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Laurel MacKenzie* and Gillian Sankoff

1 Introduction

Examining the progression of the [r] → [ʀ] shift across subsequent generations of young Montreal French speakers as well as among individual speakers tracked longitudinally, Sankoff and Blondeau (2007) were able to demonstrate that one's linguistic system does not strictly crystallize after puberty: changes later in life in the direction of the community are possible, particularly when speakers experience a change in social status.

The change examined by Sankoff and Blondeau is a categorical shift of consonant place of articulation, from apical to dorsal. It is also a change from above, being borrowed from a source outside the community. This paper examines the potential for gradient changes from below (i.e., vowel shifts) to be involved in similar longitudinal change. In keeping with previous work, we examine two matched trend samples, to provide evidence of generational change, as well as a panel of speakers tracked over their lifetimes. Along the way, we lay out the acoustic correlates of the Montreal French vowel system, in order to better situate the changes we examine.

2 Design and Methodology

This paper makes use of data from three major studies of Montreal French: Sankoff, et al. 1976, which sampled 120 speakers in 1971; Thibault and Vincent 1990, carried out in 1984, which resampled 60 of the 1971 speakers as well as an additional 12 younger speakers; and Vincent, et al. 1995, carried out in 1995, which sampled 12 speakers who had been interviewed in 1971 and 1984, and 2 speakers who had been interviewed in 1984 only. Access to data from the 12 speakers who were sampled three times, plus data on the community (made possible by cohorts of young speakers sampled in 1971 and 1984) has allowed us to carry out panel and trend comparisons.

In addition to examining a variable process of long vowel diphthongization in the dialect, we also examine the overall vowel system of Quebec French. Though the vowel system has been extensively studied by phonologists (Walker 1984 and Dumas 1987, among others), little acoustic phonetic work has been done on Quebec French, and the phonetic correlates of the vowels have not yet been reported in the literature. In this paper, then, we examine short vowels as well as long, to provide acoustic benchmarks of the vowel system.

2.1 Sample

Of the twelve speakers who were interviewed three times across their lives, two working class, two middle class, and two upper-middle class speakers were selected to be analyzed, forming a panel of six, equally divided between the sexes (one male and one female per class group). Judgments of "class" were based on the Linguistic Marketplace Index (LMI) scores (Sankoff and Laberge, 1978) assigned to speakers at the time of recording, with "working class" (WC) being defined as LMI 0–40, "middle class" (MC) LMI 40–75, and "upper-middle class" (UMC) LMI 75–100. Speakers were matched for age to the extent possible. The panel sample is shown in Table 1.

Additionally, data were collected from a subsample of 1971 speakers and a subsample of 1984 speakers to allow for a trend comparison. To the extent possible, these subsamples were matched for age, sex, and social class, to facilitate real-time comparisons between the two. Each trend sample comprised six speakers, one male and one female from each class group (working class, middle class, upper-middle class). Unfortunately, the survey of the community performed in 1995 included no speakers younger than 28, so a third matched trend sample from 1995 was not possible. The breakdown of the two trend samples is provided in Table 2.

*Thanks to Bill Labov, Michael Friesner, and audiences at NWAV 37, LSA 2009, and CVC III.

Speaker name[1] and Corpus ID		Sex	LMI	1971 Age	1984 Age	1995 Age
Lysiane B.	(007)	F	9 (WC+)[2]	24	37	48
Paul G.	(002)	M	9 (WC)	25	38	49
Louise C.	(008)	F	55 (MC)	29	42	53
Ghislain N.	(013)	M	67 (MC)	20	33	44
Claire R.	(049)	F	75 (UMC)	16	29	40
Charles P.	(117)	M	100 (UMC)	22	35	46

Table 1: Composition of panel.

Speaker name and Corpus ID		SEX; LMI	Age	Speaker name & ID., 1984		Sex; LMI	Age
Ginette G.	(106)	F; 4 (WC)	19	Camille C.	(129)	F; 20 (WC)	15
Michel L.	(052)	M; 5 (WC)	23	Edouard A.	(132)	M; 0 (WC)	16
Hélène R.	(112)	F; 74 (MC)	20	Johanne P.	(127)	F; 75 (MC)	17
Germain T.	(088)	M; 53 (MC)	19	Yannick C.	(126)	M; 70 (MC)	17
Mireille T.	(070)	F; 92 (UMC)	27	Laure T.	(124)	F; 90 (UMC)	20
Bernard L.	(087)	M; 85 (UMC)	18	François A.	(122)	M; 85 (UMC)	15

Table 2: Composition of 1971 and 1984 trend samples.

2.2 Coding and Normalization

Data were collected both from vowels in non-lengthening contexts and vowels in lengthening contexts. Vowels in non-lengthening contexts were defined as those presented in Table 3.[3]

i	*qui* 'who'	y	*lu* 'read'	u	*coup* 'blow'
ɪ (iC)	*quitte* 'leave'	ʏ (yC)	*lutte* 'fight'	ʊ (uC)	*coupe* 'cut'
e	*fee* 'fairy'	ø	*jeu* 'game'	o	*pot* 'pot'
ɛ	*fait* 'fact'	œ	*jeune* 'young'	ɔ	*poste* 'post'
a	*patte* 'paw'			ɑ#	*là* 'there'

Table 3: Vowels coded in non-lengthening contexts.

Five tokens per speaker per interview were collected for each of the above vowels. Non-lengthened vowels were coded by taking a single measurement from the midpoint of the vowel, approximately 20 ms away from formant transitions out of or into the surrounding consonants, following the procedure in Labov, Ash, and Boberg 2006.

Vowels in lengthening contexts were defined as those in Table 4. (Lengthening contexts are described in Section 3.1.) Fifteen tokens per speaker per speech sample were collected for each of the above vowels. Long vowels were coded by taking a single measurement from the nucleus (the initial steady state after any formant transitions out of the preceding consonant) and from the offglide (the final steady state before any transitions into the following consonant).

Le Glossaire du parler français au Canada was used as a reference when coding. Forms that were not in that volume were found in *Harrap's New Shorter French and English Dictionary*.

[1]All names are pseudonyms.

[2]Lysiane B. was a member of Sankoff and Blondeau's (2007) panel sample as well; they describe her as "a case of exceptional upward social mobility" (consult their paper for more details of her social situation). For this reason, we abbreviate her social class as "WC+".

[3]Though the French vowel system also contains contrastive /ə/ (e.g. /ʒə/ 'I' ~ /ʒø/ 'game'), /ə/ was not measured as it appears in very few stressed tokens.

Outliers were checked aurally and acoustically.

We follow much of the literature (Dumas 1981, Gess 2008) in assuming that, despite a small number of length-induced minimal pairs (e.g., [fɛt] 'fact'/[fɛːt] 'party', [mɛtʀ] 'to put'/[mɛːtʀ] 'master'), length is not contrastive in Montreal French: as Dumas (1981) notes, the few contrasts "n'ont pas dans la langue le statut général et largement productif des grandes oppositions vocaliques" (4). When referring to long and other unstable vowels in this paper, we follow the traditional sociolinguistic convention of notating a variable in parentheses: e.g., (ɛː) represents the long vowel found in words like *fête* 'party' and *faire* 'to make'.

iː	*sourire* 'smile'	yː	*sûr* 'sure'	uː	*cours* 'course'
				oː	*chose* 'thing'[4]
ɛː	*père* 'father'	œː	*peur* 'fear'	ɔː	*alors* 'so'
				ɑː	*art* 'art'

Table 4: Vowels coded in lengthening contexts.

In order to facilitate comparisons across the speech community, values were log-mean normalized (Nearey 1977). For each of the six speakers on the panel, tokens from the three separate years in which they were recorded were pooled and normalized as if they had been produced by a single speaker, rather than by three separate speakers.

3 Diphthongization in Montreal French

3.1 Phonetic Background

In Montreal French, a process of diphthongization affects long vowels (Santerre and Millo 1978, Dumas 1981). Long vowels come from two sources: (1) vowels may be inherently long, due to historical loss of *s (e.g. *même* 'same' < **mesm*) or simplification of a geminate (e.g., *baisse*); (2) vowels may be allophonically lengthened when preceding /ʀ/ or one of the voiced fricatives /v, z, ʒ/; these consonants are known as "consonnes allongeantes" (lengthening consonants). Diphthongization is said to affect the following vowels when stressed (Dumas 1981; see Côté 2008 for a discussion of diphthongs in unstressed position), non-final, and lengthened:[5]

i y u
e ø o
ɛ œ ɔ
ɑ

The potential of high vowels to be diphthongized is debated: though Dumas includes them in a chart of vowels that may be diphthongized (13), Santerre and Millo note that "high vowels […] do not present diphthongized variants but only a variation in quality" (174). The idea that high vowels may be exempt from lengthening and diphthongization is similarly put forward by Gess (2008), who points out the negative correlation between vowel height and inherent duration noted in acoustic studies. Shorter durations of high vowels could prevent diphthongization from occurring, even in lengthening environments. Walker (1984:61) does provide diphthongal variants for the high vowels, but he notates them as [ij, üɥ, uw]: i.e., with an offglide but no concomitant lowering of the nucleus. Diphthongization of high vowels will be further explored in Section 4.

Diphthongization involves lowering of the vowel nucleus and addition of a raised offglide. Dumas provides the following diphthongized variants of the long vowels given above:

[4]/o/ is long regardless of following consonant.
[5]Nasalized vowels also undergo diphthongization (Dumas 1981), but will not be considered here.

ɪ^{i} ʏ^{y} ʊ^{u}
ɛ^{i} œ^{y} ɔ^{u}
a^{i} a^{y} ɑ^{u}
ɑ^{u}

For each vowel, Dumas maintains that the nucleus of the diphthongized variant “s’ouvre et descend d’un degré dans l’échelle d’aperture,” while the offglide “se ferme et tend vers la voyelle fermée homorganique” (12). The nature of the nuclei and offglides will be examined in Section 4.

3.2 Sociolinguistic Background

Santerre and Millo (1978) impressionistically coded eight diphthongs (/ø, œʀ, ɜ, aʒ, wa, ɑ, ɔʀ, o/) collected from working and middle class speakers interviewed in the 1971 Sankoff-Cedergren corpus. They found diphthongization to be affected by sex, social class, and age. For all vowels, diphthongization was found to be more common among the working class than the middle class, leading the authors to conclude that “diphthongization is slightly in progress among the working class speakers and […] regressing except for /o/ among middle class speakers” (179). In some cases, they note “a reduction in the degree of diphthongization” (184).

Cedergren, et al. (1981) also studied diphthongization via impressionistic coding in the 1971 Sankoff-Cedergren corpus, and analyzed two long vowels, (œʀ) and (o:), as diphthongizing in apparent time Of the two, (o:) is the more recent process: they date the introduction of (o:) diphthongization to 1940-1945, with (œʀ) diphthongization having been introduced at least ten years before. Yaeger-Dror (1989) extends this analysis by examining (ɛ:) and (ɔ:), attributing the appearance of their diphthongal variants to working class women before the First World War.

Yaeger-Dror (1994) is notable for providing the first evidence of longitudinal change in Montreal French vowels. Her work (see also Yaeger 1979, Yaeger-Dror 1996) is also unique in the literature in using acoustic measurements rather than impressionistic coding, though these measurements are not reported in the 1994 paper. Her regression analysis finds apparent time as well as real time change: those speakers who were sampled across their lifetimes “advance their dialect toward a newer phonology well into middle age” (286). However, since the report groups (ɛ:, ɔ:, œ:) together, it is not clear which individual vowels these speakers were advancing.

4 The Montreal French Vowel System

The first goal of this paper is to provide quantitative measurements of the vowels of Montreal French, in order to provide a frame of reference in which to situate further analysis of diphthongs. After coding and normalization, data from all speakers were pooled, and vowels were plotted using a version of the Plotnik software designed for French. The means of all speakers’ normalized tokens for each vowel were calculated and are indicated by colored circles in Figure 1.

A number of features of the dialect are evident in Figure 1. First of all, the process of vowel laxing (Walker, 1984; Dumas, 1987) is clearly indicated by the vowels in closed syllables (notated as “iC, üC, ouC”), which are found to be significantly lower and less peripheral than their open syllable counterparts by means of a t-test:

	[iC]	/i/	*p*-value
F1 (Hz)	458	381	<.001
F2 (Hz)	1994	2343	<.001
N	153	168	

	[yC]	/y/	*p*-value
F1 (Hz)	441	378	<.001
F2 (Hz)	1739	1939	<.001
N	159	145	

	[uC]	/u/	*p*-value
F1 (Hz)	457	367	<.001
F2 (Hz)	1270	971	<.001
N	160	153	

Table 5: Comparison of laxed (closed) and open vowels.

A process of low vowel backing in open syllables (Walker, 1984) is also evident by the high, back position of word-final /ɑ/ (notated as “a#”).

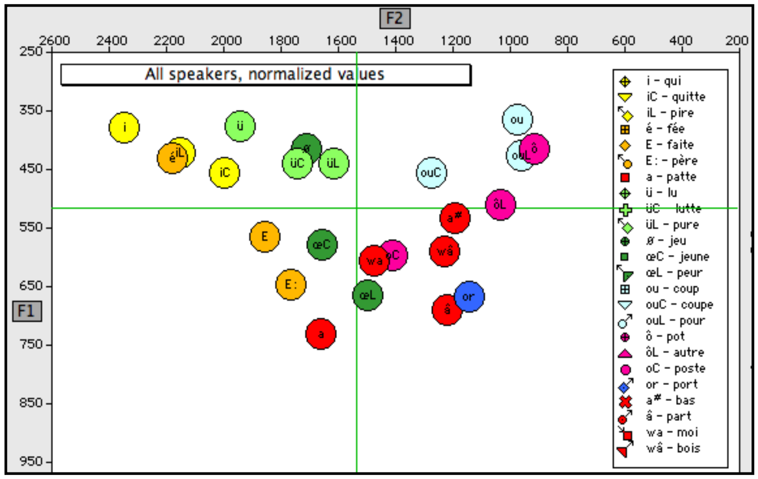

Figure 1: Mean long and short vowels of all interviewed speakers (normalized values).

Each long vowel's nucleus is found to be significantly different on at least the height dimension from its short counterpart by means of a t-test as shown in Table 6. It can thus be stated with confidence that high vowels do undergo a process of lowering in lengthening contexts.

	(i:)	/i/	*p*-value
F1 (Hz)	424	381	<.001
F2 (Hz)	2147	2343	<.001
N	452	168	

(ɛ:)	/ɛ/	*p*-value
648	568	<.001
1761	1854	<.001
574	186	

(y:)	/y/	*p*-value
441	378	<.001
1611	1939	<.001
324	145	

	(œ:)	/œ/	*p*-value
F1 (Hz)	667	417	<.001
F2 (Hz)	1495	1709	<.001
N	467	153	

(u:)	/u/	*p*-value
429	367	<.001
957	971	n.s.
382	153	

(o:)	/o/	*p*-value
512	416	<.001
1030	913	<.001
428	158	

Table 6: Comparison of long and short vowels.

Mean glide targets for each long vowel were also calculated, and are plotted in Figure 2. Glide targets are indicated by heavy-outlined circles and connected to their nuclei by an arrow (unless the two are especially close together).

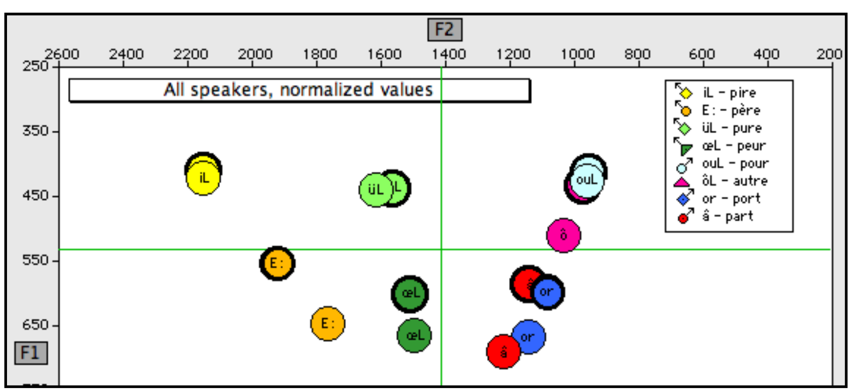

Figure 2: Mean nuclei and glide targets (outlined in black) for all speakers' long vowels.

Table 7 shows the results of t-tests comparing long vowel nuclei to their glides. These results must be interpreted with caution, because degree of diphthongization (and thus nucleus/offglide displacement) varies depending on a speaker's social profile and word stress (Santerre and Millo 1978, Yaeger-Dror 1994). However, some broad conclusions can still be drawn. The assumption in the literature that high vowels do not diphthongize is not fully borne out by these data, as the offglides of (i:), (y:), and (u:) do differ significantly from their nuclei on one dimension, but high vowels are clearly less diphthongized than non-high ones, as they display much shorter trajectories. The effects of diphthongization are thus shown most clearly, as noted by Yaeger-Dror (1996), in mid and low vowels, all of which, with the exception of (œ:), show significant differences between nucleus and offglide on both F1 and F2. An interesting pattern of symmetry can be noted: the front mid vowel (ɛ:) glides up and to the front, the front rounded (and thus more centralized) vowel (œ:) glides up only, and the back mid and low vowels (o:), (ɔʀ), and (ɑ:) glide up and to the back. There may thus be a general principle at work which seeks to maintain identical values of [±front] in nuclei and their accompanying offglides.

	(i:)	glide	*p*-value
F1 (Hz)	424	412	<.01
F2 (Hz)	2147	2143	n.s.
N	452	449	

(ɛ:)	glide	*p*-value
648	556	<.001
1761	1920	<.001
574	570	

(y:)	glide	*p*-value
441	438	n.s.
1611	1561	<.01
324	324	

	(œ:)	glide	*p*-value
F1 (Hz)	667	600	<.001
F2 (Hz)	1495	1504	n.s.
N	467	467	

(u:)	glide	*p*-value
429	414	<.005
957	954	n.s.
382	377	

(o:)	glide	*p*-value
512	436	<.001
1030	966	<.001
428	422	

	/ɔʀ/	glide	p-*value*
F1 (Hz)	670	599	<.001
F2 (Hz)	1137	1078	<.001
N	415	413	

/ɑ:/	glide	p-*value*
693	589	<.001
1215	1132	<.001
452	449	

Table 7: Comparison of long vowel nuclei with their offglides.

5 Real Time Community Changes

This section examines changes in the Montreal French vowel system, specifically in the degree and direction of diphthongization, that can be tracked in real time by comparing the 1971 trend sample to the matched 1984 trend sample. Identifying the changes that are being advanced by cohorts of young people will allow us to examine individuals' capacity to participate in these changes as they age.

In the case of (o:) and (œʀ), our analysis replicates that of Cedergren et al., the crucial difference being that we analyze acoustic measurements while they used impressionistic coding. Their results indicate increased diphthongization of (œʀ) and of (o:) (both apparently involving nucleus-lowering, judging by their transcriptions).

Contra the apparent time inferences from the 1971 data of Cedergren et al., we observe no nucleus lowering in tokens of (œ:) between 1971 and 1984. Instead, the vowel has backed, and the glide target has lowered, decreasing the nucleus-glide distance (N=93 tokens analyzed in 1971, 81 tokens analyzed in 1984).[6] Similar changes are in evidence for the other front vowels: (ɛ:) lowers and backs, though the degree of diphthongization remains consistent between the two years (N=133 in 1971, 103 in 1984); (y:) backs and lowers (N=43 in 1971, 44 in 1984); and (i:) lowers with decreased diphthongization (N=85 in 1971, 79 in 1984). In general, then, long front vowels seem to be undergoing real time changes of lowering, backing, and decreased diphthongization.

[6]All F1 and F2 movements reported here were found to be significant at the $p<.01$ level with a *t*-test.

Figure 3 shows mean nucleus (N) and glide (G) values for each of these four long front vowels (each with its own symbol) in 1971 (blue) and 1984 (red).

Similarly, we observe no nucleus lowering in tokens of (o:) between 1971 and 1984 (N=72 in 1971, 71 in 1984). Instead, we find that the glide target lowers, decreasing the nucleus–glide distance, much as we saw for many of the front vowels examined. In fact, two other back vowels, (ɑ:) and (ɔʀ), also show this pattern of nucleus stability and decreased diphthongization between 1971 and 1984 ((ɑ:) N=93 in 1971, 98 in 1984; (ɔ:) N=72 in 1971, 76 in 1984). (u:) was not found to be involved in any significant changes apart from decreased diphthongization (N=60 in 1971, 72 in 1984). The plot in Figure 4 shows mean nucleus (N) and glide (G) values for each of these four long back vowels (each with its own symbol) in 1971 (blue) and 1984 (red).

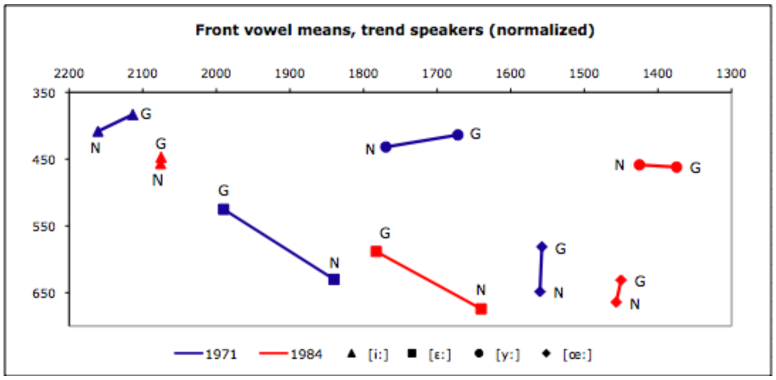

Figure 3: Real time long front vowel changes.

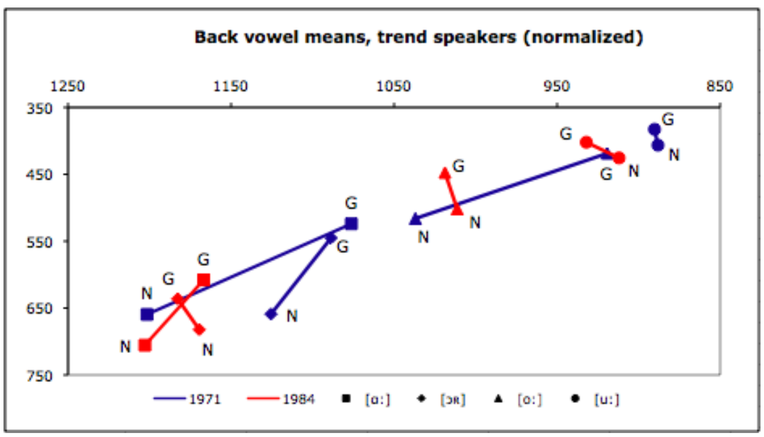

Figure 4: Real time long back vowel changes.

Overall, there is a general trend for glides to move closer to their nuclei between the 1971 and 1984 trend samples: of the eight vowels analyzed, six of them display significantly decreased diphthongization between the two years. The Cedergren et al. analysis covers only the period from the early 20th century through 1971, so it may be that the nucleus lowering that they found has been arrested by 1984, with a subsequent lowering of the glide among young speakers. It is also possible that reduced diphthongization reflects a stylistic difference in the 1984 corpus, in which many interviews focused on school and work, topics that may not have encouraged use of the vernacular. As for nuclei movements, there are no significant real-time changes among the back vowels; among the front vowels, we find lowering and backing.

6 Real Time Lifespan Changes

Table 8 charts the six panel speakers' participation in the changes observed in the community between 1971 and 1984. A check mark (√) indicates that a speaker's vowel moves significantly ($p<.01$ by means of a t-test) in the direction of the community between his first interview in 1971 and his second interview in 1984. (No data is given for panel speakers in 1995 because there is no 1995 trend sample to provide a comparison.) "STABLE" indicates that a speaker displays no significant change for that vowel between 1971 and 1984. Where a speaker's vowel movements diverge significantly from what is observed in the community, his specific movements are reported.

Community changes	Paul G. (WC)	Lysiane B. (WC+)	Louise C. (MC)	Ghislain N. (MC)	Claire R. (UMC)	Charles P. (UMC)
[i:] lowering	backs	fronts	backs	STABLE	√	raises glide
[y:] backing & lowering	√	STABLE	√	STABLE	√	√
[ɛ:] backing & lowering	√	STABLE	raises	√	√	STABLE
[œ:] backing	√	STABLE	lowers	STABLE	lowers	STABLE
[ɑ:]†	STABLE	backs	√	STABLE	lowers & fronts	raises & backs
[ɔ:]†	lowers & fronts	STABLE	STABLE	STABLE	lowers & fronts	STABLE
[o:]†	fronts	STABLE	STABLE	STABLE	lowers	STABLE
[u:]†	fronts	STABLE	STABLE	STABLE	lowers	STABLE

Table 8: Panel speakers' participation in community changes. †Glide fronts/lowers, nucleus stable.

Immediately obvious is the large number of speakers who display stability across their lifespans with regard to community changes: this is what we would expect for speakers well past the critical period in the first set of recordings. Lysiane B. and Ghislain N., in particular, display a high degree of stability in their system of long vowels as they age. This is evident for Lysiane B., as shown in Figure 5: though her (œ:) appears to raise and back, neither movement is statistically significant (N=14 in 1971, 15 in 1984).

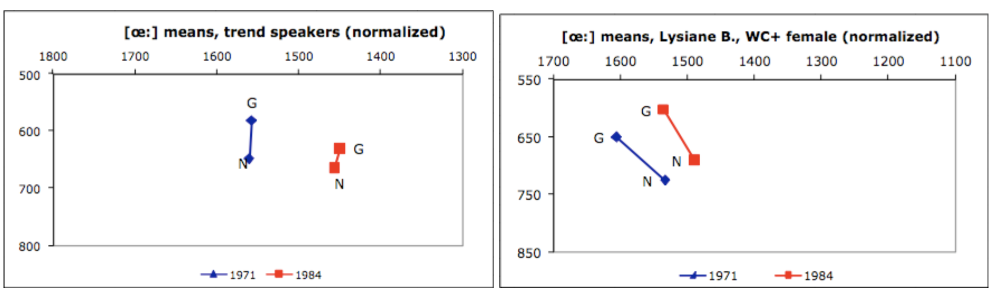

Figure 5: (œ:) changes among the trend and one panel speaker.

However, every speaker shows a significant change in at least one vowel, with Paul G., the working class male, changing in the direction of the community for three vowels, the most of any speaker. By way of example, the plots in Figure 6 compare the trend sample's (y:) change to that of Paul G. (N=14 in 1971, 15 in 1984).

Though Claire R. also appears to follow the community in a number of changes, closer investigation reveals that it is only those changes that involve vowel lowering; in fact, she significantly lowers her other long vowels as well, despite the fact that the community does not. In her case, then, there seems to be a general process of lowering of her entire vowel system.

Finally, all speakers but Ghislain N. (the most stable) show at least one vowel moving in a different direction from the community, as exemplified by the plots in Figure 7, in which the community backs and lowers but Louise C. raises[7] (N=22 in 1971, 15 in 1984).

[7]Louise's 1984 mean nevertheless brings her closer to other speakers: while her 1971 nucleus is much lower

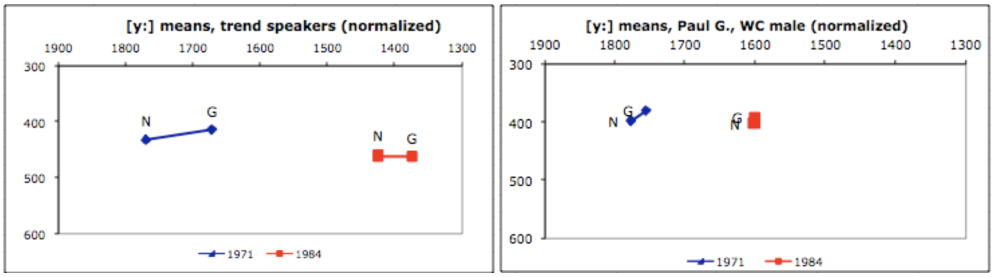

Figure 6: (y:) changes among the trend and one panel speaker.

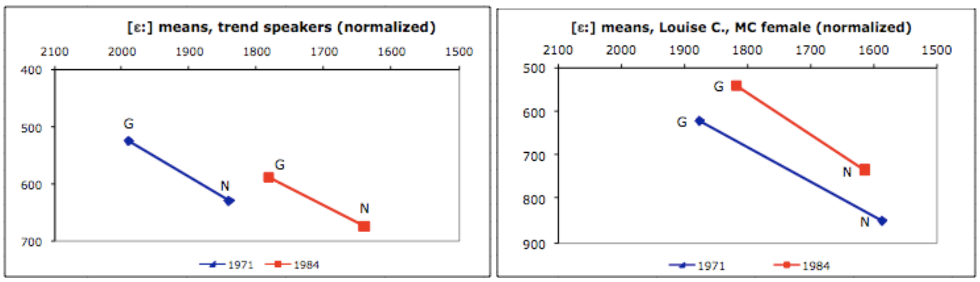

Figure 7: (ɛ:) changes among the trend and one panel speaker.

How can we explain such anomalous movements, which clearly do not indicate participation in community changes? One possible explanation is that they result from physiological changes due to the aging process. In his longitudinal study of the vowel system of the Queen of England, Harrington (2006) examines her pronunciation of [ə] in two different time periods. Since [ə] is not expected to be undergoing community change, any observed changes in this vowel should be due to age effects rather than to participation in community changes. Harrington finds that all formant frequencies of [ə] significantly lower across the Queen's lifespan. Based on these results, then, the aging process may explain any formant lowering observed in our panel, such as the anomalous raising and backing observed among speakers such as Louise C. and Charles P.

We also considered the possibility that anomalous speakers may in fact be participating in changes in the surrounding community that for some reason are not evident in our trend sample, but this seems unlikely: our trend sample is large enough that any significant changes should be evident; furthermore, the anomalous movements are scattered throughout the panel and typically speaker-specific, and thus do not appear to be part of a unified or organized change. Most likely, these anomalous movements are simply noise in the data, due to relatively small sample sizes (~15 tokens per vowel per interview). Finally, it's worth noting that many of the anomalous movements are restricted to (i:), which has been reported to display considerable phonetic variation in other languages with no effects on perception (Paul De Decker, p.c.).

7 Conclusion

This paper has followed the lead of Sankoff and Blondeau (2006) by examining the potential for speakers to change their linguistic systems later in life, by participating in ongoing changes observed in the surrounding community. While Sankoff and Blondeau examined a change from above, our work differs by examining a change from below the level of consciousness, namely diphthongization of long vowels. We find that, though there is considerable stability in the long vowels of our panel speakers over the 24-year span of our study, a few display linguistic malleability, shifting one or more vowels in the direction of real-time community changes.[8]

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than the community mean, her 1984 nucleus closely approaches the community norm.

[8]It is perhaps noteworthy that 5 of our 6 panel speakers were already age 20 or over at the time of the first

We have a number of ideas for future work, in addition to the always-present need to expand the size of our sample. We plan to examine a vowel which is not reported to be undergoing change, such as /a/, to serve as a control for the other vowels examined. This should help us identify which longitudinal vowel movements are due to general effects of aging or random fluctuations and which are due to actual change. We also hope to look more carefully at the effects of stress, speaking rate, and phonological environment (specifically, the nature of the following consonant) on diphthongization. But our study has provided some initial evidence that, even in the case of changes from below the level of consciousness, some particularly malleable speakers have the potential to change their linguistic systems even beyond the critical period.

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recording, going from their early or mid twenties to mid or late forties; Claire, only 16 in 1971, is the speaker who showed the most malleability.