Title: The effect of L1 regional variation on the perception and production of standard L1 and L2 vowels

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Abstract

This study reports on the perception and production of Standard Dutch and Standard British English vowels by speakers of two regional varieties of Belgian Dutch (East Flemish and Brabantine) which differ in their vowel realizations. Twenty-four native speakers of Dutch performed two picture naming tasks and two vowel categorization tasks, in which they heard Standard Dutch or English vowels and were asked to map these onto orthographic representations of Dutch vowels. The results of the production tasks were acoustically analyzed in PRAAT (Boersma and Weenink 2013) and normalized and plotted through NORM (Thomas and Kendall 2010). The results of the Dutch production and categorization tasks revealed that the participants' L1 regional variety importantly influenced their production and especially perception of vowels in the standard variety of their L1. The two groups also differed in how they assimilated non-native English vowels to native vowel categories, but no major differences could be observed in their productions of non-native vowels. The study therefore only partly confirms earlier studies showing that L1 regional variation may have an influence on the acquisition of non-native language varieties.

Keywords: perception, production, regional variation, L3 phonology, vowels

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1 Introduction

1.1 The production and perception of non-native vowels

It is well known that not only the production, but also the perception of non-native (or second language, henceforth L2) sounds is importantly influenced by properties of the native language (henceforth L1) (for a comprehensive review, see Gut 2009). The most widely used models which aim to predict and explain how L2 sounds are perceived and produced are Flege's (1995) Speech Learning Model (SLM) and the Perceptual Assimilation Model (PAM) developed by Best and colleagues (Best 1995; Best et al. 2001). The latter model is further developed in Escudero's (2005) Second Language Linguistic Perception Model (L2LP). SLM (Flege 1995) predicts different patterns of acquisition for L2 sounds on the basis of their degree of acoustic similarity to L1 sounds. PAM, originally developed for naïve, inexperienced listeners, was followed by PAM-L2 (Best and Tyler 2007), explaining perceptual mappings by L2 learners. According to PAM and PAM-L2, non-native listeners perceptually map L2 sounds onto L1 sounds on the basis of phonetic similarity between L1 and L2 sounds as well as on the basis of phonological category membership. When two or more L2 categories are mapped onto a single L1 category, termed "single-category assimilation" in PAM(-L2) and described as a "SUBSET scenario" in Escudero's L2LP. Second Language Linguistic Perception Model (L2LP, Escudero 2005), learning is predicted to be difficult. In SLM as well as in PAM(-L2) and L2LP, the native language thus plays a decisive role in L2 perception and production. On the basis of these models, it would seem a straightforward prediction that any variation, such as regional variation, in the realization of L1 categories will influence the perceptual mappings and the production of L2 sounds. Yet, the influence of regional variation in the native or first language (L1) on the target or second language (L2) has long been a largely unexplored issue in the field of L2 phonology. Recently, there has been a growing awareness that the assumption of homogeneous groups of L1 speakers in previous studies examining cross-linguistic influence in phonological acquisition may have obscured potential differences between speakers that can be attributed to their L1 regiolect or dialect (O'Brien and Smith 2010: 297; Chládková and Podlipský 2011:187; Marinescu 2012: ii). In other words, it is not until recently that the L1 regional variety been taken into account as a factor potentially influencing perception (e.g. Chládková and Podlipský 2011; Escudero et al. 2011; Escudero and Williams 2012; Marinescu 2012) and production (e.g. Lew 2002; O'Brien and Smith 2010; Marinescu 2012) of L2 sounds. A number of recent studies on regional L1 influence on L2 perception and production of vowels are briefly discussed here.

Marinescu (2012) examined L1 regional dialect (in particular, Cuban and Iberian Spanish) effects on non-native perception and production of English /æ, ʌ, ɑ/. Not only spectral differences, i.e. differences in terms of vowel quality, were discovered between the two dialects, but also durational ones. A vowel discrimination task with real English CVC words (/CæC, CʌC, CɑC/), in

which participants heard two sounds, which we can call A and X and had to indicate whether sound X was the same as or different from sound A, revealed only limited effects of L1 regional Spanish on L2 English perception. However, the production results suggested that these L2 learners with different L1 regional dialectal backgrounds used different interlanguage strategies for producing English /æ, ʌ, ɑ/: Cuban participants produced these vowels with significant spectral differences, but no durational differences. For Peninsular Spanish speakers, the opposite held: they produced the vowels with significant durational but no spectral differences.

Chládková and Podlipský (2011) investigated the influence of dialectal differences in Bohemian and Moravian Czech on Dutch vowel perception. Their study focused on the high front vowel region, in which Czech has fewer vowel phonemes than Dutch. In line with Best's (1995) PAM and Escudero's (2005) L2LP, the authors predicted instances of single-category assimilations for the vowels in this region. In contrast with Bohemian listeners, Moravian listeners attach more weight to durational than to spectral cues in their perception of the Czech /iː–ɪ/ contrast. Since (Standard) Dutch has a predominantly spectral difference in its /i–ɪ/ contrast, the authors predicted perceptual differences in the two groups of Czech speakers. The results supported Escudero's (2005) L2LP, in that different perceptual assimilation patterns of the Dutch vowel contrasts were revealed for the two dialect groups: since Moravian listeners attach more weight to duration, they assimilated Dutch short /i/ to Czech /ɪ/, which is short, while Bohemian listeners mapped it onto long but spectrally similar Czech /iː/.

Escudero and Williams (2012) examined how Peruvian and Iberian Spanish learners of Dutch performed in categorical discrimination and categorization tasks involving Dutch vowels. Peruvian and Iberian Spanish differ in the realization of some vowels. For instance, both varieties have only one phonemic unit, namely /i/, in the vowel space in which Dutch has two: /i/ and /ɪ/. However, the realizations of /i/ in Peruvian and Iberian Spanish display acoustic differences: while Peruvian Spanish /i/ is spectrally situated approximately in the middle between Dutch /i/ and /ɪ/, Iberian Spanish /i/ is acoustically close to Dutch /i/. The expectation for Peruvian Spanish then is that both Dutch vowels will be perceptually assimilated to Peruvian Spanish /i/, resulting in poor discrimination (Escudero and Williams 2012: 408). As Escudero and Williams (2012: 406) point out, "non-native contrasts that are mapped on to a single native category lead to the most difficulty in discrimination and learning" (this also ties in with Best's PAM (1995), Best and Tyler's PAM-L2 (2007) and Escudero's (2005) L2LP).Since Iberian Spanish /i/ is acoustically closer to Dutch /i/ than to Dutch /ɪ/, a slightly different PAM-scenario with a *Category-Goodness Difference* (Best 1995: 195) occurs, whereby Dutch /i/ is mapped onto Iberian Spanish /i/, but is considered a less good exemplar of that category.

Finally, Escudero et al. (2012) examined the influence of regional variation in L1 Dutch (North Holland Dutch on the one hand, East and West Flemish Dutch on the other hand) on the

perception of the English /ɛ–æ/ contrast. Although the contrast itself is absent in both the Netherlandic and the Belgian Dutch varieties, these varieties do realize Dutch /ɛ/ differently. Methodologically, Escudero's (2005) L2LP was followed, with its proposal that a detailed analysis of both the relevant L1 and L2 sounds can predict L2 perception with considerable accuracy. It was found that the two Dutch listener groups differed in their perception of English /ɛ/ and /æ/, and the authors noted that dialectal differences in the acoustic properties of Dutch /ɛ/ seemed to account for differences in the L2 English vowel perception. Moreover, the data "show that the exact acoustic vowel properties in the variety of the native language can predict how vowels in a second language will be perceived" (Escudero et al. 2012: 287). This conclusion, with its focus on an acoustic/phonetic rather than an abstract phonological level, is in line with both Escudero's (2005) L2LP and Best and Tyler's (2007) PAM-L2.

1.2 Objectives

The present study examines to what extent regional variation in the L1 influences L2 perception and production. On the basis of current perception and production models reviewed in Section 1.1, in which phonological and phonetic similarity between the L1 and the L2 plays a major role in L2 perception and production, we predict to find different L2 perception and production patterns for speakers of different regional L1 varieties. Specifically, we examine the effect of regional variation in the L1 vowel phonemes /i, ɪ, y, ʏ/ of two groups of native speakers of Dutch with different dialectal backgrounds – East Flemish and Antwerp Brabantine Dutch speakers – on the perception and production of L1 Standard Belgian Dutch and L2 Standard British English vowels. A first aim of this study is to examine whether regional differences in the production of /i–ɪ/ and /y–ʏ/ (contrasted differently in East Flemish and Antwerp Brabantine Dutch) can be observed in new data from adult participants, and whether such regional differences would also be reflected in listeners' perception of L1 Standard Dutch vowels. The main aim of the present study is to then examine whether and how the potential L1 regional differences influence the perception and production of L2 English vowels /i, ɪ, ʊ, ʌ/. In order to address the issues, two experiments were performed by a group of Dutch-speaking adults: a perception experiment and a production experiment. Predictions for specific vowel pairs are formulated in Section 1.3.

1.3. Vowel contrasts in Dutch and English: specific hypotheses

The vowel inventory of Dutch contains 12 monophthongs, excluding schwa. The present study focuses on two Dutch vowel contrasts, namely /i–ɪ/ and /y–ʏ/. These two vowel contrasts were selected because East Flemish and Brabantine speakers differ in the way they realize the contrast. In Standard Belgian Dutch – as in the East Flemish variety of Dutch – the contrast between the vowels in the pairs /i–ɪ/ and /y–ʏ/ is mostly spectral, with /i/ and /y/ being more closed and more fronted

than /ɪ/ and /ʏ/, respectively (see, e.g., Table 1 in Adank et al. 2004a: 1732), some studies, though (Koopmans-van Beinum 1980; Rietveld et al. 2004), also report durational differences between the members in the pairs /i–ɪ/ and /y–ʏ/, with /i/ and /y/ being described as "half-long". Then again, in the Brabantine dialect spoken around the city of Antwerp, this spectral contrast has been reported to be limited (Verhoeven and Van Bael 2002a, 2002b); instead, the contrast between /i/ and /ɪ/ and between /y/ and /ʏ/ is essentially durational, with /i/ and /y/ being considerably longer than /ɪ/ and /ʏ/. It should be noted that /i–ɪ/ and /y–ʏ/ are not the only vowels which are realized differently in the Brabantine dialect around Antwerp and in East Flemish. On the basis of formant measurements in vowels produced by 12 Brabantine and 12 East Flemish speakers, Van Bael and Verhoeven (2002a) also report the following differences: (i) Brabantine back vowels /u, o, ɔ/ are lower than in East Flemish, (ii) Brabantine open mid vowels /a/ and /ɑ/ are spectrally very similar, while East Flemish /a/ is more fronted and more open than /ɑ/, (iii) Brabantine front vowel /ɛ/ is more closed than in East Flemish, and (iv) front vowels /e/ and /ø/ are more open and more central in Brabantine than in East Flemish Dutch. While all vowels thus have a different quality in the two dialects, we focus on the four front and mid vowels /i–ɪ/ and /y–ʏ/, because the contrast between these vowels is based on a different cue (spectral vs. durational) in the two dialects.

The two English vowel contrasts focused on in the study are /i–ɪ/ and /ʊ–ʌ/. The vowels /i–ɪ/ were selected, because they are acoustically close to Dutch /i–ɪ/. As in Standard Dutch, the English (RP) contrast between /i/ and /ɪ/ has been reported to be one of quantity and quality, with /i/ being produced longer and tenser, relative to /ɪ/, in an identical consonantal context. The other two Dutch vowels under investigation, /y/ and /ʏ/, are not part of the English vowel inventory. Therefore, two English vowels were chosen, /ʊ/ and /ʌ/, for which it was predicted that Dutch learners might assimilate them at least partly to the Dutch vowels /y/ and /ʏ/. The English vowel /ʌ/ was selected because Collins and Mees (2003: 95) note that native speakers of Dutch frequently substitute Dutch /ʏ/ for English /ʌ/, even though Dutch /ʏ/ is somewhat closer and rounded. Finally, English /ʊ/ was included, because it is the English vowel which is closest to Dutch /y/ in terms of height and liprounding, even though it is more back. The English vowels /ʊ/ and /ʌ/ differ only in quality, not in duration.

Table 1 presents an overview, with references, of the vowel contrasts in Standard Belgian Dutch, East Flemish Dutch, Brabantine Dutch and Standard British English (RP).

Table 1: Vowel contrasts in the standard and regional L1 and L2 varieties

Variety	Vowel pairs	Durational contrast	Spectral contrast	References

Standard Belgian Dutch	/i–ɪ/	limited (some studies: /i/ = half-long)	yes	Nooteboom (1971); Koopmans-van Beinum (1980); Verhoeven and Van Bael (2002a, 2002b); Adank et al. (2004a); Rietveld et al. (2004); Van Leussen et al. (2011)
	/y–ʏ/	limited (some studies: /y/ = half-long	yes	
East Flemish Dutch	/i–ɪ/	limited	yes	Taeldeman (1985); Verhoeven and Van Bael (2002a, 2002b)
	/y–ʏ/	limited	yes	
Brabantine Dutch	/i–ɪ/	yes	limited	Nuyts (1989); Belemans et al. (2000); Verhoeven and Van Bael (2002a, 2002b)
	/y–ʏ/	yes	limited	
English RP	/iː–ɪ/	yes	yes	Collins and Mees (2003); Hawkins and Midgley (2005); Harrington et al. (2011)
	/ʊ–ʌ/	no	yes	

The perception experiment consisted of two tasks. First, a Dutch perceptual categorization task explored whether there are regional differences between Antwerp and East Flemish listeners in the perception of the Dutch vowel pairs /i–ɪ/ and /y–ʏ/ produced by a Standard Belgian Dutch speaker. This was done by examining onto which native phonological categories these vowels are mapped by listeners from the two different dialect areas. In a second, cross-language (English-Dutch) perceptual categorization task, listeners were presented with the Standard British English vowels /iː, ɪ, ʊ, ʌ/, and were asked to map these onto native Dutch vowel categories (they were not informed on the language/variety of the stimuli). The second experiment consisted of a Dutch and an English picture-naming task, in which the target stimuli again contained the Dutch vowels /i, ɪ, y, ʏ/ and the English vowels /iː, ɪ, ʊ, ʌ/.From the models discussed in the introduction section (1.1), we can derive a number of predictions vis-à-vis the perception and production of the specific vowel pairs tested in this study. With respect to the perception and production of Standard L1 vowels, it is of course, important to bear in mind that models like SLM (Flege 1995), PAM(-L2) (Best 1995; Best and Tyler 2007) and L2LP (Escudero 2005) were developed to predict and explain patterns in L2 acquisition based on properties of the L1. By applying these models to the perception and production of Standard L1 vowels by speakers of regional varieties, we are testing their validity not only for L2 acquisition, but also for the acquisition of a new variety, i.e. the standard one, within the L1. In

addition, we are testing to what extent properties of the regional vs. the standard variety of the L1 play a role in L2 perception and production. The following hypotheses are posited:

(i) *Hypotheses on L1 perception.* Since East Flemish is similar to Standard Dutch in terms of the realization of /i–ɪ/ and /y–ʏ/, we predict that the East Flemish listeners will map Standard Dutch [i-ɪ] and [y–ʏ] onto /i–ɪ/ and /y–ʏ/, respectively. This would constitute a case of a two-category assimilation in PAM. In L2LP, it is argued that in such cases, the learners only need to (slightly) shift the boundaries between the two vowels. We predict that the Brabantine listeners will show a more complex mapping and will, to some extent, map both Standard Dutch [i] and [ɪ] onto /ɪ/. Even though there is a contrast in their regional L1 as well, this contrast is mostly durational. As the Brabantine listeners cannot rely on durational differences between the members of the Standard Dutch vowel pairs, we predict they will map both vowels onto the same short vowel /ɪ/. This would, in PAM's terms, constitute a case of single-category assimilation.

(ii) *Hypotheses on L1 production.* The East Flemish speakers will, in accordance with the standard variety, produce a larger *spectral* difference between the members of the pairs /i–ɪ/ and /y–ʏ/, compared to the Brabantine listeners, who will produce a larger *durational* contrast.

(iii) *Hypotheses on L2 perception.* Both East Flemish and Brabantine listeners will map English [i:–ɪ] onto Dutch /i–ɪ/, since English has both a spectral and durational contrast between these vowels, and relying on spectral and/or durational cues will lead to the same mapping. English [ʊ] is acoustically close to Dutch /u/ and is predicted to be mapped onto this vowel by both listener groups. East Flemish listeners and Brabantine listeners are predicted to map [ʌ] onto /ɑ/ or /a:/. In addition, the East Flemish listeners may also select /ʏ/. This latter mapping is unlikely for the Brabantine listeners, since they realize Dutch /ʏ/ as the more closed [y].

(iv) *Hypotheses on L2 production.*

a. If it is the *regional* L1 variety that exerts the most important influence on L2 production, the East Flemish speakers will produce a larger spectral but smaller durational contrast between /i–ɪ/ (and possibly /ʊ–ʏ/), compared to the Brabantine listeners.

b. If it is the *standard* L1 variety that exerts the most important influence on L2 production, the two groups will not differ, i.e. they will produce a spectral contrast between /i/ and /ɪ/, and a spectral contrast between /ʊ/ and /ʌ/.

2 Experiment 1: perception

2.1 Participants

In total, 24 native speakers of Dutch took part in the perception experiment: twelve East Flemish Dutch listeners from the Ghent area (four males, eight females) and twelve Brabantine Dutch listeners from the Antwerp area (two males, ten females).[1] The East Flemish participants were aged between 18 and 26 years at the time of testing (mean age of the East Flemish participants: 20;7; mean age of the Brabantine participants: 19;2). All participants were higher education students. They all had Dutch as their native language, and they did not speak any other languages on a daily basis. They had been exposed to English through popular media all their lives (since in Flanders English is pervasive in media like television, radio and the internet) and had studied English as a subject in school. Although the participants' general L2 proficiency was not measured and there may have been individual differences, all participants had received five to six years of English classes during their formal secondary education, starting at the age of twelve to thirteen, ranging from two to four hours per week. None of the participants had studied English or Dutch at university level, or had stayed in an English-speaking country for longer than three months. Participants were paid a small fee for their participation.

2.2 Procedure and materials

The perception experiment consisted of two vowel categorization tasks and was set up in PRAAT (Boersma and Weenink 2013). In the first task, listeners were presented with Standard Belgian Dutch vowels and were instructed to map these onto orthographic representations of Dutch vowels (*Kies de klank die je hoort* 'Choose the sound that you hear'). The second task was a cross-language categorization task, in which listeners had to map Standard British English vowels onto orthographic representations of Dutch vowels. The instruction sentence was the same.

The stimuli for the Dutch task were produced by a young female native speaker of Standard Belgian Dutch who teaches Dutch at university. Similarly, the stimuli for the English task were produced by a young female native speaker of Standard Southern British English ("near-RP") who teaches (British) English pronunciation at university. The stimuli consisted of four Dutch (non)words containing the vowels /i, ɪ, y, ʏ/ and four English (non)words containing the vowels /iː, ɪ, ʊ, ʌ/ in the consonantal frame /h_s/. The speakers produced each token four times, yielding a total of 16 unique stimuli per task, which was presented twice to the participants in random order. Figure 1 presents the vowels in the Standard Belgian Dutch and Standard British English target stimuli in a vowel diagram based on their mean first and second formant (F1 and F2) values, which reflect the vowels' height

[1] Since a minority of participants lived in municipalities directly neighboring the cities of Ghent and Antwerp, the broader terms "East Flemish Dutch" and "Brabantine Dutch" are used throughout this paper (instead of the narrower terms "Ghent Dutch" and "Antwerp Dutch"). Unless stated otherwise, "Brabantine" and "East Flemish" are used to denote the Dutch varieties, and not the provinces.

and frontness, respectively. The average durations of the target Dutch and English vowels are presented in Figure 2.

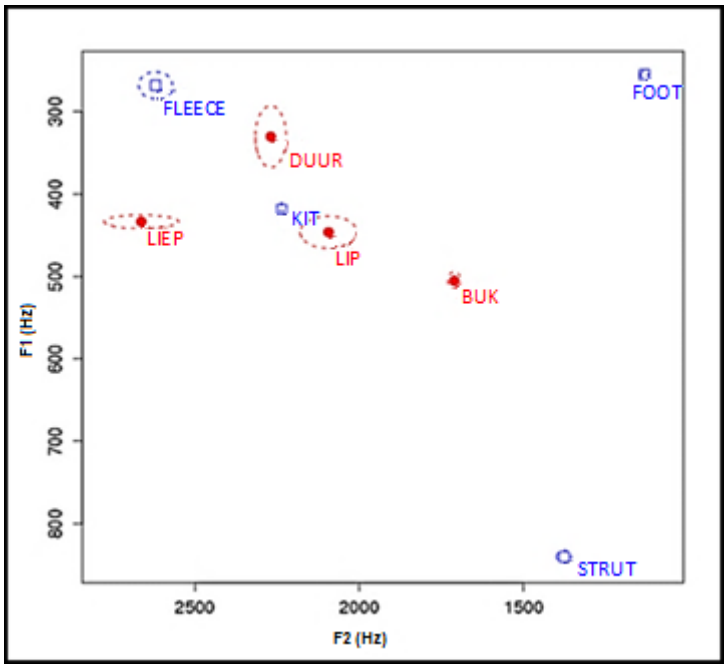
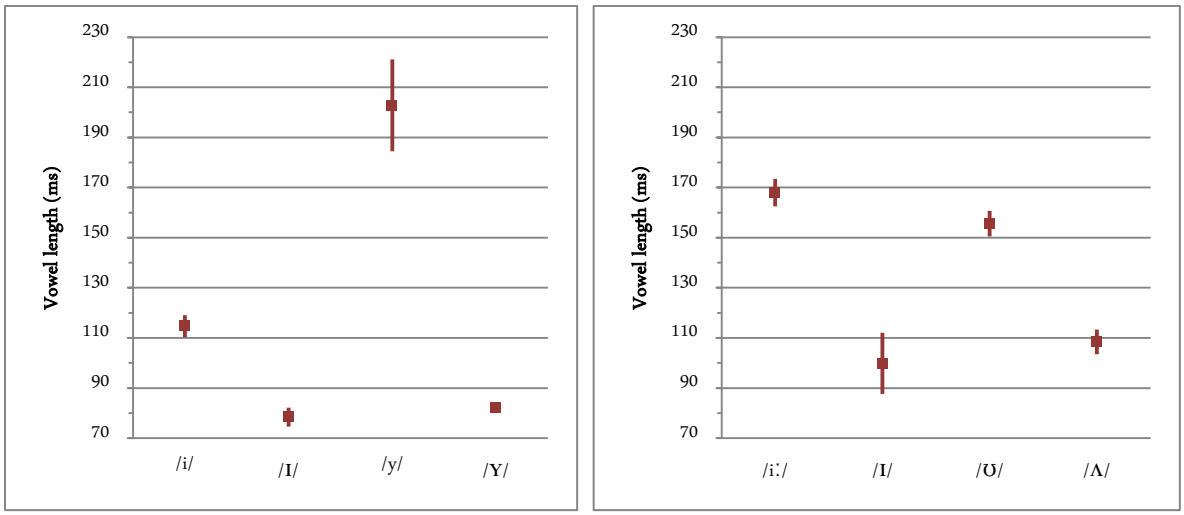


Figure 1: Mean F1 and F2 values (in Hz) of the Standard Belgian Dutch target stimuli (in red) and the Standard British English target stimuli (in blue). Ellipses represent one standard deviation (SD) away from the mean.[2]



[2] Since the NORM Vowel Normalization and Plotting Suite used to graphically represent the spectral features of the target stimuli does not support the use of IPA characters (Thomas and Kendall, 2007: http://ncslaap.lib.ncsu.edu/tools/norm/norm1_help.php), the Dutch and English vowels are represented by means of keywords. Dutch keywords are taken from Verhoeven (2005): LIP /ɪ/, LIEP /i/, BUK /ʏ/ and DUUR /y/. English keywords are taken from Wells (2000) and include KIT /ɪ/, FLEECE /iː/, FOOT /ʊ/ and STRUT /ʌ/.

Figure 2: Average vowel duration (in ms) of the Standard Belgian Dutch (left) and Standard British English (right) target stimuli of the perception tasks. The vertical bars indicate one SD away from the mean.

Figure 1 shows that the native speaker of Dutch produced a clear spectral contrast between the vowels of the pairs /ɪ–i/ and /ʏ–y/, as expected in Standard Dutch (see Table 1). Similarly, the native speaker of English produced different vowel qualities for the vowels in the pairs /ɪ–i/ and /ʊ–ʌ/. The left panel in Figure 2 reveals that the speaker of Dutch made a durational contrast between /i/ and /ɪ/, and between /y/ and /ʏ/, confirming the pattern of Standard Dutch. The native speaker of British English produced the vowel /i/ longer than the vowel /ɪ/, as was expected, but also produced a durational contrast between /ʊ/ and /ʌ/. This latter contrast was not expected (see Table 2), since both vowels are considered to be short vowels in standard descriptions and they were produced in the same consonantal context. One possible explanation may be related to the phonotactics of English, namely the fact that the vowel /ʊ/ is typically, though not exclusively, followed by /k/ (as in *hook*, *book*, *took*, but see also, for instance, *blood*, *flood*), and that the native English speaker was hence not used to producing /ʊ/ preceding /s/ (as in the frame /hVs/). This may have led to a slightly artificial production, i.e. lengthening, of the vowel in this context.

After each auditory stimulus, participants were instructed to click on one of twelve Dutch words (see Table 2) presented on the screen in orthographic form, and containing each of the twelve Dutch monophthongs.

Table 2: Dutch words presented in orthographic form on the screen.

kus /k ʏ s/ 'kiss'	*muur* /m y r/ 'wall'	*deur* /d ø r/ 'door'
zeep /z eː p/ 'soap'	*kaas* /k aː s/ 'cheese'	*kop* /k ɔ p/ 'cup/head'
hoop /h oː p/ 'hope/pile'	*boek* /b u k/ 'book'	*dief* /d i f/ 'thief'
pit /p ɪ t/ 'kernel'	*bed* /b ɛ t/ 'bed'	*dak* /d ɑ k/ 'roof'

2.3 Results

The results of the perception experiment are presented in two tables, showing the mappings of the Dutch and English vowels onto Dutch vowel categories (Tables 3 and 4, respectively).

Table 3 presents the results of the Dutch perception task: columns represent the twelve Standard Dutch monophthong response categories, and rows represent the four Standard Dutch stimuli categories. The percentages are based on 96 categorizations of each stimulus. Cells show how

often on average each vowel label was selected as a response to the auditory stimuli with one of the four Dutch vowels.

Table 3: Results of the Dutch perception task for East Flemish and Brabantine Dutch listeners (means in %; scores below 5% are excluded from presentation).

East Flemish Dutch response percentages													Brabantine Dutch response percentages											
	i	ɪ	eː	ɛ	aː	ɑ	oː	ɔ	øː	u	y	ʏ		i	ɪ	eː	ɛ	aː	ɑ	oː	ɔ	øː	u	y	ʏ
i	90	7	-	-	-	-	-	-	-	-	-	-	i	53	46	-	-	-	-	-	-	-	-	-	-
ɪ	-	99	-	-	-	-	-	-	-	-	-	-	ɪ	6	90	-	-	-	-	-	-	-	-	-	-
y	-	-	-	-	-	-	-	-	5	-	91	-	y	-	-	-	-	-	-	-	-	14	-	77	6
ʏ	-	-	-	-	-	-	-	-	-	-	-	99	ʏ	-	-	-	-	-	-	-	-	5	-	-	95

Fisher's exact tests (the test statistic which we will refer to as F) revealed significant ($\alpha = 0.05$) differences between East Flemish and Brabantine speakers in terms of their categorization of Standard Dutch /i/ ($F = 39.505$, $p < 0.001$) and /ɪ/ ($F = 11.162$; $p = 0.002$). No significant differences were found for /y/ ($F = 7{,}409$; $p = 0.066$) and /ʏ/ ($F = 5{,}891$; $p = 0.059$).

In particular, concerning the perception of Standard Dutch /ɪ/, the twelve East Flemish listeners categorized 99% of the /hɪs/ stimuli as /ɪ/. Although Table 3 and the Fisher's exact test reveal a (significant) difference between the East Flemish and Brabantine listeners for Dutch /ɪ/, the Brabantine listeners still categorized /ɪ/ as /ɪ/ in a substantial majority of tokens (90%). The fact that 6% of the 96 /hɪs/ stimuli were categorized as /i/ by the Brabantine listeners (as opposed to none by the East Flemish listeners) can be attributed to the smaller spectral differences between Brabantine /ɪ/ and /i/ than between East Flemish /ɪ/ and /i/. As for the perception of Standard Dutch /i/, the results show that East Flemish listeners categorized 90% of /his/ stimuli as Dutch /i/. Brabantine listeners, however, categorized only 53% of the /his/ stimuli as /i/; 46% of the stimuli were categorized as /ɪ/. With regard to the perception of Standard Dutch /ʏ/ and /y/, it can be observed that in total, 99 and 95% of the /hʏs/ stimuli were categorized as /ʏ/ by East Flemish and Brabantine listeners, respectively; for /hys/, East Flemish and Brabantine listeners categorized 91 and 77% of the stimuli as /y/, respectively.

Table 4 presents the results of the cross-language categorization task: columns represent the twelve Standard Dutch monophthong response categories, and rows represent the four RP English stimuli categories. The percentages are based on 96 categorizations of each stimulus. Cells show how often on average each vowel label was selected as a response to the auditory stimuli with one of the four English vowels.

Table 4: Results of the cross-language perception task for East Flemish and Brabantine Dutch listeners (in %; scores below 5% are excluded from presentation).

East Flemish Dutch response percentages													Brabantine Dutch response percentages											
	i	ɪ	eː	ɛ	aː	ɑ	oː	ɔ	øː	u	y	ʏ		i	ɪ	eː	ɛ	aː	ɑ	oː	ɔ	øː	u	y	ʏ
iː	99	-	-	-	-	-	-	-	-	-	-	-	iː	85	14	-	-	-	-	-	-	-	-	-	-
ɪ	-	98	-	-	-	-	-	-	-	-	-	-	ɪ	-	96	-	-	-	-	-	-	-	-	-	-
ʊ	-	-	-	-	-	-	-	-	-	98	-	-	ʊ	-	-	-	-	-	-	-	-	-	84	-	15
ʌ	-	-	-	-	44	40	-	-	-	-	-	17	ʌ	-	-	-	-	34	57	-	-	-	-	-	8

Fisher's exact tests revealed significant differences between East Flemish and Brabantine speakers in terms of their categorization of Standard British English /iː/ ($F = 12{,}925$, $p = .001$), /ʊ/ ($F = 19{,}849$, $p < .001$) and /ʌ/ ($F = 6{,}854$, $p = .032$). No significant difference was observed for /ɪ/ ($F = 3{,}806$, $p = .246$).

While only 1% of the RP English /iː/ stimuli was categorized as /ɪ/ by East Flemish listeners, Brabantine listeners categorized 14% of English /iː/ stimuli as Dutch /ɪ/. East Flemish listeners frequently mapped English /ʊ/ onto Dutch /u/: 98% of the /ʊ/ stimuli were categorized as such. Brabantine listeners, in comparison, did not select /u/ as often as East Flemish listeners: 84% of the /hʊs/ stimuli were categorized as /u/.

While the /ʌ/ stimuli were categorized as Dutch /aː, ɑ, ʏ/ by both groups, there were some distributional differences. The categorizations of English /ʌ/ in the /aː/ (44%) and /ɑ/ (40%) response categories were distributed more evenly among the East Flemish listeners, while Brabantine listeners displayed a preference towards an /ɑ/ categorization (57%). Furthermore, /ʌ/ was categorized as /ʏ/ more than twice as often by East Flemish listeners (17%) than by Brabantine listeners (8%).

2.4 Discussion of the perception task results

2.4.1 Dutch perception task

The results of the Dutch perception task are consistent with the different vowel pronunciations in the two Belgian Dutch varieties reviewed in the introduction, and they confirm the hypotheses posited for L1 perception in Section 1.3. Concerning the perception of Standard Dutch /ɪ/, the twelve East Flemish listeners categorized 99% /hɪs/ stimuli as /ɪ/. In line with Flege's (1995)'s SLM, this suggests that East Flemish listeners have developed a phonetic category for /ɪ/ that can also be applied to (or is based on) the perception of Standard Dutch /ɪ/, which is consistent with the

observation that the qualities of this vowel in East Flemish and Standard Dutch are similar. The observation that Brabantine listeners also categorized this vowel frequently as /ɪ/ can be explained by Standard Dutch /ɪ/ being durationally short, like Brabantine /ɪ/ (but unlike Brabantine /i/). Durational information thus seems to play a role in the accurate categorization of Standard Dutch /ɪ/ by Brabantine listeners.

As for the perception of Standard Dutch /i/, the results reveal a clear pattern. While East Flemish listeners (as expected) nearly always perceive Standard Dutch /i/ as /i/, Brabantine listeners do not consistently categorize this vowel as /i/. The fact that Standard Dutch /i/ corresponds to Brabantine /i/ on a spectral level, and to Brabantine /ɪ/ on both a spectral and a durational level, may account for this variation. The Brabantine listeners' phonetic categories for /i/ and /ɪ/ seem to be fine-tuned solely on the basis of durational rather than spectral features.

East Flemish listeners categorized Standard Dutch /y/ as /y/ and /ʏ/ as /ʏ/ more often than Brabantine listeners, although the results are less outspoken for this vowel contrast. The average spectral distance between the vowels of the target stimuli in the /y–ʏ/ vowel pair is greater (Figure 1), and the durational differences are considerably larger (see Figure 2). The more frequent mapping of /y/ onto long /øː/ by Brabantine listeners (despite spectral differences between these vowels) was not predicted, but could be tied to the greater weight Brabantine listeners assign to durational differences. In terms of Escudero's (2005) L2LP, the more developed durational cue constraints in Brabantine listeners would cause these listeners to put comparatively less weight on spectral cue constraints in their perception of these vowels.

2.4.2 Cross-language perception task

What is striking about the /iː–ɪ/ contrast is that, overall, the two listener groups performed similarly and categorized English /iː–ɪ/ as Dutch /i–ɪ/, thus confirming the hypothesis formulated in Section 1.3. However, some regional differences which were also present in the Standard Dutch perception task could be discerned in this task as well. While only one of the 96 RP English /iː/ stimuli was categorized as /ɪ/ by East Flemish listeners, Brabantine listeners categorized 14% of English /iː/ stimuli as /ɪ/. An explanation for this observation could be that Brabantine listeners actually need to hear the English vowels /iː/ and /ɪ/ after each other, in order to be able to hear that /iː/ is longer than /ɪ/. In the experiment, these vowels were separated by other stimuli.

The RP English vowel /ʊ/was mostly classified as Dutch /u/, in line with the hypothesis formulated in Section 1.3. East Flemish listeners mapped English /ʊ/ onto /u/ in 98% of the cases, while Brabantine listeners did so in 84% of the cases. In addition, Brabantine listeners categorized 14% of the /ʊ/ stimuli as /ʏ/, as opposed to the East Flemish listeners who categorized none of the /ʊ/ stimuli as such. This mapping was not predicted, but could be explained by the spectral and durational features of /ʊ/ being more similar to Brabantine /ʏ/ than to East Flemish /y/ or /ʏ/, so that

equivalence classification/perceptual assimilation could take place for Brabantine listeners, but not for East Flemish listeners.

With respect to English /ʌ/, the differential categorization by the listener groups can be accounted for by the spectral coinciding of /aː/ and /ɑ/ in Antwerp (Brabantine) Dutch (Verhoeven and Van Bael 2002a: 157). This could explain why Brabantine listeners are more inclined to choose the shorter alternative of the two vowels when perceiving a relatively short vowel, adding evidence for the hypothesis that Brabantine listeners pay comparatively more attention to durational than to spectral differences. East Flemish listeners also categorize English /ʌ/ as /ʏ/ to a greater extent than Brabantine listeners, which was predicted (Section 1.3). Brabantine and East Flemish /ʏ/ is the short member of the Dutch /y–ʏ/ contrast, which suggests that the smaller number of mappings onto /ʏ/ by Brabantine listeners finds its origins on a spectral level: since Brabantine /ʏ/ is more closed than East Flemish /ʏ/, it appears to be a less likely candidate for perceptual assimilation.

3 Experiment 2: production

3.1 Participants

The participants who had carried out Experiment 1 (perception) then participated in Experiment 2 (production). They carried out the experiments in that order, so that the language of the perception task was not revealed to the participants. (The production task contained an English part.)

3.2 Procedure and materials

The production experiment consisted of a Dutch and an English picture-naming task. Participants first saw a picture on the screen (e.g. a picture of a *stoel* 'chair' in the Dutch production task; a picture of a cup in the English production task) and were asked to name the object. Subsequently, they saw the same picture with a carrier sentence underneath (e.g. *Een ... heeft een leuning* 'A chair has a back' for Dutch; *He drank tea from a …* for English*)*, which they were asked to read out while adding the target word. Participants could proceed to the next picture by pressing a button on the keyboard. They were instructed to speak at a normal speaking rate, but no instructions were given as to whether they should produce the words in Standard Dutch or in their dialect, i.e. with a regional accent, or, in the second task, in RP English. None of the participants asked any questions about this, but as the task itself was rather formal, more standard-like productions were likely to be elicited.

As in the perception task, the target vowels were /i, ɪ, y, ʏ/ for Dutch and /iː, ɪ, ʊ, ʌ/ for English. For each vowel, four different pictures were shown, leading to a total of 16 unique productions of each vowel per participant. Nine distracters were added to each task, providing a total of 25 words per task. The order of the pictures was randomized. A complete list of the target stimuli

and distracters can be found in Appendix A.[3] The production experiment was conducted in the same session as the perception experiment, in a quiet, well-isolated room. The productions were recorded with a Marantz PMD620 digital recorder and a Sony ECM-MS907 one-point stereo microphone.

3.3 Analysis

The twelve East Flemish and twelve Brabantine participants each produced four realizations of the four stimuli in each of the two production tasks, rendering a total of 384 Dutch and 384 English productions. The task results were analyzed using PRAAT (version 5.3.45, Boersma and Weenink 2013). The vowel duration of the stimuli was determined through auditory analysis of the sound files and visual analysis of the accompanying acoustic waveforms, and the vowel boundaries of each target vowel were marked. Subsequently, the exact middle of the vowel was determined automatically by PRAAT (this point was chosen to ensure a minimal influence of consonantal context). At this midpoint, the first and second formants were manually measured.

3.4 Results

3.4.1. Dutch production task

Figure 4 presents the spectral properties in terms of F1 and F2 of the Dutch vowels produced by the Ghent and Antwerp speakers. All vowels were normalized using the Lobanov normalization method (Lobanov 1971), since it has been shown that this method is effective in eliminating physiological sex-related differences, while preserving regional differences (see Verhoeven and Van Bael 2002a, 2002b and Adank et al. 2004b).

[3] We are aware of the non-uniform format of the visual stimuli, as pointed out by an anonymous reviewer. However, since the pictures were only used to elicit word productions without providing orthographic information (no reaction times were measured), the main criterion in the selection of the pictures was that they were clear and would elicit the target word. This criterion was satisfied, as naming the target objects on the basis of the pictures proved unproblematic.

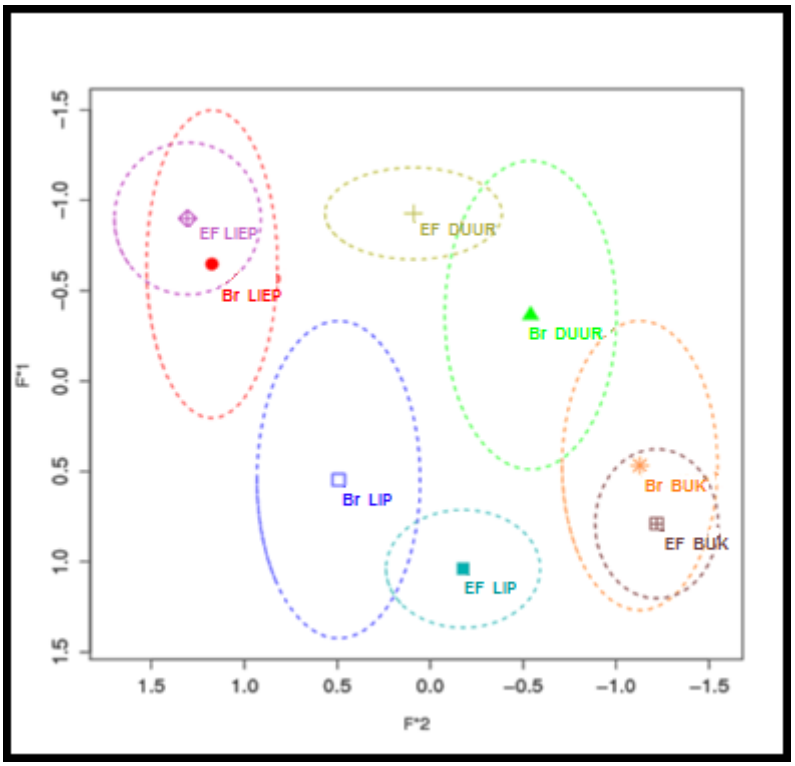


Figure 4: Dutch production task: Lobanov normalized average production of /i/, /ɪ/, /y/ and /ʏ/ by the East Flemish (EF) and Brabantine (Br) speakers (ellipses represent one standard deviation away from the mean).

Figure 4 shows first that short /ɪ/ and /ʏ/ are (on average) produced more raised and fronted in Brabantine Dutch, and secondly, that Brabantine /i/ and /y/ are slightly more open than their East Flemish equivalents. As a result, there is a smaller spectral distance between the two members in the /i–ɪ/ and /y–ʏ/ vowel pairs in the Brabantine dialect than in the East Flemish dialect.

Figure 5 presents a boxplot showing the durational differences between the vowel pairs produced by the two speaker groups in the Dutch task.

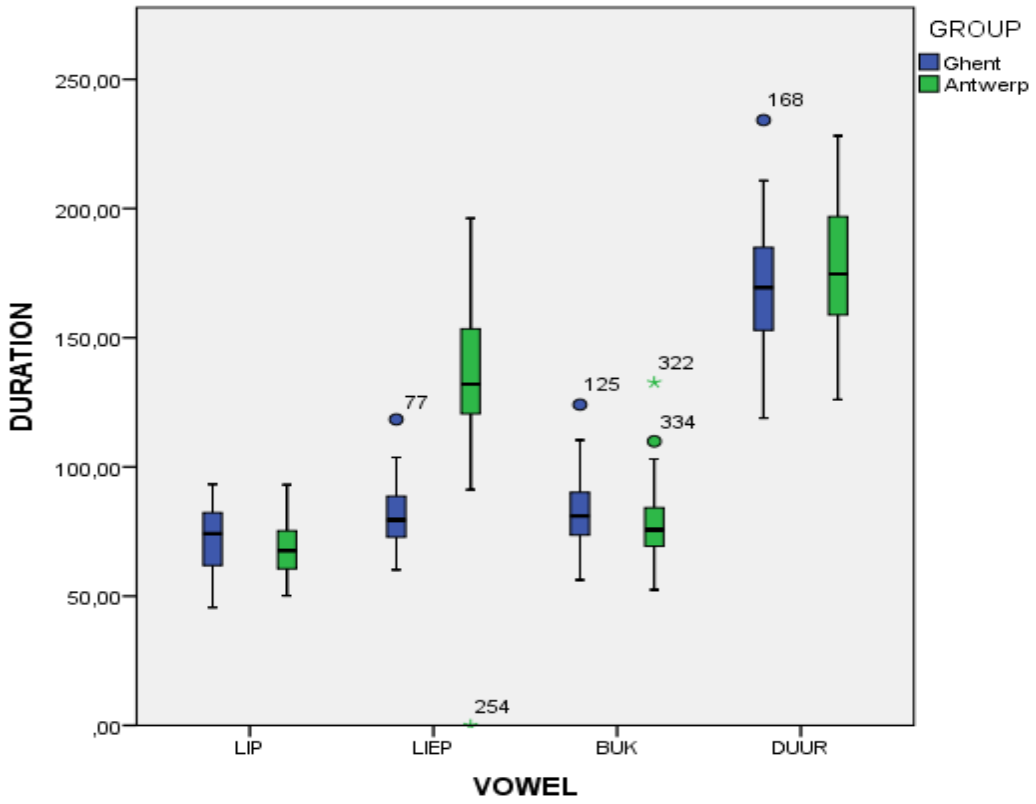


Figure 5: Average vowel duration (in ms) of the Dutch productions of the target stimuli by the East Flemish (Ghent – blue) and Brabantine (Antwerp – green) participant group per target vowel; whiskers extend to values which are one SD away from the mean.

Figure 5 reveals that in East Flemish, the durational contrast between /i/ and /ɪ/ is very subtle, with /i/ being only slightly longer. Results of an independent samples T-test revealed that this difference is not significant ($p = 0.319$). In Brabantine Dutch, by contrast, /i/ is realized as highly significantly longer than /ɪ/ ($p < 0.001$). For the vowels /ʏ/ and /y/, a highly significant durational difference could be observed in both groups (for both groups $p < 0.001$). Based on the descriptions in the literature (see Table 1), a durational contrast had been expected for Brabantine /y–ʏ/ only, not for East Flemish Dutch. That no difference between the two groups was observed can probably be accounted for by the lengthening of Dutch /y/ before /r/ in all Dutch varieties (Collins and Mees 2003: 132). Although there are some exceptions (e.g. *fuut* 'grebe (name of a bird)'; *Huub* 'a proper name'), Dutch /y/ is almost exclusively followed by /r/ in monosyllabic words (Van Herreweghe 1987). Since the stimuli needed to be common monosyllabic words for which there was an easy picture representation,all stimuli with the /y/ vowel ended in /r/. As a result, /y/ was realized as a very long vowel by both groups.

3.4.2. English production task

Figure 6 shows the spectral results for the English production task.

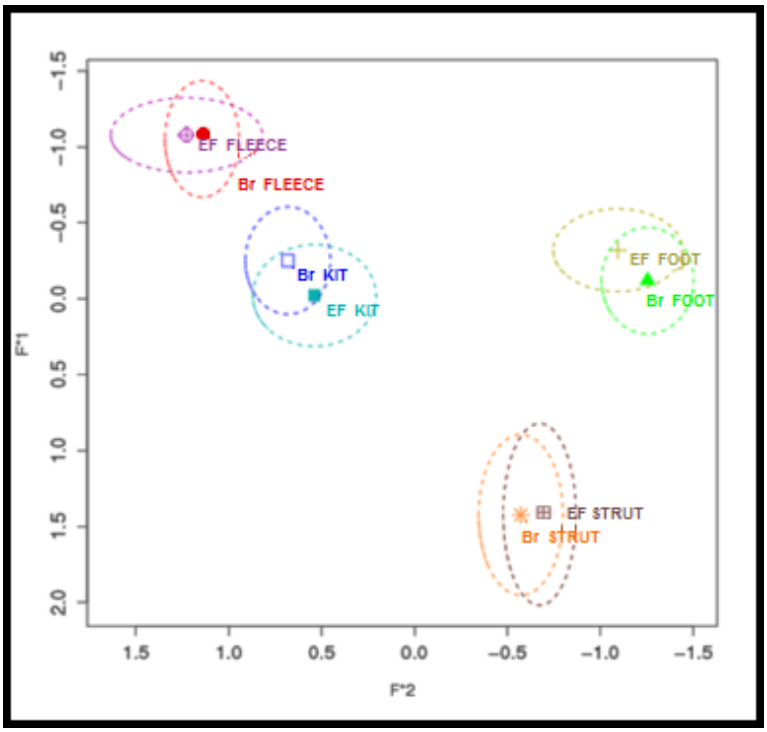


Figure 6: English production task: Lobanov normalized average production of /iː/, /ɪ/, /ʊ/ and /ʌ/ by the East Flemish (Ghent) and Brabantine (Antwerp) speakers.

In comparison with East Flemish speakers, Brabantine speakers produced a slightly smaller spectral contrast between /i/ and /ɪ/. However, when comparing Figure 6 for L2 English with Figure 5 for L1 Dutch, it is clear that, on average, the L2 productions of the two groups are much more similar than their L1 productions. To compare the learners' vowel productions with those of native English speakers, Figure 8 presents the Lobanov normalized spectral results for the English productions of /iː/, /ɪ/, /ʊ/ and /ʏ/ by the East Flemish and Brabantine speaker groups of the present study, and those by five RP English speakers with ages ranging from 20 to 25 years, reported in Hawkins and Midgley (2005).

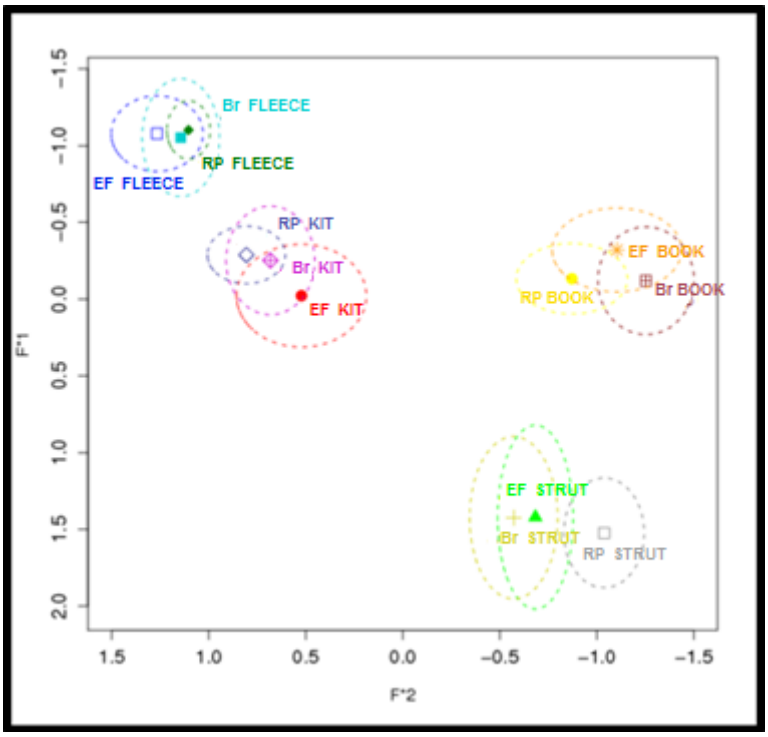


Figure 8. The English /iː ɪ ʊ ʌ/ productions by the East Flemish and Brabantine speakers, compared to productions by RP speakers reported in Hawkins & Midgley (2005). Ellipses represent one SD away from the mean.

The graph reveals that the English L2 vowels produced by both East Flemish and Brabantine participants are, with the exception of /ʌ/, [4] spectrally close to productions of these vowels by the RP speakers reported on by Hawkins and Midgley (2005). Importantly, none of the L2 vowel categories overlap, indicating that both learner groups are able to produce a spectral contrast between the vowels under investigation. Although Hawkins and Midgley (2005) did not collect durational data, Figure 7 shows that the durations of /iː, ɪ, ʊ, ʌ/ are along the lines of the RP English vowel descriptions in Table 1.

Figure 7 shows the durational differences between the vowel pairs produced by the two speaker groups in the English task.

[4] The direction in which both Dutch productions deviate from the RP realization of /ʌ/ might be in part due to Dutch speakers' frequent substitution of English /ʌ/ with Dutch /ʏ/ for English /ʌ/ (Collins and Mees 2003: 95).

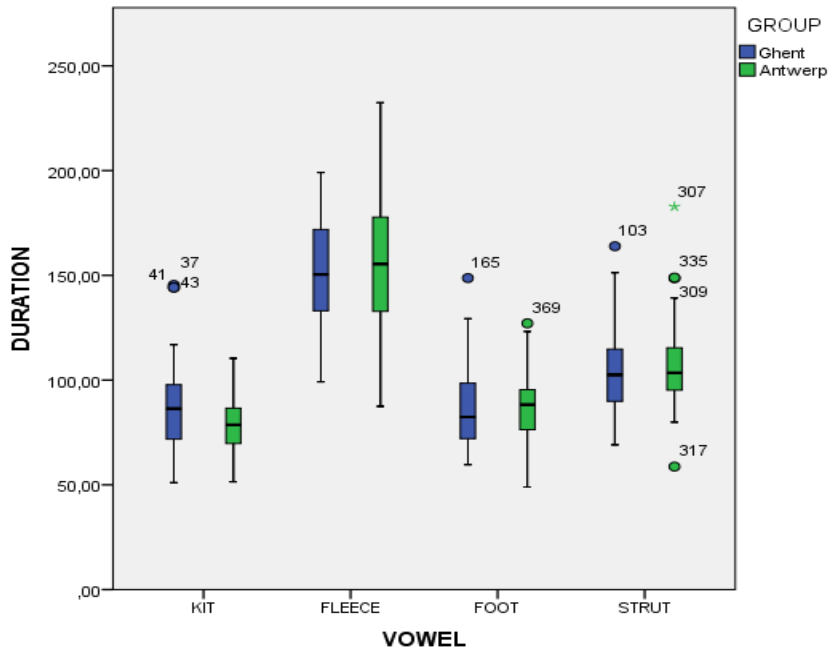


Figure 7. Average vowel duration (in ms) of the English productions of the target stimuli by the East Flemish (Ghent – blue) and Brabantine (Antwerp – green) participant group per target vowel.

Figure 7 shows that East Flemish speakers make a durational distinction between English /iː/ and /ɪ/ (mean difference = 65.2ms; SD = 21.8). As expected, Brabantine speakers show a slightly greater durational contrast between English /iː/ and /ɪ/ (mean difference = 76.6ms; SD = 36). However, an independent samples T-test showed no significant difference between the two groups ($p > 0.05$). With regard to English /ʊ/ and /ʌ/, both are relatively short, which was expected. There are no observable regional differences: the Brabantine results (mean difference = 18.8ms; SD = 14.7) are parallel with the East Flemish results (mean difference = 19.4ms; SD = 35.85), although there is a wider spread within the East Flemish group.

3.5 Discussion of the production task results

The results of the Dutch production task revealed that the predicted regional differences in L1 production could indeed be observed in the sample of East Flemish and Brabantine speakers, mainly with respect to the Dutch /i/ and /ɪ/ vowels, where a greater durational and more limited spectral distinction between Brabantine Dutch /i/ and /ɪ/ productions was found. These productions differed significantly from East Flemish Dutch /i–ɪ/ productions, with their greater spectral and durationally more limited distinctions. For /y–ʏ/, no significant durational production differences between the two groups were found, yet the spectrally significantly differing /ʏ/ productions showed a pattern which was similar to that of the /i–ɪ/ contrast. These findings confirm the hypothesis that the L1 regional variety influences the production of L1 standard vowels.

The results of the English production task showed that the vowels produced by the East Flemish and Brabantine listeners were highly similar in spectral terms, but that in durational terms a difference could be observed (i.e. between /ɪ/ and /i/) although it was not a significant one. These results seem to suggest that the standard variety of the L1 rather than the regional variety played the most important role in L2 production. In Section 4 we discuss a potential explanation for this finding.

4 General discussion

A first aim of this study was to examine whether the L1 regional differences between East Flemish Dutch and Brabantine Dutch /i–ɪ/ and /y–ʏ/, as described in the literature, could be observed in new samples of East Flemish and Brabantine participants, and whether regional differences would also be observed in listeners' perception of L1 Standard Dutch vowels. With regard to L1 Standard Dutch perception, categorization by the two participant groups confirmed the predicted dialectal differences. The more accurate performance by East Flemish listeners in categorizing all four Standard Dutch stimuli /i, ɪ, y, ʏ/ confirms that, with respect to these vowels, East Flemish Dutch is more similar to Standard Dutch than Brabantine Dutch. The Brabantine participants' comparatively lower performance on the categorization of Standard Dutch stimuli furthermore revealed Escudero's (2005) L2LP cue weighting in Brabantine perception grammar, which leans towards durational rather than spectral features (at least to distinguish between the vowel pairs examined in the present study).

The results from the Dutch perception task were confirmed in the Dutch production task. In all, the two Dutch tasks thus illustrated that the boundaries of the phonological categories for /i–ɪ/ and /y–ʏ/, and the weight attached to phonetic features in order to distinguish between the members of these two vowel pairs, were significantly different in East Flemish and Brabantine Dutch. This seems to suggest that models like SLM (Flege 1995), PAM(-L2) (Best 1995; Best and Tyler 2007) and L2LP (Escudero 2005), which predict patterns in L2 acquisition based on properties of the L1, can be extended to the acquisition of a new variety within the L1. The different behavior of the two participant groups in the Standard Dutch perception task can be explained on the basis of acoustic similarities and the use of cues in the speakers' regional L1 variety.

However, the main objective of this study was to examine whether and how these regional L1 vowel differences influenced the L2 perception and production of English /iː/, /ɪ/, /ʊ/ and /ʌ/. In the cross-language perception task, East Flemish participants more often categorized English /iː/ and /ɪ/ as Dutch /i/ and /ɪ/, respectively, than Brabantine speakers. Despite the categorization distributions being roughly similar between the two participant groups, the East Flemish and Brabantine results for English /ʊ/ and /ʌ/ categorizations were significantly different, and these differences could be accounted for by the way in which the vowel distributions in the L1 regional varieties were

organized. The fact that, even allowing for regional differences, English /ʌ/ was categorized mainly as Dutch /aː/ and /ɑ/ by both participant groups suggests that this is an instance of the SUBSET scenario in Escudero's (2005) L2LP.

With regard to the English production task, L1 regional differences revealed to be of some influence on the L2 production of English vowels, yet the two participant groups differed to a lesser extent than would be expected when taking their L1 productions into consideration. Although minor regional differences in L2 production can be observed, the English productions of East Flemish and Brabantine speakers are in general comparable. The question then arises how we can account for the limited effect of the L1 dialect on L2 perception and especially L2 production. The absence of negative transfer from the L1 dialect on L2 acquisition can be explained in two ways: either there is no negative transfer (anymore), because the L2 contrasts have been acquired by the learners, or the learners do not transfer from the L1 dialect (negative transfer), but from the L1 standard variety (positive transfer).

The first explanation for the limited effect of L1 regional variety of L2 perception and production is thus that the L2 English speaker-listeners were tested at a point in their L2 development at which they had acquired the new vowel properties of the L2. Flege points out that his SLM (Flege 1995) predicts that initially, L2 learners may "fail to produce new L2 sounds authentically, but may eventually do so as a result of establishing phonetic categories" (Flege 1997: 39). We hence propose that L2 learners may have considered the L2 English vowels as new vowels they had to acquire rather than as vowels similar to their regional L1 vowels, for which L2 learners generally fail to create new phonetic categories. For instance, rather than transferring their regional L1 /ɪ–i/ contrast, based on duration (hence phonetically an [i–iː] contrast), they may have (positively) transferred their (regional) Dutch /i/ into English, but developed a separate category for the 'new' English vowel /ɪ/. In this context, it is also worth bearing in mind that all participants had had five years of formal English instruction in school. It is possible that in conversation or pronunciation classes, they actually trained on minimal pairs like *ship – sheep* and *bit-beat,* which could have helped the acquisition process.

A second, alternative account is that the participants had successfully acquired the vowels of the standard L1 variety, and positively transferred these vowels into the L2, rather than the vowels of their L1 regional variety. Such an account would fit in the current literature on L3 acquisition: the participants' regional Dutch variety would be their L1, Standard Dutch the second language system (L2) they acquired and English their third language system (L3).[5] L3 acquisition studies have

[5] It should be noted that in Flanders, French is the first non-native language taught in schools, typically from the age of 10 or 11 onwards. Hence, pupils get formal instruction in French before they get English classes;French could in that sense be considered the "L3", while English would be the "L4". However, all children are massively exposed to English through the media, while most children (in Ghent and Antwerp) have little contact with French outside of the school. As a result, we believe it is

provided ample evidence of intricate patterns of interaction between speakers' L1, L2 and L3 (see Wendel et al. 2010 and Cabrelli Amaro et al. 2012 for overviews). An L3 acquisition account of the present results would suggest that speech learning and perception patterns predicted in models of L2 acquisition (such as SLM, Flege 1995; PAM(-L2), Best 1995 and Best andTyler 2007; and L2LP, Escudero 2005) may need to be adapted when a third language system comes into play, i.e. L1–L2 interaction patterns cannot necessarily be generalized to contexts in which the non-native language is the third language to be acquired, besides the regional and standard L1 varieties. In the Dutch perception task in the current study, the participants were not explicitly told they were going to hear Standard Dutch vowels, and in the picture-naming task they were not explicitly instructed to speak Standard Dutch. Although the production task itself was likely to elicit more formal, standard speech, it is possible that the participants had different vowel systems for their L1 regional variety and for the L1 standard variety. In future studies, it would be interesting to instruct participants to speak with a Standard Dutch accent to be able to observe to what extent the speakers have two separate vowel systems in their native language, and to what extent English can indeed be viewed as an L3. Future studies could also adopt a developmental point of view to study to what extent L2 learners from different L1 dialectal backgrounds take different learning paths in the acquisition of the L2.

5 Conclusions

This study has provided evidence for the effect of regional differences in the L1 on the perception and production of vowels from a shared standard language. The differences observed in the East Flemish and Brabantine speakers in this case study confirm earlier studies on impressionistic and acoustic measurements of Dutch vowels. In addition, these results contribute to the growing awareness of the need for assessing participants' regional background in phonological and phonetic research.

However, despite these clear differences in L1 perception and production, participants performed notably more similarly in the cross-linguistic perception task (with regional differences nevertheless being reflected to a certain extent in the categorizations) and in the English production task (where near-native pronunciation was observed for all but the /ʌ/ vowel). We suggest that the absence of transfer from the L1 regional variety may either mean that the native Dutch speakers had acquired the English vowel contrasts, or that they transferred not from the L1 regional variety, but from the L1 standard variety. In the latter account, English can be regarded as a third language system to be acquired, besides the L1 dialect and the L2 standard variety, which would explain the more intricate pattern of cross-linguistic interactions we observed.

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more likely that the participants transfer properties from L1 Standard Dutch, their native language, into English, rather than from French.

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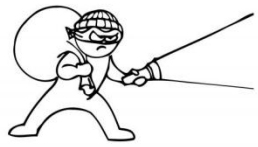
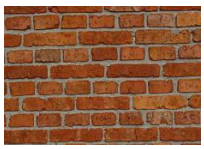
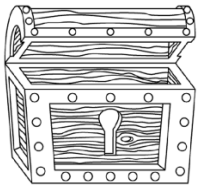
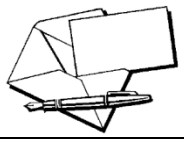
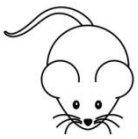
Appendix: production experiment: visual stimuli and carrier sentences

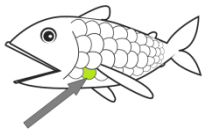
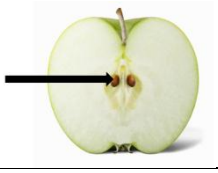
1. Dutch production task (in order or appearance; distracters are in italics.)

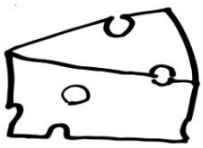
schip /sxɪp/ ‘ship’	vuur /vyr/‘fire’	*stoel /stul/ ‘chair’*	kus /kʏs/ ‘kiss’
			
Hij is matroos op een… ‘He is a sailor on a …’	Ze verbrandde zich aan het… ‘She burnt herself on the…’	*Een… heeft een leuning ‘A… has a back.’*	Ze gaf de jongen een … ‘She gave the boy a…’

dief /dif/ ‘thief’	muur /myr/ ‘wall’	*geel /ɣeːl/ ‘yellow’*	*beer /beːr/ ‘bear’*
			
Ze werden bestolen door een… ‘They were robbed by a…’	Ze klom over een… ‘She climbed a…’	*Citroenen zijn… ‘Lemons are…’*	*Hij werd aangevallen door een… ‘He was attacked by a…’*

kist /kɪst/ ‘chest’	*glas /ɣlas/ ‘glass’*	*huis /hœys/ ‘house’*	put /pʏt/ ‘pit’
			
Hij vond een schat in de… ‘He found a treasure in the…’	*Het… viel op de grond en brak. ‘The … fell on the ground and broke.’*	*Ze woont in een groot… ‘She lives in a big…’*	Ze vielen in een… ‘They fell in a…’

brief /brif/‘letter’	stuur /styr/ ‘steering wheel’	*bal /bɑl/ ‘ball’*	*muis /mœys/ ‘mouse’*
			
Hij schreef haar een… ‘He wrote her…’	Hij verloor de controle over het … ‘He lost control of the…’	*De… rolde in het doel. ‘The… rolled in the goal.’*	*Het gepiep kwam van een… ‘The peeping noise came from a…’*

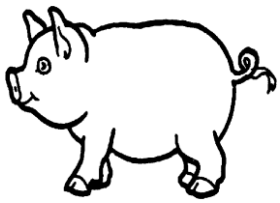
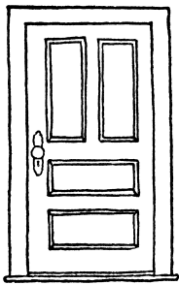
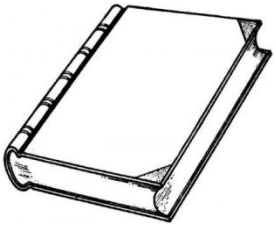
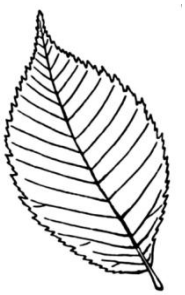
schub /sxʏp/ ‘scale’	duur /dyr/‘expensive’	*aap /aːp/ ‘monkey’*	pit /pɪt/‘kernel’
			
De vis miste een… ‘The fish missed a…’	Die jas was… ‘That coat was…’	*De… at een banaan. ‘The… ate a banana.’*	In de appel zit een… ‘The apple contains a a…’

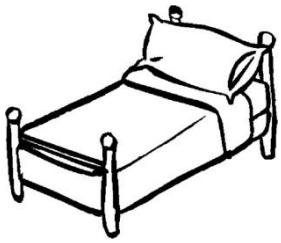
kies /kis/ ‘molar’	brug /brʏx/‘bridge’	sik /sɪk/ ‘goatee’	*kaas /kaːs/ ‘cheese’*
			
Er zat een gaatje in haar… ‘There was a hole in her…’	Hij wandelde over de… ‘He walked across…’	De geit heeft een… ‘The goat has a…’	*De… stond al op tafel. ‘The… was already on the table.’*

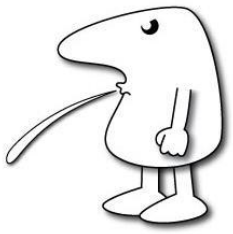
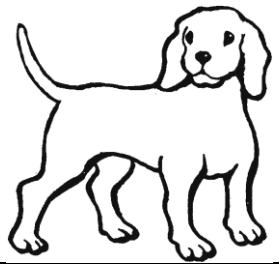
ziek /zik/ ‘ill’

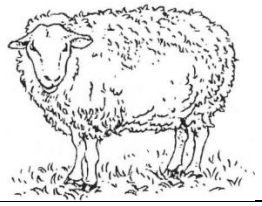
Deze man is… ‘This man is…’

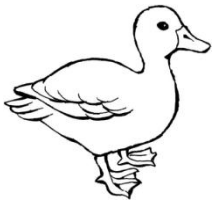
2. English production task (in order or appearance; distracters are in italics.)

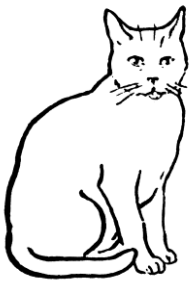
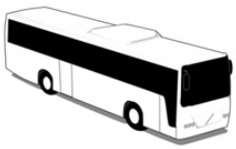
pig /p ɪ g/	*door /d ɔː/*	book /b ʊ k/	leaf /l iː f/
			
He had a little farm with one…	*She locked the…*	The girl was reading a…	He stepped on a crunchy …

hug /h ʌ g/	key /k iː/	*bed /b ɛ d/*	cook /k ʊ k/
			
She gave him a…	He turned the …	The… was empty.	He's a very skilled…

spit /s p ɪ t/	*dog /d ɒ g/*	*shoe /ʃ uː/*	cup /k ʌ p/
			
There was… on the floor.	The… barked at him.	He tied the laces of his…	He drank tea from a …

grass /g r ɑː s/	foot /f ʊ t/	sheep /ʃ iː p/	*bat /b æ t/*
			
The… is green.	There was a splinter in his left…	Wool comes from a…	He was scared by a…

fist /f ɪ s t/	*rose /r ə ʊ z/*	duck /d ʌ k/	peace /p iː s/
			
She punched him with her …	A … is a type of flower.	He fed bread crumbs to a …	The Nobel Prize for…

six /s ɪ k s/	*red /r ɛ d/*	*cat /k æ t/*	bus /b ʌ s/
			
He had to be home by…	The wine was a dark…	He gave food to the …	She always takes the…

hook /h ʊ k/

There was a fish on his…