

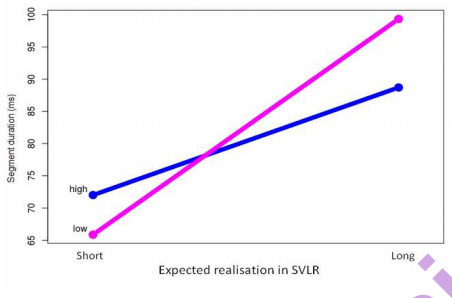

Figure 6: Vowel duration (estimates) and contact (high/low) with Anglo-English

We investigated whether those longer SVLR-*short* vowels could correspond to SVLR/VE non-overlapping contexts (i.e. segments followed by lateral, nasals or voiced plosives); the raw data seem to suggest that VE-*long* vowels are noticeably longer (18ms) for these two high contact speakers than for the rest of our sample. Although there is not sufficient data to draw firm conclusions on this issue, it is likely that exposure to Anglo-English varieties lead these speakers to adopt a different quantity opposition pattern: this would match the predictions of sociolinguistic theory as well as the trend found in the Berwick-Upon-Tweed and Shetland studies.

4.3 Further study

The issue discussed in the paragraph above highlights the crucial importance of individual and interactional level behaviours in sound change. These behaviours can be viewed through the lens of a wider theory of language change: diachronic variation may be the result of speakers' exposure to a different idiolect (Trudgill 1986). Following this reasoning, long-term community-level sound change would result from short-term inter-speaker phonetic convergence, also referred to more broadly as *Speech Accommodation Theory* (Giles *et al.* 1973). Work is under way to examine mechanisms of short-term phonetic convergence within all interactions from the same corpus (Chevalier 2018). This will enable us to isolate (a) linguistic factors (e.g. type of segment, prosodic context), social factors (e.g. gender, age), situational factors (e.g. conversational acts, style of interaction) likely to trigger or prevent convergence; (b) to compare the trajectory and speed of sound change for specific phonetic features within conversations as well as in real and apparent time; and (c) to contribute to the larger review of the evolution of Glaswegian vowels from the twentieth century onwards.

4.4 Acknowledgements

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