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Low vowel variation in three French-speaking countries

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Abstract

It is commonly noted that standard French is losing the contrast between its two low vowels /a/ and /ɑ/, due to the fronting of the back vowel. The difference in length, which accompanied the qualitative difference of this pair, is affected as well. In mainland France, this tendency can be found to various degrees across the country, and is spreading throughout the speech community. This article further develops the picture of the current status of the low vowel contrast by investigating Belgian and Swiss French, where length is known to play overall a far more prominent role in the vowel inventories than it does in standard French. Are Belgian and Swiss French also affected by the merger of the two low vowels? To what extent can a difference in length and/or timbre still be found? And how do the patterns of contrast neutralisation/preservation relate to the developments in France?

Keywords: Low vowels, contrast neutralisation, sociophonetics, French, phonology

Résumé

Il est communément noté que le français standard est en train de perdre le contraste entre ses deux voyelles basses /a/ et /ɑ/, en raison de l'avancement de la voyelle arrière. La différence de longueur, qui a accompagné la différence qualitative de cette paire, est également affectée. En France métropolitaine, cette tendance peut être constatée à des degrés divers à travers le pays et se répand dans toute la communauté linguistique. Cet article met au point l'image de l'état actuel du contraste de voyelle faible en étudiant le français belge et le français suisse. Contrairement au français standard, on sait que la longueur joue globalement un rôle beaucoup plus important dans les inventaires vocaliques de ces variétés. Les français belge et suisse sont-ils également affectés par la fusion des deux voyelles basses? Dans quelle mesure peut-on encore trouver une différence de longueur ou de timbre? Et comment les schémas de neutralisation/préservation des contrastes sont-ils liés aux évolutions en France?

Mots clés: Voyelles basses, neutralisation du contraste, sociophonétique, français, phonologie

1. Introduction

French inherited two low vowels from Latin: anterior /a/ and posterior /ɑ/[1]. This vowel pair is generally still included in pronunciation manuals of French, but the distinction has been gradually disappearing in France since the 1950s (Martinet and Walter 1973: 32, Walter 1988: 256). The back vowel tends to merge with its front counterpart, which leads to neutralisation in minimal pairs such as *patte-pâte* ('paw'-'dough/pastry') or *mat-mât* ('mat'-'mast') (Léon 1966: 64, 1992: 87; Walter 1977: 41–42; Tranel 1987: 62–65; Hansen and Juillard 2011; Hansen 2014). Corpus research (Berns 2015) has shown that sometimes a clear distinction is maintained in vowel quality (timbre) and/or quantity (length), but the difference is often partially or fully neutralised: /ɑ/ loses its length and becomes a central or front vowel. This phenomenon can be found throughout France: the contrast is most systematically neutralised in the South, but also in other regions clear patterns of neutralisation emerge. The older generations are more likely to maintain a difference (in frontness/backness and/or length) than the younger generations, but a considerable amount of variation exists among speakers of each generation. It is beyond all doubt, however, that the back vowel is strongly involved in a process of centralisation/fronting across the various speech communities of France. Interestingly, compared with the "Metropolitan French" varieties, the low vowel contrast in the Belgian and Swiss varieties of French seems to be of a different nature.

French spoken in Belgium and Switzerland differs from the reference variety in several respects, although the three varieties are in principle mutually intelligible (e.g., Walter 1988; Miller and Grosjean 1997; Francard 1999, 2008; Grosjean et al. 2007; Miller et al. 2011). An important number of differences can be found at the lexical level, but salient particularities also exist in the pronunciation. It is hard, if not impossible, to provide a characterisation of "the" Belgian[2] or "the" Swiss variety because of geographical variation in Wallonia[3] and the French-speaking part of Switzerland (Métral 1977: 146, Walter 1988, Francard 1999, Hambye and Francard 2004), but one of the characteristic features of each of these accents is the role length plays in the vocalic system. Both Walloon and Swiss French systematically produce length distinctions for qualitatively (i.e., spectrally) identical vowels, for instance in minimal pairs like *aimé/aimée*, *tu/tue*, *bout/boue*. In standard French, the vowels in each of these pairs are completely homophonous. Another Swiss and Walloon characteristic concerns the way the contrast between the low vowels /a/ and /ɑ/ is realised: for both varieties, length is claimed to be an important cue, with /ɑ/ being longer than /a/. For Belgium, it is commonly reported that a length

[1]Abbreviations used: ANOVA: Analysis of Variance test; PFC (database): Phonologie du français contemporain; SPSS: Statistical Package for the Social Sciences.

[2]Moreover, for a long time, the available data on Belgian French were biased towards the variety of Liège (Francard 1999: 5, Hambye et al. 2003: 56–57, Francard 2008: 43).

[3]'Wallonia' is used in two different ways in the literature. It either refers to the French-speaking part of Belgium, or, in a more restricted sense, to the area where the Walloon dialect is spoken. In this study, the former definition is adopted (i.e., the area covering the dialectal regions of Walloon, Picard, Lorrain and Champenois, see Francard 2008: 39).

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difference between the vowels is maintained, whereas the qualitative distinction has been neutralised. This is most apparent in the Centre and East of Wallonia, and less in the Western part (i.e., the area with a Picard substratum) (Pohl 1985, Walter 1988, Francard 2008). For Switzerland, length is also said to be involved, but the presence of a qualitative parameter is less clear. According to Métral (1977: 152) the contrast primarily involves length, rather than vowel quality, whereas Miller and Grosjean (1997: 278) and Andreassen et al. (2010: 222) state that both durational and spectral differences are involved.

The existing literature thus does not yet provide a clear and comprehensive picture of the low-vowel contrast in the Belgian and Swiss varieties of French. By analysing spoken language data, this study aims to provide a precise characterisation of the parameters of variation involved: to what extent are qualitative and quantitative contrasts produced across the Swiss and Walloon territories? The nature of the low vowel contrast in these two varieties will also be discussed in light of the developments in Metropolitan France, where the contrast is gradually disappearing and affects both the vocalic quantity and quality.

The article is organised as follows. Section 2 presents the corpus material used in this study and describes the methodology adopted. Section 3 discusses the results, focusing on the degree of vowel fronting and length differences, and is followed by a general discussion and conclusion in section 4.

2. METHODOLOGY

A number of surveys of the PFC (*Phonologie du français contemporain*) database (Durand et al. 2002, 2005, 2009; Detey et al. 2010)[4] were selected and analysed. This large spoken-language corpus of different varieties of French currently contains three Belgian and three Swiss surveys. For Belgium, these are Gembloux (situated to the south-east of Brussels, in the province of Namur), Liège (which lies close to the Dutch and German borders, in the province of Liège) and Tournai (located close to the French border, to the west-south-west of Brussels, in the province of Hainaut). The Swiss samples are from Geneva (the capital of the canton of Geneva, in the South-West, mainly surrounded by French borders), Neuchâtel (the capital of the canton of Neuchâtel, situated between the French border and the Swiss-German-speaking canton of Bern), and Nyon (situated in the canton of Vaud, to the north of Geneva). The surveys each contain about a dozen speakers, and are balanced for gender and age.[5] Figure 1 shows the geographical spread of the Belgian and Swiss surveys, and the distribution of the sociolinguistic features across the samples is given in Table 1.[6]

[4]<www.projet-pfc.net>

[5]Information about the socioeconomic background of the speakers is provided in the metadata accompanying the corpus. This parameter has not been used as a selection criterion during the recruitment of participants and will therefore not be included as a variable in this study.

[6]Generation I includes students and young people in the early years of their professional career. The lower bound for Generation III was set at age 55, as the reference samples from

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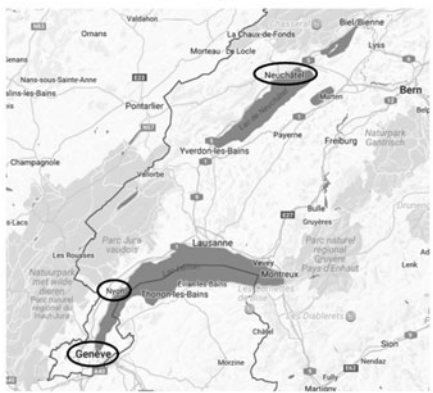
(a) Belgium



(b) Switzerland

Figure 1: Geographical distribution of the surveys (www.snazzymaps.com)

		Generation I *18–30*	*Generation II* *31–54*	*Generation III* *≥55*	Total	
Gembloux	**Male**	**2**	**2**	**2**	**6**	*12*
	Female	2	3	1	6	
Liège	**Male**	**2**	**2**	**2**	**6**	*12*
	Female	2	2	2	6	
Tournai	**Male**	**4**	**1**	**1**	**6**	*12*
	Female	2	2	2	6	
All locations	**Male**	**8**	**5**	**5**	**18**	*36*
	Female	6	7	5	18	
	Total	*14*	*12*	*10*		

Table 1a: Demographic information for Belgium (*n* speakers)

		Generation I *20–30*	*Generation II* *31–54*	*Generation III* *≥55*	Total	
Geneva	**Male**	**1**	**2**	**1**	**4**	*9*
	Female	1	2	2	5	
Neuchâtel	**Male**	**0**	**4**	**2**	**6**	*13*
	Female	2	3	2	7	
Nyon	**Male**	**0**	**4**	**3**	**7**	*12*
	Female	1	3	1	5	
All locations	**Male**	**1**	**10**	**6**	**17**	*34*
	Female	4	8	5	17	
	Total	*5*	*18*	*11*		

Table 1b: Demographic information for Switzerland (*n* speakers)

In order to put the Belgian and Swiss performances in proper perspective, the speakers of these varieties will be compared to the hexagonal French speakers studied in Berns (2015). The demographic details of this reference group[7] are given in Figure 2 and Table 2.

France already included a substantial number of retired people from that age onwards. Every classification of speakers into generations is of course to a certain extent artificial, as for instance a speaker who has just turned 31 will not start to talk dramatically differently immediately after his birthday, but the classification adopted here at least allows to distinguish, without too much overlap, between students, working people, and speakers approaching retirement/retired speakers.

[7]This selection contains only those speakers whose recordings could be analysed. A very limited number of participants had to be discarded because one or more of the required token(s) in their recordings was/were disturbed by background noise.

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Figure 2: Geographical spread of the surveys in France

		Generation I 20–30	*Generation II 31–54*	*Generation III ≥55*	*Total*	
Aveyronnais à Paris (a)	**Male**	**2**	**1**	**2**	**5**	*12*
	Female	4	1	2	7	
Brunoy (b)	**Male**	**1**	**1**	**3**	**5**	*10*
	Female	1	1	3	5	
Lyon (c)	**Male**	**1**	**3**	**1**	**5**	*7*
	Female	2	0	0	2	
Marseille (d)	**Male**	**1**	**2**	**1**	**4**	*10*
	Female	2	2	2	6	
Nantes (e)	**Male**	**1**	**0**	**3**	**4**	*10*
	Female	2	1	3	6	
Ogéviller (f)	**Male**	**0**	**2**	**2**	**4**	*10*
	Female	2	1	3	6	
Paris centre ville (g)	**Male**	**2**	**2**	**2**	**6**	*12*
	Female	2	2	2	6	
Puteaux-Courbevoie (h)	**Male**	**1**	**0**	**1**	**2**	*5*
	Female	2	0	1	3	
Rodez (i)	**Male**	**2**	**0**	**1**	**3**	*7*
	Female	2	0	2	4	
All locations	**Male**	**11**	**11**	**16**	**38**	*83*
	Female	19	8	18	45	
	Total	*30*	*19*	*34*		

Table 2: Demographic information (*n* speakers)[8]

In order to enable optimal comparison of the Belgian and Swiss outcomes with the Metropolitan French corpus study, the same methodology as used in Berns (2015)

[8]The PFC database contains three Parisian subcorpora. The 'Paris centre ville' survey contains speakers living in the city centre of Paris. The 'Aveyronnais à Paris' are Parisian citizens

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was adopted. All PFC speakers participated in two conversation tasks (an interview and a spontaneous conversation) and in two reading tasks (a wordlist with 94 items and a one-page narrative text).

The minimal pair *patte* (/a/ 'paw') and *pâte* (/ɑ/ 'dough/pastry') are present in both the text and the wordlist, but only the wordlist tokens were taken into account here. That is, they occur in stressed position in this task (i.e., the most likely context for the low vowel contrast to be maintained (Léon 1966: 64, Walter 1977: 41–42, Tranel 1987: 62–65) whereas they are phrase-internal (i.e., in unstressed position) in the read text. The words *patte* and *pâte* each occur twice in the list. The first time, they occur as randomly ordered items, the second time, they are directly sequenced and constitute a minimal pair. These four tokens were acoustically analysed with Praat software (Boersma and Weenink 2016). The vowel length was measured by taking the beginning of the first full glottal pulse of the vowel at the zero crossing as the starting point. The qualitative parameter of interest is the second formant (F2), representing frontness/backness.[9] It was extracted at 50% of the vowel (Harrington 2010: 206–213). For the statistical analyses, the linear frequency values in Hertz were converted to the non-linear Bark scale (Traunmüller 1990),[10] which incorporates most faithfully the non-linear nature of perception of frequency.

3. Results

The contrastive parameters vowel quality and vowel quantity will first be described separately, followed by a discussion of their combined presence or absence.

3.1 Vowel frontness/backness

The corpus study for France has shown that speakers who maintained a certain degree of qualitative difference between the two vowels generally produced larger F2 differences when they were directly confronted with the contrast, as when the items were listed as a minimal pair (see Table 3c and Berns 2015: 9–10 for a complete overview and discussion). The average absolute F2 differences between the two low vowel tokens for Belgium and Switzerland are given in Tables 3a and 3b.[11]

who moved from the Aveyron region in the South of France to Paris during the middle of the 19th century and the first decades of the 20th century. This survey contains recordings of the older original migrants but also of their children, who were born and raised in Paris. The third corpus was recorded in the suburbs of Puteaux and Courbevoie, to the west of Paris, near the business quarter of *La Défense*.

[9]The parameters generally mentioned to be of relevance for the low-vowel contrast are frontness/backness, and length. As shown in Berns (2015), the first formant (F1), representing vowel height, indeed does not play a role, and is therefore excluded here. F2 thus represents frontness/backness: the higher the F2 value, the more front the vowel.

[10]An online converter can be found on the following website: <http://www2.ling.su.se/staff/hartmut/umrechnung.htm>

[11]Rietveld and Van Heuven (2001: 202) state that the perceptual threshold for discrimination between two vowels on the basis of F2 lies at 1.5%. Section 3.3 will discuss this aspect in more detail.

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		Random order	Minimal pair sequence
a.	**Belgium**		
	Gembloux	66.42 (SD: 55.89)	48.75 (SD: 46.83)
	Liège	73.00 (SD: 45.03)	58.92 (SD: 66.65)
	Tournai	89.08 (SD: 66.25)	76.67 (SD: 48.84)
	Overall	**76.17 (SD: 55.60)**	**61.44 (SD: 54.52)**
b.	**Switzerland**		
	Geneva	113.22 (SD: 101.87)	151.67 (SD: 146.31)
	Neuchâtel	205.77 (SD: 103.01)	173.77 (SD: 166.91)
	Nyon	259.33 (SD: 162.22)	311.08 (SD: 141.59)
	Overall	**200.18 (SD: 135.99)**	**216.38 (SD: 164.69)**
c.	**France**		
	Aveyronnais à Paris	52.67 (SD: 34.67)	56.92 (SD: 41.14)
	Brunoy	146.10 (SD: 150.71)	229.30 (SD: 185.74)
	Lyon	143.57 (SD: 90.61	120.86 (SD: 63.69)
	Marseille	51.50 (SD: 41.65)	86.30 (SD: 115.01)
	Nantes	197.90 (SD: 118.13)	272.80 (SD: 156.22)
	Ogéviller	184.20 (SD: 128.22)	226.10 (SD: 152.45)
	Paris centre	107.17 (SD: 98.04)	168.00 (SD: 141.17)
	Puteaux-Courbevoie	171.20 (SD: 141.69)	240.00 (SD: 166.58)
	Rodez	102.29 (SD: 136.45)	56.00 (SD: 36.91)
	Overall	**124.00 (SD: 114.96)**	**160.02 (SD: 146.49)**

Table 3: Average absolute F2 differences (in Hertz)

The Swiss surveys for Geneva and Nyon show larger overall mean differences between *patte* and *pâte* in the minimal pair context. The pattern is the reverse for Neuchâtel. However, the standard deviations of all three Swiss samples are substantial, indicating a considerable amount of inter-speaker variation.[12] As far as the mean F2 differences per se are concerned, Geneva's score approximates the mean value of France. Still, as the different French means show, this country does not behave as a homogeneous zone and it is therefore more accurate to say that Geneva behaves rather similarly to the Paris centre survey. Interestingly, Neuchâtel and especially

[12]In the randomised context, four speakers produced a difference between the two tokens that was smaller than 1.5%. Among the 30 Swiss speakers producing larger differences than this 1.5%, 29 speakers produced a higher F2 in *patte* than in *pâte*, while for one participant the pattern was slightly reversed. In the minimal pair sequence, the realised patterns were about equal: the F2 differences of three speakers fell below the 1.5% threshold, one speaker (a different one than in the random order) reversed the pattern by producing a subtly higher F2 for *pâte*, and the remaining 30 participants produced a difference where *patte* had higher F2 values than *pâte*.

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		Differences in Hertz					
		0–25	26–100	101–150	151–200	201–300	>300
a.	**Random order**						
	Gembloux	4	6	1	1	0	0
	Liège	1	8	2	1	0	0
	Tournai	3	4	3	1	1	0
	All locations	**8**	**18**	**6**	**3**	**1**	**0**
b.	**Minimal sequence**						
	Gembloux	5	5	2	0	0	0
	Liège	4	6	1	0	1	0
	Tournai	3	6	2	1	0	0
	All locations	**12**	**17**	**5**	**1**	**1**	**0**

Table 4: Absolute F2 differences for Belgium (individual speakers per survey)

Nyon highlight the frontness/backness cue in a far stronger way than Geneva and most surveys in France.

More striking differences arise when the Belgian scores are also taken into account. Contrary to the general tendency of producing a larger contrast in the minimal-pair context among the not-fully-neutralising speakers of France and Switzerland, the Belgian F2 differences in the random sequence are the reverse of what would be expected: for all samples they are somewhat larger than in the minimal pair context.[13] Even more striking, however, is the observation that the Belgian qualitative differences (as well as the standard deviations) in both contexts are overall considerably smaller than in Switzerland and the Middle and North of France.[14]

As the standard deviations have quite substantial ranges, it is worthwhile to zoom in on the individual realisations and the way these patterns are dispersed among the different age groups and genders. Tables 4 and 5 more explicitly illustrate the individual variation by providing the dispersion of contrasts realised by the Swiss and Belgian participants. When considering the data in these tables, the reader should keep in mind the information provided in footnotes 12 and 13. That is, the tables present the absolute differences, but a number of speakers reversed the contrast.

[13]In the randomised context, seven of the 36 participants produced F2 differences between the two tokens which were smaller than 1.5%. Twelve of the 29 remaining speakers reversed the contrast by producing a higher F2 value for the low vowel in *pâte*, and 17 participants maintained a difference between the two tokens where the vowel in *patte* was more front (higher F2) than in *pâte*. In the minimal pair context, one third of the speakers neutralised the contrast below the 1.5% level, eight speakers reversed the contrast to a greater or lesser extent, and nine participants produced a more front vowel in *patte* in comparison with *pâte*.

[14]Marseille and Aveyronnais à Paris are closest to the Belgian pattern. Note that the other French surveys, which all neutralise F2 to a certain extent, still maintain larger differences than in Belgium.

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		Differences in Hertz					
		0–25	26–100	101–150	151–200	201–300	>300
a.	**Random order**						
	Geneva	3	2	1	1	2	0
	Neuchâtel	0	2	2	2	5	2
	Nyon	1	1	1	1	4	4
	All locations	**4**	**5**	**4**	**4**	**11**	**6**
b.	**Minimal sequence**						
	Geneva	2	3	0	1	1	2
	Neuchâtel	0	4	4	1	2	2
	Nyon	1	0	0	2	2	7
	All locations	**3**	**7**	**4**	**4**	**5**	**11**

Table 5: Absolute F2 differences for Switzerland (individual speakers per survey)

These reversals show the speakers' uncertainty on the nature of the contrast and reflect the degree of instability of the distinction. Figures 3 and 4 show the average absolute frontness/backness differences between the low vowels in the *patte* and *pâte* tokens with respect gender and age.[15] The full descriptive statistics are given in Tables 13 and 14 in the Appendix.

The Belgian and Swiss data were analysed by means of a repeated measures ANOVA in SPSS. As indicated above, the statistical analysis was based on the Bark frequency values, and included the within-subject factor 'context' (random order or minimal pair sequence) and the between-subject factors 'age', 'gender' and 'regional background'. The significance level α was set at .05. For both the Belgian and Swiss surveys, no significant effects were obtained: the difference between the random and minimal pair contexts for each country does not exceed chance level, and the different Belgian and Swiss speakers are still quite stable across the different genders, generations and even regions.[16]

An extended repeated measures computation, including the individual realisations of the French, Belgian and Swiss surveys at the same time, yields a number of interesting insights.[17] The asterisks in Table 6 indicate the significant differences.

[15]As stated in footnote 11, F2 differences between two vowels are perceptible for a listener if they are larger than 1.5%. With respect to the F2 values given in Tables 4 and 5, this roughly holds for the F2 differences larger than 25 Hertz.

[16]Belgium: Context: $F_{1,18} = 1.741$ ($p = 0.204$); Age: $F_{2,18} = 0.031$ ($p = 0.970$); Gender: $F_{1,18} = 0.696$ ($p = 0.415$); Region: $F_{2,18} = 0.781$ ($p = 0.473$).
Switzerland: Context: $F_{1,18} = 1.361$ ($p = 0.259$); Age: $F_{2,18} = 0.020$ ($p = 0.980$); Gender: $F_{1,18} = 0.005$ ($p = 0.945$); Region: $F_{2,18} = 1.164$ ($p = 0.335$).

[17]The different French, Swiss and Belgian regions were listed as 15 separate surveys. The factor 'country' was not included as such because of the considerable amount of heterogeneity within each country.

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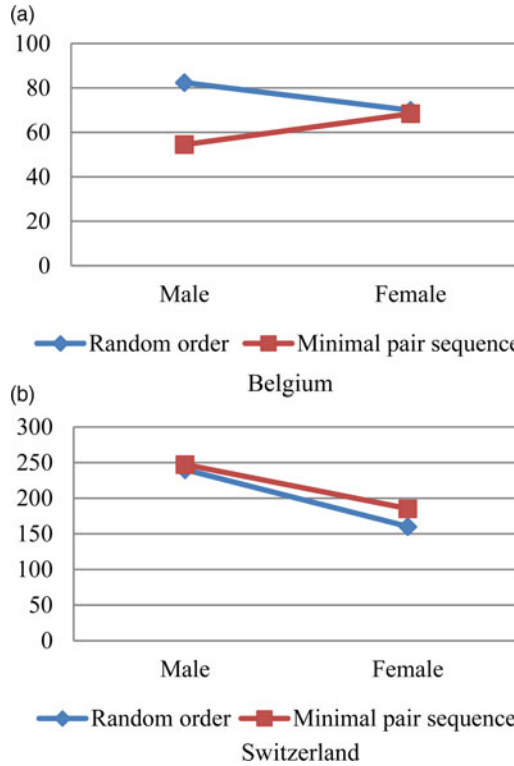

Figure 3: Average absolute F2 differences (in Hertz) according to gender

The Belgian speakers produced significantly smaller F2 differences than the speakers in the French surveys of Brunoy, Nantes and Ogéviller, which preserved a considerable F2 difference. Gembloux and Liège differ from all three of these Metropolitan samples, Tournai (the Belgian survey closest to the French border and with the highest average differences in Table 3a), deviates only from Nantes and Ogéviller. As the F2 difference has become very unstable and variable across France, no systematic overall difference between the two countries emerges.

A France-Switzerland comparison shows no meaningful differences for Neuchâtel and Geneva, which thus behave quite France-like. The picture is different for Nyon, the sample with the most pronounced F2 distinctions. It differs statistically from the most strongly neutralising samples of France: Aveyronnais à Paris, Lyon, Marseille, Rodez (i.e., surveys with speakers living in or originating from the South of France) and Paris centre. Statistical differences also emerge between Belgium and Switzerland. As expected on the basis of the figures in Table 3, these countries do not differ just by chance. The statistical comparison reveals that the large differences of Nyon are indeed higher than in all three Belgian samples, and Neuchâtel differs from Gembloux (the most radically F2-neutralising Belgian

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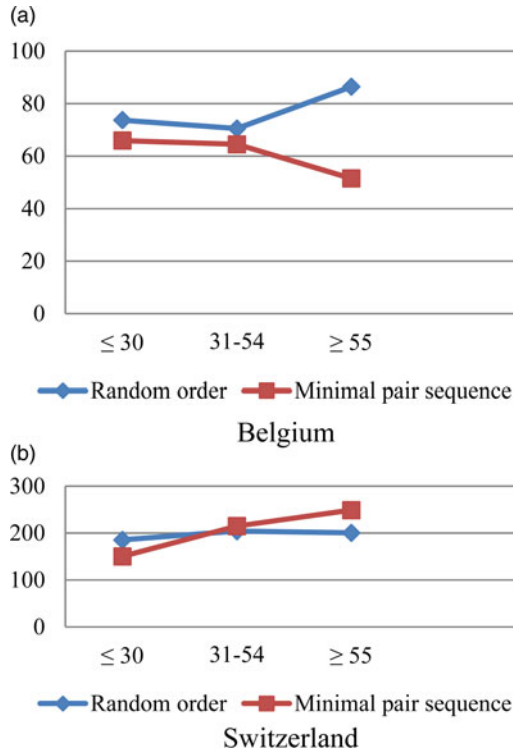

Figure 4: Average absolute F2 differences (in Hertz) according to generation

survey). Geneva, the most extreme F2-reducing Swiss sample, does not differ significantly from the Belgian productions.

Even though within both Belgium and Switzerland no statistically relevant differences arose between the regions, the full set of F2 results suggests that the three countries under scrutiny differ along a continuum: at one end we find the least reducing surveys (with Nyon at the low end), followed by a middle range of moderately reducing surveys, where several Swiss and French varieties intertwine to various degrees. At the high end of the continuum, we find the surveys that tend to reduce the contrast most strongly: those of Southern France and Belgium.

Adjacency to the French border, the degree of contact with France, and/or attitudes towards France seem to influence the degree of F2 maintenance (see Figure 1). That is, Geneva, situated close to the border and with close social and economic ties to France, is less pronounced in its F2 maintenance than the other Swiss varieties, and Tournai is less extreme in its F2 reduction than the other Belgian samples further removed from the border. Still, note that in Nyon, which is not far removed from France geographically speaking, no such effect is observable, probably

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		France (F)									Belgium (B)			Switzerland (CH)		
		Avey. à Paris	Brunoy	Lyon	Marseille	Nantes	Ogéviller	Paris centre	Puteaux-Courbevoie	Rodez	Gembloux	Liège	Tournai	Geneva	Neuchâtel	Nyon
F	Avey. à Paris					*	*									*
	Brunoy										*	*				
	Lyon															*
	Marseille					*	*									*
	Nantes	*			*					*	*	*	*			
	Ogéviller	*			*						*	*	*			
	Paris centre															*
	Puteaux-Courbevoie															
	Rodez					*										*
B	Gembloux		*			*	*								*	*
	Liège		*			*	*									*
	Tournai					*	*									*
CH	Geneva															
	Neuchâtel										*					
	Nyon	*		*	*			*		*	*	*	*			

Table 6: F2: France, Belgium and Switzerland

		Random order	Minimal pair sequence
a.	**Belgium**		
	Gembloux	117.83 (SD: 60.31)	145.00 (SD: 70.97)
	Liège	152.75 (SD: 79.79)	146.58 (SD: 34.72)
	Tournai	92.08 (SD: 66.43)	107.83 (SD: 68.60)
	All locations	**120.89 (SD: 71.88)**	**133.14 (SD: 61.40)**
b.	**Switzerland**		
	Geneva	99.33 (SD: 72.69)	75.00 (SD: 56.21)
	Neuchâtel	159.85 (SD: 46.11)	115.08 (SD: 61.71)
	Nyon	137.50 (SD: 72.25)	157.42 (SD: 76.19)
	All locations	**135.94 (SD: 66.22)**	**119.41 (SD: 71.81)**
c.	**France**		
	Aveyronnais à Paris	25.65 (SD: 15.89)	38.23 (SD: 27.49)
	Brunoy	54.62 (SD: 38.47)	59.60 (SD: 83.36)
	Lyon	24.16 (SD: 22.43)	32.61 (SD: 16.50)
	Marseille	17.83 (SD: 18.49)	15.08 (SD: 8.38)
	Nantes	34.28 (SD: 32.11)	39.03 (SD: 44.89)
	Ogéviller	70.60 (SD: 51.57)	102.30 (SD: 74.31)
	Paris centre	54.12 (SD: 56.62)	58.38 (SD: 51.15)
	Puteaux-Courbevoie	32.44 (SD: 24.65)	62.90 (SD: 71.46)
	Rodez	7.44 (SD: 4.03)	14.77 (SD: 9.06)
	All locations	**37.52 (SD: 38.85)**	**47.78 (SD: 54.78)**

Table 7: Average absolute length differences (in milliseconds)

because its contacts with and/or attitudes towards mainland France are not as strong as in Geneva.[18]

3.2 Vowel length

The length results in Table 7 are even more intriguing than the F2 outcomes. As the scores in Table 7c show, the length parameter has not been preserved to the same extent across France. In the zones where considerable traces of the length distinction can still be found, the longer length cues typically accompany the larger F2 contrasts. In comparison with speakers from France, Belgian and Swiss francophones generally produce a greater length contrast between the two vowels in both contexts.[19]

[18]Another factor that might play a role, if one considers the scores in Table 3, is that in zones where the contrast is not yet fully reduced – Switzerland and the North and Centre of France – the contrast is nevertheless affected to a greater extent in the larger cities (Paris centre, Lyon, Geneva). This could be an indication that a movement towards a new norm of contrast levelling or neutralisation is taking place in the larger urban zones, whereas more remote areas get involved only at a later stage (e.g., Milroy and Milroy 1993, Milroy 2004). We return to this point in section 4.

[19]As noted by Rietveld and Van Heuven (2001: 202), for a hearer to be able to perceive the length distinction between two vowels, the difference should be at least 10%.

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	Differences in milliseconds					
	0–25	26–50	51–75	76–100	101–200	>200
a. Random order						
Gembloux	2	1	0	1	8	0
Liège	0	1	0	2	7	2
Tournai	3	2	0	0	7	0
All locations	5	4	0	3	22	2
b. Minimal pair sequence						
Gembloux	0	0	0	4	6	2
Liège	0	0	0	1	10	1
Tournai	2	1	0	2	6	1
All locations	2	1	0	7	22	4

Table 8: Absolute length differences Belgium (individual speakers per survey)

The patterns observed for Gembloux, Tournai and Nyon suggest that the speakers involved tend to emphasise the length contrast when they are directly confronted with the minimal pair. The mean for Liège is about equal in both contexts, whereas the length difference between the *patte* and *pâte* tokens in the Geneva and Neuchâtel samples seem instead to be attenuated somewhat in the minimal pair context.[20] Again, as the standard deviations show, variation among speakers is substantial, which makes it difficult to interpret these data without looking at the more fine-grained distributions. The absolute individual length differences for the speakers of each survey are given in Tables 8 and 9, which should be considered in the light of the observations made in footnote 20. Figures 5 and 6 show the sociolinguistic distribution of the length cues with respect to the age and gender of the participants. Tables 15 and 16 in the Appendix provide the full descriptive statistics.

Statistical assessment of the data[21] (again a repeated measures ANOVA with α set at .05) reveals that for both Belgium and Switzerland, the difference between the

[20] Belgium: in the randomised context, four speakers realised a *patte-pâte* difference smaller than 10%. For 31 of the remaining 32 speakers, *pâte* was longer than *patte* (in line with expectations), and in only one case, the contrast was reversed, with *patte* longer than *pâte*. In the minimal pair sequence, two of 36 speakers produced a contrast below the 10% threshold. Thirty-three of the remaining 34 speakers produced a longer vowel in *pâte*, while one (not the same speaker as in the random sequence) reversed the contrast.
Switzerland: in the randomised sequence, all speakers produced a length that exceeded the 10% threshold. Thirty-two participants produced the expected pattern where the vowel in *pâte* was longer than in *patte*, and two speakers slightly reversed the pattern. In the minimal pair context, two speakers produced a difference between the two tokens that was smaller than 10%, for the 31 of the 32 remaining speakers, the vowel in *pâte* was perceptually longer than in *patte*, and again for one speaker the contrast was reversed (not the same speaker as in the random sequence).

[21] Belgium: Context: $F_{1,18} = 0.553$ ($p = 0.467$); Age: $F_{2,18} = 0.912$ ($p = 0.420$); Gender: $F_{1,18} = 0.931$ ($p = 0.347$); Region: $F_{2,18} = 2.908$ ($p = 0.08$).

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	Differences in milliseconds					
	0–25	26–50	51–75	76–100	101–200	>200
a. Random order						
Geneva	0	3	2	1	2	1
Neuchâtel	0	0	1	0	9	3
Nyon	0	1	1	3	4	3
All locations	0	4	4	4	15	7
b. Minimal pair sequence						
Geneva	1	3	1	1	3	0
Neuchâtel	2	0	0	2	7	2
Nyon	0	1	1	1	6	3
All locations	3	4	2	4	16	5

Table 9: Absolute length differences Switzerland (individual speakers per survey)

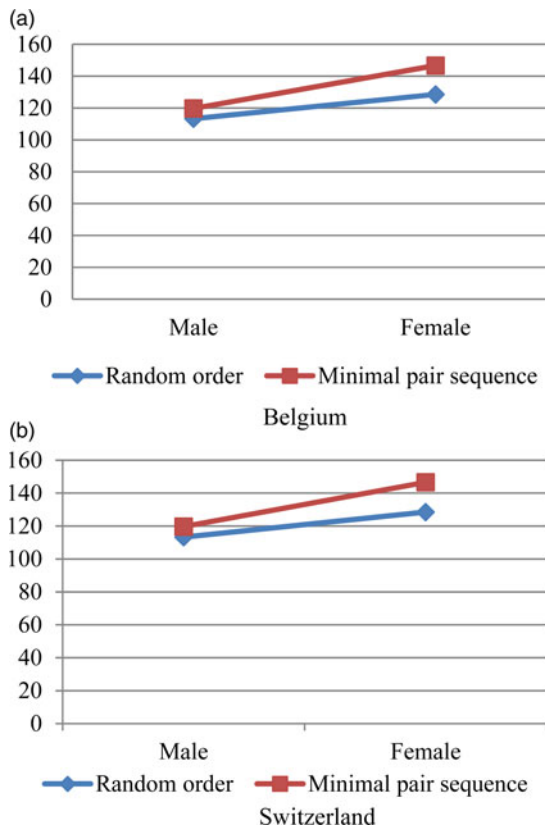

Figure 5: Average absolute length differences (in milliseconds) according to gender

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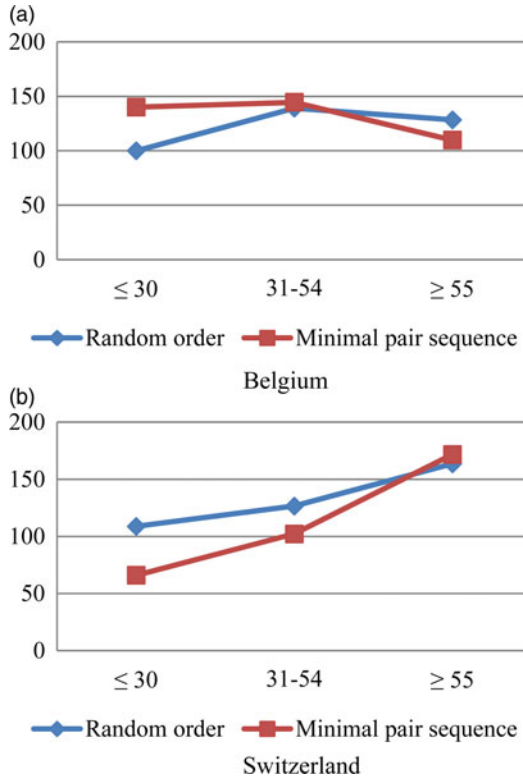

Figure 6: Average absolute length differences (in milliseconds) by generation

random and minimal-pair context is not significant. The between-subject variables are, however, of different magnitude in these two varieties. The Belgian speakers do not differ systematically from one another on the basis of their age, gender or regional origin, whereas the Swiss speakers behave quite differently according to their age and regional background. The differences in Geneva are significantly smaller than in Nyon, while Neuchâtel lies between the two. Irrespective of regional background, age turns out to be statistically relevant. Several aspects may be involved here. As was found for their French neighbours, the length distinction may be disappearing to a certain extent among the younger Swiss speakers. Crucially though, this reduction is more moderate for the Swiss: length differences tend to be smaller for younger Swiss people than for their older compatriots, but the differences realised by these younger Swiss speakers are generally still considerable compared with those of their French peers. Another aspect that may play a role is that, in comparison with the younger generations, older speakers have more explicit or vivid knowledge

Switzerland: Context: $F_{1,18} = .956$ ($p = 0.341$); Age: $F_{2,18} = 6.399$ ($p = 0.008$); Gender: $F_{1,18} = 3.666$ ($p = 0.072$); Region: $F_{2,18} = 5.833$ ($p = 0.011$).

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of the existence of a low vowel contrast. When presented with the tokens in question, their awareness is triggered, and they put this knowledge into practice in a more extreme way than do the younger generation(s).

As with F2, an extended repeated measures computation was carried out to compare the individual realisations of the speakers from France, Belgium and Switzerland. The results are given in Table 10, where the asterisks again indicate the significant differences.

With respect to the Swiss surveys, essentially Neuchâtel and Nyon deviate from France, both differing significantly from eight Metropolitan samples (all except Ogéviller). The situation is different for Geneva, which differs only from Rodez and Marseille, two Southern groups that reduce length quite drastically. Like Tournai for Belgium, Geneva thus behaves quite Central/Northern French-like, and both surveys also did as far as F2 was concerned. Our findings are thus in line with the commonly expressed ideas that the variety of the Tournai region is the Walloon variety which sounds most France-like (e.g., Hambye et al. 2010), and that the variety of French spoken in Geneva is the Swiss variety closest to standard French (e.g., Francard 2001, Racine et al. 2013).

The Belgian and Swiss surveys do not deviate significantly from each other, which implies that the relative presence of length is not radically different in these varieties (contrary to what was seen for F2). This does not hold for the Belgium-France comparison. The differences are most obvious for Gembloux, which differs from eight out of nine French surveys, and Liège, which differs from all nine of the French surveys. The speakers of Tournai differ from the Southern French speakers (i.e., the most radical neutralisers in France), but do not systematically deviate from the Central and Northern France varieties. As shown by Table 7a, the mean length distinction in Tournai is smaller than in the other two Belgian surveys, and the statistical results again strongly suggest that geographical distribution plays a role here. Tournai is situated in a region with a Picard substratum, and moreover, it is located close to the French border and maintains intensive economic contacts with the Northern France city of Lille; this evidently influences the degree of length maintenance.

The presence of a more extensive, systematic length contrast can thus be seen as characteristic of the Belgian and Swiss varieties. This contrast is still quite pronounced in both countries, although with different age-based patterns. However, as noted earlier for F2, the differences must be interpreted on a continuous scale: adjacency to the French border, degree of contact with France, and the attitudes towards France and its linguistic variety, are all likely to affect the degree of maintenance of the length contrast. Section 4 will discuss these sociolinguistic influences in more detail.

3.3 Anteriority and length

The preceding sections focused on the parameters of vowel quality and quantity in isolation. For France, different patterns of contrast maintenance and reduction were revealed, with length and timbre being affected to different degrees. The large(r)

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		France (F)									Belgium (B)			Switzerland (CH)		
		Avey. à Paris	Brunoy	Lyon	Marseille	Nantes	Ogéviller	Paris centre	Puteaux-Courbevoie	Rodez	Gembloux	Liège	Tournai	Geneva	Neuchâtel	Nyon
F	Avey. à Paris										*	*	*		*	*
	Brunoy										*	*			*	*
	Lyon										*	*	*		*	*
	Marseille						*				*	*	*	*	*	*
	Nantes										*	*	*		*	*
	Ogéviller				*					*	.	*				.
	Paris centre										*	*			*	*
	Puteaux-Courbevoie										*	*			*	*
	Rodez						*				*	*	*	*	*	*
B	Gembloux	*	*	*	*	*		*	*	*						
	Liège	*	*	*	*	*	*	*	*	*						
	Tournai	*		*	*	*				*						
CH	Geneva				*					*						*
	Neuchâtel	*	*	*	*	*		*	*	*						
	Nyon	*	*	*	*	*		*	*	*				*		

Table 10: Length: France, Belgium and Switzerland (significant differences are indicated by *)

a. Randomised order	*n*	b. Minimal pair sequence	*n*
Large quality difference (>20%)	*1*	*Large quality difference* (>20%)	*0*
large length difference (>50%)	0	large length difference (>50%)	0
medium length difference (21%–50%)	1	medium length difference (21%–50%)	0
small length difference (11%–20%)	0	small length difference (11%–20%)	0
no length difference (≤10%)	0	no length difference (≤10%)	0
Medium quality difference (*11%–20%*)	*4*	*Medium quality difference* (*11%–20%*)	*2*
large length difference (>50%)	4	large length difference (>50%)	1
medium length difference (21%–50%)	0	medium length difference (21%–50%)	1
small length difference (11%–20%)	0	small length difference (11%–20%)	0
no length difference (≤10%)	0	no length difference (≤10%)	0
Small quality difference (*1.6%–10%*)	*24*	*Small quality difference* (*1.6%–10%*)	*22*
large length difference (>50%)	7	large length difference (>50%)	10
medium length difference (21%–50%)	11	medium length difference (21%–50%)	9
small length difference (11%–20%)	3	small length difference (11%–20%)	1
no length difference (≤10%)	3	no length difference (≤10%)	2
No quality difference (*≤1.5 %*)	*7*	*No quality difference* (*≤1.5 %*)	*12*
large length difference (>50%)	4	large length difference (>50%)	6
medium length difference (21%–50%)	2	medium length difference (21%–50%)	6
small length difference (11%–20%)	0	small length difference (11%–20%)	0
no length difference (≤10%)	1	no length difference (≤10%)	0

Table 11: Patterns of contrast maintenance and reduction: Belgium

length differences showed up with large(r) F2 differences, but overall the two parameters proved to be only weakly correlated: the squared correlation coefficient (r^2) indicated that only 13% of the variation in length could be ascribed to variations in F2 (Berns 2015: 12–13). In the Metropolitan French varieties that maintain the low vowel contrast to a certain extent, length is thus more than just an enhancing cue for F2, and the two can be used as independent contrastive signals.

Let us now consider how Belgian and Swiss speakers do or do not combine the parameters of frontness/backness and length in their realisations of the two low vowel tokens under scrutiny. Table 11 gives an overview of the patterns produced by the Belgian participants. These results again clearly show the general absence of a strong F2 difference between the two vowels, but now we are able to see how, at the level of the individual speaker, frontness/backness goes together with length. The majority of speakers, in both the minimal-pair context and the randomised order, produce little or no F2 difference: instead, the back vowel turns into a central or front vowel. Still, among these F2-reducing speakers, the length cues are quite clearly pronounced, as most of them produce medium to large length contrasts.

The contrast between the two low vowels has disappeared in the speech of only one Belgian speaker (no qualitative and no length differences left); for the others,

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a. Randomised order	*n*	b. Minimal pair sequence	*n*
Large quality difference (>20%)	*12*	*Large quality difference* (>20%)	*12*
large length difference (>50%)	4	large length difference (>50%)	4
medium length difference (21%–50%)	8	medium length difference (21%–50%)	6
small length difference (11%–20%)	0	small length difference (11%–20%)	1
no length difference (≤10%)	0	no length difference (≤10%)	1
Medium quality difference (*11%–20%*)	*10*	*Medium quality difference* (*11%–20%*)	*8*
large length difference (>50%)	3	large length difference (>50%)	3
medium length difference (21%–50%)	6	medium length difference (21%–50%)	4
small length difference (11%–20%)	1	small length difference (11%–20%)	1
no length difference (≤10%)	0	no length difference (≤10%)	0
Small quality difference (*1.6%–10%*)	*8*	*Small quality difference* (*1.6%–10%*)	*11*
large length difference (>50%)	2	large length difference (>50%)	1
medium length difference (21%–50%)	6	medium length difference (21%–50%)	8
small length difference (11%–20%)	0	small length difference (11%–20%)	0
no length difference (≤10%)	0	no length difference (≤10%)	2
No quality difference (≤ *1.5 %*)	*4*	*No quality difference* (≤ *1.5 %*)	*3*
large length difference (>50%)	2	large length difference (>50%)	1
medium length difference (21%–50%)	1	medium length difference (21%–50%)	0
small length difference (11%–20%)	1	small length difference (11%–20%)	2
no length difference (≤10%)	0	no length difference (≤10%)	0

Table 12: Patterns of contrast maintenance and reduction: Switzerland

length helps to discriminate between the two vocalic tokens in the absence of the qualitative cue. The contrast between the front and back low vowels in the traditional sense (i.e., a quality distinction accompanied by a difference in length) is maintained by five speakers in the randomised order and by only two speakers in the minimal pair sequence. This strongly suggests that the low-vowel contrast has indeed been transformed into primarily a length distinction for the majority of Belgian PFC participants. It could of course be the case that the wordlist task triggers a certain linguistic awareness, which causes the contrast to be more explicitly pronounced than it would be in fully spontaneous speech, but even then, it generally does not lead the Belgian speakers to produce a contrast involving both parameters, but rather only length. In France, patterns where length was strongly present in the absence of a qualitative frontness/backness distinction were not found (Berns 2015: 14)

Analogously to Table 11, Table 12 presents the detailed individual realisations of the Swiss participants.

Unlike the Belgian patterns, F2 distinctions are clearly present in Switzerland. Differences between individuals do of course exist, but the distribution of the speakers of the two countries across the various degrees of F2 differences is substantially different. The Swiss patterns realised in the random-order context and the minimal-

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pair sequence are quite similar. Although a small number of participants show very moderate traces of the contrast, none of the speakers in these samples neutralise the distinction between the two vowels to below the perceptual thresholds for F2 and length. The traditional contrast, involving both length and quality, is maintained by 21 speakers in the random-order context and by 17 speakers in the minimal-pair sequence (i.e., these speakers exhibit medium or large differences in both length and quality). If medium or large F2 cues are present, they are mostly accompanied by a medium to large length difference. If the frontness/backness distinction is less overtly present, length is either present to some extent or fully gone.

In several surveys in France, the contrast has indeed fully disappeared (Berns 2015), but Tables 11 and 12 show that this full neutralisation is clearly exceptional in Belgium and Switzerland. Interestingly, though, the Swiss and Belgian low-vowel patterns are far from identical; section 4 discusses in more detail the perspective in which the developments in each of these countries should be seen.

Correlating vowel quality and quantity for Belgium and for Switzerland, respectively, shows a very strong independence of the two cues. The squared correlation coefficients indicate that in Switzerland, 2.28% of the variation in length covaries with variation in F2, and, unsurprisingly, for Belgium this score is only 0.49%. In Figures 7 and 8, the mean length differences are plotted as a function of the mean F2 differences for each individual speaker.[22]

Figure 7 shows a weak negative correlation between length and F2 in Belgium, which reflects the fact that length can be present, even if the difference in quality is reduced. In contrast, for Switzerland the regression line in Figure 8 shows a positive correlation, meaning that, to some extent, large(r) F2 and length differences go hand in hand.[23]

4. Discussion and conclusion

This section first contrasts the situation in the three Francophone countries, and then discusses the possible mechanisms involved in the initiation and propagation of the specific sound change under scrutiny in this paper.

4.1 France, Belgium and Switzerland

The PFC results presented in the previous sections allow us to characterise the low vowel contrast in three European French-speaking countries. As set out in the introduction, existing descriptions commonly note that, unlike in France, length in general plays a noticeable role in the vocalic system of Belgian and Swiss French, and this

[22]The dots in these figures show the individual realisations of the contrasts in the randomised order and in the minimal pair sequence. The line is the line of fit which best represents the data as a whole.

[23]It goes without saying that in these computations all surveys of each country are grouped together, and that the correlation of each survey individually will thus be somewhat stronger or weaker.

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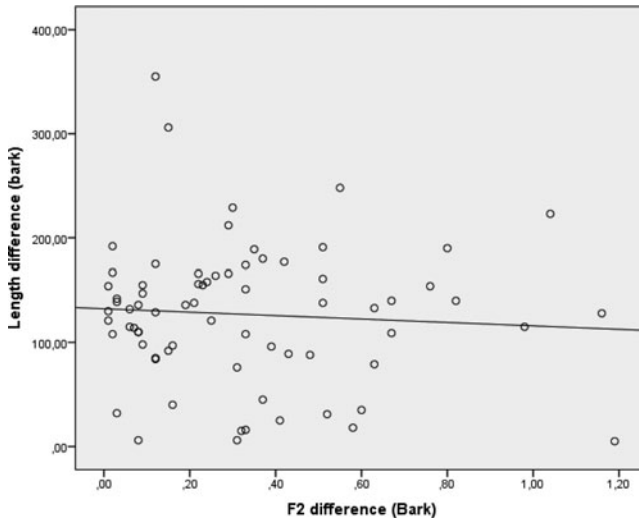

Figure 7: Belgium F2 and length ($r^2 = 0.0049$)

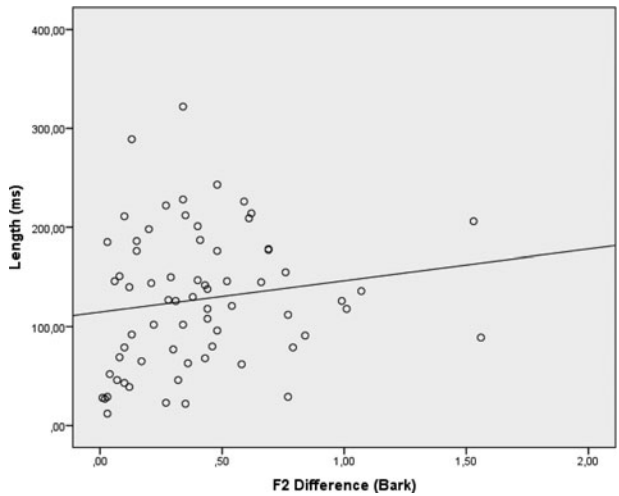

Figure 8: Switzerland F2 and length ($r^2 = 0.0228$)

length is also of relevance for the /a/-/ɑ/ contrast in these varieties. For Walloon French, the F2 distinction is said to have virtually disappeared in the low vowel contrast, whereas descriptions are less explicit about the presence of a qualitative difference among the low vowels in Swiss French. Using corpus data, these general observations have been given empirical grounding, more fine-grained patterns have been detected and the developments in the different varieties have been compared.

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As shown by previous research (e.g., Martinet 1957, Martinet and Walter 1973, Hansen and Juillard 2011, Hansen 2014, Berns 2015), the timbre of the low vowels in France is changing, in the sense that the back vowel tends to merge with the front token. In the South of France, the contrast has been mostly neutralised, while in the Centre and North of the country, variation exists between speakers as to the degree of contrast maintenance in terms of F2 and/or length. If we compare the more recent findings of synchronic descriptions and apparent-time studies with the observations made several decades ago, it is highly likely that France is witnessing an ongoing change, which spreads naturally as the younger generations grow older.

The Belgian and Swiss contrasts each have their own specific properties. In Belgium, the qualitative difference has essentially disappeared,[24] as it has in the South of France. The low-vowel contrast of Belgian speakers primarily involves a robust length difference, stable across the genders and generations. In France the quantitative difference was clearly less steady across the different regions and speakers, and it is therefore not unlikely that the Belgian contrast will survive in its current shape for some time to come. Even though robust length cues can be found in all three Belgian samples, the geographical distance to France, orientation towards the North of France and/or contacts[25] with that region are highly likely to influence the exact shape of the contrast. That is, in comparison with Gembloux and Liège, Tournai most closely resembles the Northern French varieties: its F2 values are somewhat higher and its length differences somewhat smaller than in the other two Belgian samples. It could be the case that the data reflect the effect of levelling in the Tournai variety, or they could reflect a change in progress; future research and time will tell which possibility is correct.

In Switzerland, the situation is in some respects similar to Belgium, but in others quite different. As in Belgium, length is an essential parameter in the low-vowel contrast: in comparison with France, we also noted quite robust length cues in all three generations for the Swiss varieties. Still, low-vowel length in Switzerland differs from that in Belgium in two important respects. First, the Swiss situation seems to be not as uniform as in Belgium, as the length cues realised by the younger generations are shorter than those of the older speakers. On the basis of our apparent-time study, it is of course not possible to say whether this is due to the start of a trend where length reduction spreads as the younger generations age, or whether it is an effect of age-grading, but it is clear that although substantial length cues are still produced in the Swiss varieties by all generations, the pattern is not as universally strong across generations as it is in Belgium. The second difference resides in the fact (see Table 12) that larger length differences accompanied by (very) small F2 differences are less systematic in Switzerland than they are in Belgium. As in France, the larger length differences in Switzerland instead tend to combine with larger F2

[24]The relatively high number of reversals of the F2 contrasts mentioned in footnote 13 is also indicative of the instability of the frontness/backness cue in Belgium.

[25]In real life, but also by means of media such as radio and television (e.g., Pooley 2000: 144).

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differences. This immediately brings us to the F2 cue itself, which is still, contrary to the situation in both Belgium and France, quite a vital parameter in the Swiss low-vowel contrast.

As we have seen for Belgium, we would miss important considerations if we did not zoom in more closely on the three different samples, since there are differences between the surveys. The most pronounced low-vowel differences can be found among the speakers of Nyon, while Neuchâtel is moderate, and the patterns found in Geneva show more reduced contrasts. The Genevan length contrast is still considerably higher than in most surveys of France, but it is quite similar to the length contrast found in the Northern France city of Ogéviller. The scores of the frontness/backness difference realised by Genevan speakers quite closely resemble those of Parisian or Lyonnais speakers. As we have seen for the Belgian variety of Tournai, levelling of the contrast seems to be taking place. The human traffic between Geneva and Northern France, e.g., for work or shopping, the influence of hexagonal France spoken media such as radio and television, and the popularity and prestige of the neighbouring varieties in the North of France are all factors that may give the Genevan contrast its specific appearance.[26] Follow-up research is of course needed to determine to what extent these different factors apply.[27]

All in all, the most significant difference between the three countries under discussion here seems to be that at this synchronic stage, contrary to the varieties of Metropolitan France, the Belgian and Swiss varieties are not (yet) involved in the same general merger of the two low vowel tokens. The Swiss contrast is characterised by pronounced length and F2 differences, while for Belgium, the length difference can be seen as a marker of the contrast.

These are the national tendencies, but perhaps even more importantly, the present study has shown that as far as the low vowels are concerned, one cannot speak of "the" Belgian or "the" Swiss contrast: political borders are not strict linguistic borders, and the low-vowel contrast too should be considered on a continuous scale of contrast reduction and maintenance.

4.2 Low vowel variation and change

We conclude by considering the nature of the (socio)linguistic variation we have explored above, and its actuation and transmission. We are witnessing a merger of the two low vowels, with the traditional parameters of vowel quality and quantity being reduced or maintained to different extents. The varieties in the most advanced stages of low vowel neutralisation are those of Southern France. Léon (1966: 64) observed in the 1960s that the contrast was most likely to be maintained in stressed position, but as the PFC data have shown, (strong) erosion is nowadays taking place

[26]The density of the social network of the speech community is a relevant notion in this respect; see Milroy and Milroy 1993, Marshall 2004, and Milroy 2004 for more discussion.

[27]Even though further research is required, the scenario can probably best be explained by a combination of factors. Geographical distance to the French border by itself could not account for the levelling in Geneva, as Nyon, which like Geneva is not far from France, exhibited no levelling effect in this survey.

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in this context as well. Even though further research, including a larger variety of tokens and contexts, is required for absolute confirmation, it is highly likely that the situation has evolved from Léon's (1992: 87) observation that 97.6% of all lexical *a* tokens are realised as [a], to an even stronger presence of [a].[28] The merger that has clearly affected France, and that could possibly also involve Swiss and Belgian varieties in a more radical way in the future, is thus an unconditioned change that will eventually result in a vocalic system where the symmetry in the low vowel region is lost.

In his study on /ɔ/ fronting in Parisian French, Martinet (1957) explains the shift from the back rounded vowel towards [œ] (e.g., *joli* [ʒɔli] 'nice/pretty' becoming [ʒœli]) in structuralist terms. In order to reduce the tension among the four back vowels in French ([u, o, ɔ, ɑ]), one of these back vowels may move towards the front region. As the pronunciation of /ɑ/ in the Parisian variety of French was close to [ɔ], and as the functional load of the existing contrast /ɔ/ ~ /œ/ was apparently not high enough to avoid a merger, /ɔ/ may have been fronted in certain sociolects. Fronting of /ɑ/ is also taking place in these varieties. As Martinet notes, this is not a direct effect of chain shifting, but is rather due to imported usage from speakers from outside Paris. At a given moment, the centralisation of the back vowel became widespread in the Parisian variety as well, making it the new pronunciation norm for the new generations.[29]

The merger of the two low vowels in France is not only puzzling from a structuralist point of view, but is also challenging for a view adopting a principle of maximal dispersion (e.g., Liljencrants and Lindblom 1972, Lindblom 1986). Instead of keeping the contrasts in a particular sound inventory as dispersed as possible, the opposite is happening as contrasts are reduced or fully lost.[30] The perspective adopted by Ohala (1981, 1983, 1989, 1990, 1993) sheds a different light on the phenomenon. In his view, sound change is essentially non-teleological and its origin can be attributed to the speaker and/or the listener. If at some point, hearers "misperceive" the back vowel tokens as front vowels (independently of whether the contrast in the signal is reduced), the front vowel can gradually become the new pronunciation variant adopted by the speakers of the speech community. Even though the origin of

[28]In 1966, Léon reported a rate of 95% of lexical *a* tokens being instances of [a].

[29]Alternatively, one could interpret the situation as a general fronting of the French back vowels. However, the other two French back vowels [u] and [o] seem still to be firmly in the back zone. Armstrong and Low (2008) suggest that the working-class feature of /ɔ/-fronting might spread on social grounds. Hansen and Juillard (2011), however, note that Parisian /ɔ/ nowadays is likely to be realised as [o]. We are thus witnessing either the beginning of a general fronting process, with [u] and [o] not yet involved, or the centralisation of /ɑ/ and /ɔ/ is not a general effect and is limited to these two phonemes.

[30]The question to be considered here is of course at what point a contrast really loses its functional load. The low-vowel distinction has a restricted functional load in the sense that it distinguished between a limited number of minimal pairs such as for instance *patte-pâte* ('paw'-'dough/pastry'), *mat-mât* ('mat'-'mast') or *rat-ras* ('rat'-'short-haired/blank'). Even though the minimal pairs are not abundant, the vowel characteristics could serve to disambiguate certain utterances when the context surrounding one of these words is not helpful.

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variation is in itself non-teleological in Ohala's perspective, the sound change as such may of course spread on teleological grounds, because at a given moment, speakers may for reasons of style or social identification adopt the new pronunciation variant. If this results in a linguistic innovation that becomes sufficiently anchored in the speech community (i.e., "long-term stable variation", Labov 2001: 85), and the new form gradually becomes the dominant form, language change will be the eventual result.

Large-scale diachronic research is required to retrieve the historical reasons underlying the actuation of the low-vowel merger. At this synchronic stage, where the contrast has virtually disappeared in the South of France, and the different Swiss and Belgian varieties are each characterised by specific degrees of contrast maintenance or reduction, we can however suggest some social influences that may play a role in the further transmission of the change. That is, as we have seen, it is not just geographical proximity to the French border that determines whether or not the contrasts in Belgium and Switzerland resemble those in neighbouring varieties in France, but rather also the physical (i.e., mobility), mental, and cultural orientation towards certain varieties that causes speakers to accommodate to a specific variety, for reasons of identity and/or prestige. People in Geneva, for instance, may identify with the popular or prestigious variety of Paris. Related to this is the density of the social network of the speech community (Milroy and Milroy 1993, Milroy 2004): if the ties within this network become less dense, speakers are more susceptible to language influences from outside their speech community. Density may be different for cities and villages in general, but also two cities or two villages may differ greatly from each other in the density of their respective speech communities.

The examination of the PFC data has provided an apparent-time image of the status of the low-vowel contrast in different varieties of French in France, Belgium and Switzerland. Longitudinal evidence is of course still required, preferably based on a representative social stratification[31] and on a variety of speech tasks, involving different degrees of linguistic self-consciousness and self-monitoring (Labov 1972: 208) in order to gain further insight into the actual long-term developments or stability of the Belgian and Swiss varieties, and the social factors involved.

It would also be informative to put these purely acoustic findings into a perceptual perspective: to what extent do listeners of the three countries run into difficulties when confronted with a low vowel, realised by a speaker of a different variety, in a potentially ambiguous context like *Je vois la patte/pâte* 'I see the paw/dough'? Moreover, the results presented here suggest that listeners of the different varieties of French would have different best exemplars of each vowel, and it might be interesting to determine how their scores relate to each other.

The PFC data studied here have provided a picture of the pronunciation habits and "norms" related to the low vowel contrast of different French-speaking communities in three different countries. In fifty years' time, researchers can look back at this picture and determine to what extent it has become out-dated.

[31] In order to determine the exact circumstances involved, network studies in the Labovian/Milroyan sense are required: what is the degree of contact of the community with France?, is the public mainly organised within the network of the city or village? etc.

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APPENDIX

		Random order	Minimal pair sequence
a.	**Belgium**		
	M	82.39 (SD: 59.23)	54.50 (SD: 47.07)
	F	69.94 (SD: 52.68)	(SD: 61.65)
b.	**Switzerland**		
	M	240.14 (SD: 147.53)	247.35 (SD: 138.99)
	F	160.22 (SD: 113.95)	185.41 (SD: 185.96)

Table 13: Average absolute F2 differences (in Hertz) according to gender

		Random order	Minimal sequence
a.	**Belgium**		
	≤30	73.71 (SD: 63.58)	65.93 (SD: 65.89)
	31–54	70.50 (SD: 48.27)	64.50 (SD: 54.47)
	≥55	86.40 (SD: 56.28)	51.50 (SD: 38.81)
b.	**Switzerland**		
	≤30	185.35 (SD: 86.06)	150.40 (SD: 169.19)
	31–54	204.07 (SD: 146.11)	214.89 (SD: 167.15)
	≥55	200.55 (SD: 147.10)	248.82 (SD: 164.97)

Table 14: Average absolute F2 differences (in Hertz) according to generation

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		Random order	Minimal pair sequence
a.	**Belgium**		
	M	113.28 (SD: 69.36)	119.67 (SD: 62.57)
	F	128.50 (SD: 75.52)	146.61 (SD: 58.85)
b.	**Switzerland**		
	M	110.82 (SD: 51.50)	118.12 (SD: 69.97)
	F	161.06 (SD: 71.08)	120.71 (SD: 75.73)

Table 15: Average absolute length differences (in milliseconds) according to gender

		Random order	Minimal pair sequence
a.	**Belgium**		
	≤30	99.93 (SD: 70.49)	140.07 (SD: 75.93)
	31–54	139.08 (SD: 46.55)	144.50 (SD: 44.80)
	≥55	128.40 (SD: 95.28)	109.80 (SD: 55.04)
b.	**Switzerland**		
	≤30	108.80 (SD: 53.94)	66.00 (SD: 60.10)
	31–54	126.56 (SD: 61.26)	102.22 (SD: 51.69)
	≥55	163.63 (SD: 74.56)	171.82 (SD: 77.79)

Table 16: Average absolute length differences (in milliseconds) according to generation

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