Listening to Regional Accents: Dutch and French Listeners' Perception of Phonetic Vowel Variation in Belgian Dutch

Ellen Simon
Linguistics Department
Faculty of Arts and Philosophy
Ghent University, Belgium.
Ellen.Simon@UGent.be

Bastien De Clercq
Brussels Centre for Languge Studies
Vrije Universiteit Brussel, Belgium
Bastien.De.Clercq@vub.be

Pauline Degrave
Institut Langage et Communication
UCL Louvaine, Belgium
Pauline.Degrave@uclouvain.be

Abstract

This study sets out to examine how first (L1) and second language (L2) listeners perceive vowel variation in standard versus regional accents. We investigate whether phonetic variation in a regional accent in Belgian Dutch affects the perception of Belgian Dutch versus French listeners. A total of 40 listeners (20 L1 Dutch and 20 L1 French speakers) took part in the study. All listeners completed a categorization task with isolated words containing Dutch /ɪ, ɑ, i, a/ and a transcription task assessing the intelligibility of the same stimuli embedded in sentences. Stimuli were produced by 4 native speakers of Dutch. Two speakers read the stimuli with a Standard Dutch and two with a regional Dutch accent. The results revealed that the Belgian French listeners, who are exposed to the Standard Dutch accent in their foreign language classrooms, did not experience difficulty categorizing or transcribing regionally accented vowels than Standard Dutch vowels, though they were outperformed by native Dutch listeners. The results suggest that a regional accent does not necessarily present an additional challenge to non-native listeners and that the acoustic proper-

ties of L2 accented vowels and their relation to L1 vowels are decisive in the listeners' success at identifying L2 vowels.

Keywords: second language acquisition; perception; vowel variation; regional variation; accent.

Résumé

Cette étude examine comment les auditeurs de langue première (L1) et seconde (L2) perçoivent la variation des voyelles dans les accents standards ou régionaux. Nous examinons si la variation phonétique d'un accent régional du néerlandais de Belgique affecte la perception des auditeurs belges néerlandophones comparés à des Belges francophones. 40 auditeurs (20 L1 et 20 L2) ont effectué une tâche de catégorisation de mots isolés contenant les voyelles néerlandaises /ɪ, ɑ, i, a/ et une tâche de transcription évaluant l'intelligibilité des mêmes stimuli dans des phrases. Les stimuli étaient produits par 4 natifs du néerlandais : deux ont lu les stimuli avec un accent du néerlandais standard et deux autres avec un accent régional. Les résultats montrent que les auditeurs francophones belges, exposés au néerlandais standard dans leurs cours de langue, n'ont pas plus de difficultés à catégoriser ou transcrire les voyelles marquées par un accent régional que celles du néerlandais standard, bien que surpassés par les auditeurs natifs. Ces résultats suggèrent qu'un accent régional ne représente pas nécessairement un défi pour les non natifs et que les propriétés acoustiques des voyelles en L2 et leur relation avec les voyelles en L1 sont déterminantes pour l'identification par des auditeurs L2.

Keywords: phonétique; acquisition d'une langue seconde; perception; variation des voyelles; variation régionale; accent.

1. Introduction

Variability is a key property of any type of natural speech and it can have various causes, including regional variation. Regional accents broadly refer to pronunciations which deviate from the standard accent of the language (by definition not bound to a particular region) and are similar between speakers from the same regional background. This study sets out to examine how second language (L2) listeners perceive vowel variation in regional accents in their L2, compared to standard accents, and in relation to first language (L1) listeners. We investigate the effects of L1-L2 vowel correspondences and accented speech input and experience on listeners' perceptual identification and intelligibility of regional accents, as assessed

through a vowel categorization and transcription task. By comparing the perception of different vowels in a standard and regional accent with which L2 listeners are to a greater or lesser extent familiar, we will gain insight into the stability of the phonological system of L2 listeners and in the degree of tolerance that listeners show towards phonetic vowel variation in different accents. Specifically, in this study, set in Belgium, we focus on how L1 and L2 listeners perceive Dutch vowels produced in the standard accent of (Belgian) Dutch as well as in the regional Brabantian accent, in which different acoustic cues signal vowel contrasts. For the L2 listeners, who are all native speakers of French, we will examine the relationships between their native French vowels and the specific properties of Standard and regional Dutch vowels. We additionally aim to examine to what extent listeners' perception of standard and regionally accented vowels is influenced by the amount of accented speech to which listeners are exposed in a listening context, operationalized as the amount of input provided during the experiment. To that end, we will compare the intelligibility of standard and accented vowels produced in isolation with those embedded in sentence-long utterances.

1.1. Adaptation to accented speech

L1 listeners are generally able to handle regional accents effectively. Literature on perceptual adaptation in L1 listeners, typically using an experimental design consisting of a familiarization phase followed by a lexical decision task, has shown that adult listeners are generally highly successful at adapting their perception to phonetic variation due to regional accents (Bent & Baese-Berk, 2021; Dahan et al., 2008). Whether this perceptual attunement should be interpreted as a shift in phonetic category boundaries or as a general relaxing of category boundaries is debated (see, for instance, Melguy & Johnson, 2021, who argue in favour of a general relaxation). Either way, as a result of L1 listeners' rapid adaptation to regionally accented speech, intelligibility issues rarely arise. However, there may still be a processing cost when listening to accented speech. As noted by Ying et al. (2013), a number of studies have shown that L1 listeners' reaction time is slowed down and their accuracy rate reduced when presented with regional accents (Floccia et al., 2006).

However, compared to L1 listeners, L2 listeners may experience greater difficulty when listening to regional accents, as their phonological representations in the L2 may be less robust, with less clearly defined boundaries (Simon, 2025). Nevertheless, research on how listeners deal with phonetic variation shows a focus on L1 listeners, especially in the literature on perceptual adaptation. Less is known about how listeners deal with regional accents in their L2, even though regional variation

is invariably present in natural languages and it is highly likely that L2 listeners will at some point come into contact with or be exposed to speakers with regional accents that deviate in some respects from the accent they have been learning. In immersion settings, learners are often exposed to a mix of native and non-native, regional and standard varieties (Drummond, 2013), while in instructed language learning contexts, learners are often exposed to a standard accent of the L2 in the classroom and not or to a much lesser extent to regional accents (cf. De Wilde, 2019, on teaching Dutch as a Foreign Language in European universities).

One way in which L2 learners cope with accent variation may be by mapping the unfamiliar accent to their existing L2 categories. Ying et al. (2013) tested L1 Chinese learners of English in Australia on their perception of a familiar accent (Australian English) and two unfamiliar ones (Jamaican Mesolect English and Cockney-accented English). An eye-tracking experiment using the visual world paradigm revealed that L2 participants had the most difficulty recognizing words in an unfamiliar accent when those words contained a phoneme that, in their familiar L2 accent, belonged to a different phonemic category. This study highlights the importance of the relationship between L1 and L2 categories in predicting perceptual difficulty of accented speech. Indeed, the difficulties which L2 listeners may face in perceiving regionally accented vowels will depend on the relation between the specific L2 vowels and the corresponding L1 vowels. As such, the potential effect of regional accentedness on intelligibility may be related to the specific vowels under investigation and their predicted level of difficulty for L2 listeners (see Section 1.2.2 for a more thorough discussion on the relationship between L1 and L2 vowels in speech perception).

Besides the effect of the relationship between L1 and L2 vowels, another factor that may affect the perception and intelligibility of accented speech is the amount of accented speech available or presented to the listeners. Most previous research has examined perceptual adaptation in listeners exposed to individual words or sounds (e.g. Verbeke et al., 2024). However, in ecologically valid listening contexts, listeners would typically be exposed to longer utterances of the same speaker accent. Moreover, listeners may or may not have previous experience or familiarity with the regional (L1 or L2) accent.

Before turning to the aims and design of the current study (Section 1.3), we provide the background to this study by discussing previous research on the adaptation to accented speech (Section 1.1) and the perception of regional accents by L2 listeners (1.2).

1.2. The perception of regional accents by L2 listeners

Previous research has firmly established that regional accents in speakers' L1 affect the way in which these speakers perceive L2 sounds. For instance, both Chládková and Podlipsky (2011), and Escudero et al. (2012) showed how phonetic variation in regional accents of, respectively, Czech and Dutch, affected the categorization of L2 Dutch and English vowels. The differences between groups of regional accent speakers could directly be explained by the acoustic vowel properties in the L1 accents. For instance, in Escudero et al.'s (2012) study, North Holland and Flemish listeners differed in their assimilation of English /ɛ/ tokens to a vowel other than Dutch /ɛ/. Specifically, the Flemish listeners selected Dutch /ɪ/ significantly more often than the North Holland listeners. This was in line with the predictions made by a model based on a linear discriminant analysis, fed with acoustic properties (F1, F2 and duration) of Dutch and English vowels.

However, regional variation is not only relevant with respect to learners' L1; the regional, sociophonetic variation that occurs in the L2 also affects speech perception by L2 learners. Specifically, previous studies have shown that L2 listeners may differ in their perception of L2 sounds depending on the regional accent they are exposed to. Escudero and Boersma (2004) examined the perception of the English contrast between tense /i/ and lax /ɪ/ by two groups of Spanish listeners: those with Southern British English and those with Scottish English as their target L2 variety. The results of identification tasks revealed that L1 Spanish learners of Scottish English have more difficulty perceiving the /i:-ɪ/ contrast than Spanish learners of Southern British English, because Scottish English does not make a contrast between these vowels based on duration, which is known to be a strong cue for L2 learners (Cebrian, 2006). The effect of target accent was also examined by Baker and Smith (2010) in a study on the acquisition of French by L1 English learners. Crucially, Quebec French differs from European French in that it uses an additional cue to distinguish /i-y/ from /ɪ/, namely the assibilation of /t, d/ before /i, y/, but not before /u/. The results of identification and discrimination tasks revealed that English learners of Quebec French were more accurate at perceiving the French /i-y-u/ contrast, compared to learners of European French, again providing evidence for the effect of exposure to target L2 accents on L2 vowel perception.

In these studies, two groups of learners of different target L2 dialects or accents are compared on their perception of L2 speech sounds. These groups of learners are immersed in communities with different L2 accents or dialects, living in different regions or different countries and hence acquiring different L2 varieties. However, another interesting context is provided by one group of L2 learners who are exposed to multiple accents of the L2 they are learning. This context is common in instructed

foreign language learning contexts, in which one or more standard varieties of the language is typically used as a model in the classroom, but in which learners are also exposed to other regional accents through exposure to the media or through contact resulting from travel. To our knowledge, little previous research has looked into how one group of L2 listeners deal with phonetic variation in different accents of the language they are speaking or learning. Notable exceptions are the studies by Lee and Shin (2015) and Lee and Cho (2020), who examined L1 Korean EFL learners' perception of English vowels in North American English and Standard Southern British English. The learners had been mainly exposed to North American English and had only limited experience with British English. The results of a vowel identification task showed that the Korean EFL learners' familiarity with the North American accent strongly correlated with accuracy rates on North American versus Southern British English vowels (Lee & Shin, 2015). The Korean listeners in Lee and Cho's (2020) study were inexperienced EFL learners, differing in Length of Residence (LoR) in the United States of America. The results revealed that a model based on listeners' L1 predicted only the vowel identifications of EFL learners with a low LoR accurately, meaning that less experienced listeners relied more strongly on their L1 categories. The results also showed that the impact of the amount of L2 experience decreased with the less familiar Southern Standard British English accent. In both studies, the L2 learners were immersed in L2-speaking communities and hence predominantly exposed to one of the accents.

The present study will examine the perception of different phonetic vowel realizations in two L2 accents by the same group of L1 and L2 listeners, with the latter group learning the L2 in a context of foreign language instruction. Unlike the study by Lee and Shin (2015), which examined the perception of two acrolectal accents of English, often used as models in EFL contexts, our study investigates the perception of one acrolectal accent (Standard Dutch) and one regional accent.

1.2.1. Perceiving accents: the effect of stimulus input and accent familiarity

When examining the effect of regional accents on perception and intelligibility, the amount of input a listener receives when listening to accented speech may also play a role. When an acoustic-phonetic input form deviates from the form which a listener has stored in their mental lexicon, the listener may fail to map the input onto a lexical representation or may map it onto an incorrect representation, in which case intelligibility may be hampered. Intelligibility refers to a listener's actual understanding of what has been uttered by the speaker (Ockey and Wagner 2018). It is hence different from 'comprehensibility', which refers to listeners' subjective perception of how easy or difficult it is to understand a speaker (Munro & Derwing 1995, 2020).

Most studies dealing with L2 perception focus on the mapping of specific L2 vowels or consonants to either L2 segments (using identification tasks) or L1 segments (cross-language categorization tasks). Often, the target segments are embedded in short, fixed segmental frames (e.g., CVC contexts for vowel perception). By contrast, most studies dealing with intelligibility and comprehensibility present listeners with longer stretches of speech, such as sentences or short excerpts (Kang et al., 2018). When examining the effect of regional accents on L2 perception and intelligibility, the amount of input during the listening process may play a role: when listeners are presented with longer stretches of speech, they can infer more information about the specific use of (spectral or durational) cues in the speaker's accent, which may facilitate perception.

Kriengwatana et al. (2016) examined listeners' adaptation to vowel variation resulting from accent variation and compared it to adaptation to variation resulting from speaker/sex differences. In their study, adult Australian English listeners, unfamiliar with Dutch, were trained on Dutch vowels produced by a speaker from the Netherlands. The results showed that the participants were successful in adapting to new vowels from a different speaker of the same accent, but that adaptation to a novel accent was only successful when participants received feedback on their categorization responses (correct or incorrect). The authors conclude that listeners can make use of feedback about the correctness of their phoneme boundaries in order to adapt to unfamiliar accents.

Besides input received during the listening process, i.e. the amount of speech in the audio stimuli presented to the listener during the listening task, previous experience with the accent may also have an effect on the perception process. If listeners are familiar with a specific accent through previous exposure, they may – if presented with a sufficiently long stretch of speech – be able to infer which (regional) accent is spoken. This may cause listeners to be more tolerant towards, for instance, vowel variation. A study by Vaughn (2019) showed that listeners who were provided with a description of the accents they were about to listen to (e.g. Spanish-accented English) outperformed listeners who had not received any information in a sentence transcription task, suggesting that this information led listeners to be more tolerant in dealing with phonetic variation.

When little such information is presented, listeners may resort to using their own (native language/accent) representations but may relax the category boundaries to allow for variation. A study by Shaw et al. (2018) with native listeners of Australian English categorizing vowels in different regional accents of their L1, English—namely accents from London, Yorkshire, Newcastle UK and New Zealand—revealed a lot of tolerance towards all but a few phonetic vowel variations. The authors also examined whether short-term exposure to multi-talker accented

speech had a facilitating effect on subsequent vowel categorization. No such effect was found, suggesting that the role of previous exposure may be limited. Instead, the authors suggest that listeners relied on existing, underlying representations.

It should be noted that the studies discussed above deal with native listeners' perception of accents in their L1, and not with non-native listeners. In the present study, we compare L1 and L2 listeners' performance on the perception of regionally accented speech.

1.2.2. The effect of the relationship between L1 and L2 vowels

The relationship between L1 and L2 vowels, both on a phonological level (in terms of contrasts) and a phonetic level (acoustic similarities and differences) may determine the extent to which phonetic vowel variation affects L2 perception. Two prevalent speech learning models, Flege's Speech Learning Model (Flege, 1995) and its revised version (SLM-r, Flege & Bohn, 2021), and Best and Tyler's Perceptual Assimilation Model for L2 speech learning (PAM-L2, Best and Tyler 2007) make predictions about the perceptual difficulty of L2 vowels based on acoustic SLM(-r) and articulatory PAM(-L2) differences and similarities with L1 vowels. According to SLM-r (Flege & Bohn, 2021), learners are more likely to create new phonetic categories for non-native vowels which display significant acoustic differences to their corresponding native vowels (the so-called "new" sounds) than for vowels which are acoustically similar to native categories (called "similar" sounds). New sounds are acoustically quite different from native categories and as such are predicted to eventually lead to new category formation, while no new categories will be created for similar sounds, as pre-existing L1 categories are predicted to block new category formation for L2 sounds. A third category is that of "identical" speech sounds; these are acoustically similar enough to L1 categories for their use in the L2 to be unproblematic.

In PAM-L2 (Best & Tyler, 2007), individual L2 sounds can be categorized as good, acceptable or poor instances of native categories, they can be uncategorized (when none of the native categories are good matches) or non-assimilable (when the L2 sounds are not perceived as speech) (Best & Tyler, 2007). Tyler (2019) argues for a further division of uncategorized sounds into 'focalized', 'clustered' and 'dispersed'. While focalized L2 sounds are weakly consistent with one L1 category, clustered L2 sounds are weakly consistent with multiple L1 categories and dispersed sounds are not perceived as similar to any L1 category. On the basis of a detailed comparison between L1 and L2 vowels, the perception of L2 vowels can be predicted to be relatively easy or more challenging. In Section 1.2.2 we present a comparison of French, Standard (Belgian) Dutch and regional Dutch vowels, which allows us to predict perceptual difficulty for specific L2 Dutch vowels (Section 1.3.3).

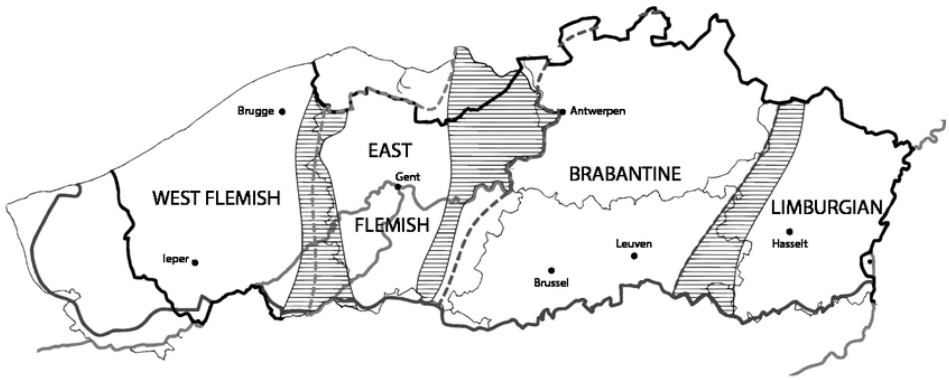
1.3. The current study

1.3.1. The setting

The study is set in Belgium, which has three official languages: while the region of Brussels is officially bilingual French-Dutch, the only official language in the northern region of Flanders is Dutch and in the southern region of Wallonia it is French (Hamers & Blanc 2000). In addition, there is a small German-speaking area in the east of the country. The majority of Dutch and French speakers do not use and are not daily exposed to the other language. This means that Dutch is in fact taught as a foreign language in secondary and tertiary education in Wallonia (Simon et al., 2022). The model used in foreign language classrooms in Wallonia is typically Standard Dutch as it is spoken in Belgium (Belgian Standard Dutch) or the Netherlands (Dutch Standard Dutch) (Hiligsmann, 2010).<?> However, there is a great deal of regional variation in Belgian Dutch and French-speaking students of Dutch will most likely be exposed to regional Dutch accents. The Dutch-speaking part of Belgium has four major dialect areas: from the west to the east, it can be divided into West-Flemish, East-Flemish, Brabantian or Brabantine, and Limburgian (see Figure 1).

Figure 1

Dialect regions in Flanders



Note. From *Verticale structuur en dynamiek van het gesproken Nederlands in Vlaanderen: een empirische studie in Ieper, Gent en Antwerpen* (p. 30), by A.-S. Ghyselen, 2016, based on *Linguistic Stability in a Language Space* (p. 35), by J. Taeldeman, 2009. https://doi.org/10.13140/RG.2.2.34145.10080. Copyright 2016 by A.-S. Ghyselen.

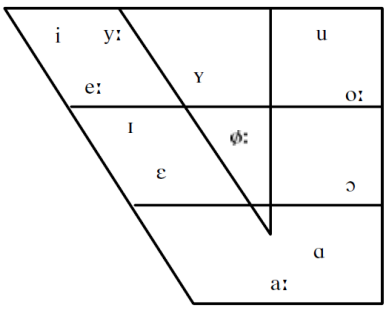
Although there is large-scale dialect loss in Flanders, in everyday conversations nearly all speakers use a regional accent, ranging from mild to strong. As noted above, with regional accents we broadly refer to pronunciations which deviate from the standard accent of the language and which are similar between speakers from the same regional background.

1.3.2. The vowels of Standard (Belgian) Dutch, regional Brabantian Dutch and French

The Standard Belgian Dutch vowel inventory contains 12 monophthongs /ɑ, ɛ, ɪ, ɔ, ʏ, a, e, o, ø, i, u, y/, three diphthongs /ɛi, œy, ɑu/ and a neutral or reduced vowel /ə/ (schwa).[<?>] Standard French has an equally dense vowel system, containing 10 oral monophthongs (/ɛ, ɔ, a, e, o, ø, i, u, y, oe/), in addition to a schwa and 3 nasal vowels (/ɛ̃/, /ɑ̃/ et /ɔ̃/).[<?>] Figures 2 presents the monophthongs of Belgian Standard Dutch and Figure 3 the oral monophthongs of Standard French. The target Dutch vowels in the present study, namely /i, a, ɪ, ɑ/, are circled, as are the closest French vowels /i/ and /a/.

Figure 2

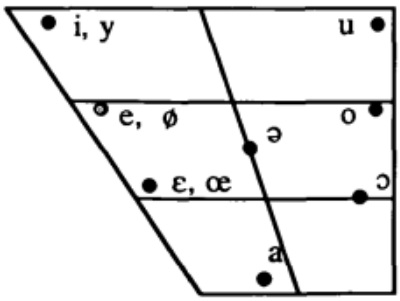
The monophthongs of Belgian Standard Dutch



Note. From "Illustrations of the IPA: Belgian Standard Dutch," by J. Verhoeven, 2005, *Journal of the International Phonetic Association*, *35*(2), p. 245 (https://doi.org/10.1017/S002510031300039X). Copyright 2005 by Cambridge University Press.

Figure 3

The oral monophthongs of French



Note. From "Illustrations of the IPA: French," by C. Fougeron and C. L. Smith, 2009 , Journal of the International Phonetic Association, 23(2), p. 73 (https://doi.org/10.1017/S0025100300004874). Copyright 2009 by Cambridge University Press.

In Dutch, the vowels /i/ and /a/ are classified as tense, while /ɪ/ and /ɑ/ are lax. Besides this spectral difference, there is also a durational difference between /a/,

which is sometimes classified as a phonologically long vowel /aː/ (often realized as a semi-long vowel, except preceding /r/, when it is lengthened), and /ɑ/, which is short. The vowels /ɪ/ and /i/ are short, but /i/ is phonetically lengthened preceding /r/ within the same syllable in the same foot (Booij, 1995).

As shown in Figure 3, French has tense /i/ and /a/, just like Dutch, but lacks the lax vowels /ɪ/ and /ɑ/. In fact, French /e/ has a vowel quality rather similar to Dutch /ɪ/, while Dutch /e/ tends to be somewhat higher. It should be noted that traditional descriptions of Standard French phonology (e.g. Battye & Hintze, 1992, p. 101) often include two open vowels, namely front /a/ and a back /ɑ/. However, as noted by Price (2005), "many native speakers of French no longer distinguish between these two vowels, using /a/ instead of /ɑ/ in all circumstances" (Price, 2005, p. 67). This is also the case for Parisian French, on which Fougeron and Smith's (2009) vowel diagram (Figure 3) is based. For Belgian French, Hambye et al. (2003) mention that the traditional qualitative distinction between front /a/ and back /ɑ/ is replaced in Belgian French by a duration contrast between long and short /a/. An example would be the minimal pair *patte* [pat] 'paw' vs. *pâte* [paːt] 'dough/pasta'. However, from Hambye and Simon's (2012) discussion of these vowels, it seems that the use of duration as a contrastive cue for these vowels is restricted to certain lexical items, in which the /a/ was lengthened to [aː] as the result of s-deletion and subsequent compensatory lengthening. Moreover, the use of the length contrast seems regionally bound and is, for instance, more prevalent in cities like Liège and Gembloux than in Tournai (Hambye & Simon, 2012). French /i/ is also subject to some regional variation, as in specific areas it is sometimes realized with a more open quality, close to [ɪ] or even [e], as in *midi* 'noon' being pronounced as [mɪdɪ] or [mede] rather than Standard French /midi/ (Hambye et al., 2003). However, this pronunciation has actually only been observed in the speech of older working-class speakers from Liège and Gembloux (Hambye & Simon, 2012, p.135). It is therefore clear that there is some phonetic vowel variation within French-speaking Belgium, both on a social and a geographical level (Francard, 2010; Hambye & Simon, 2012). However, there seems to be consensus that in Standard (i.e. hexagonal) French, unlike in some other accents, such as Swiss French, duration is not a contrastive cue for vowels in French and is heavily dependent on the phonetic (consonantal) context (Grosjean et al.. 2007; O'Shaughnessy, 1981).

It should be noted that a number of vowels in the regional Brabantian accent are markedly different from those in Standard Dutch and in the East-Flemish accent (see map in Figure 1). The most notable difference relevant to the present study is the reduction in spectral differences between the members of three vowel pairs. Specifically, the members of the vowel pairs [i] and [ɪ], [a] and [ɑ], [y] and [ʏ] have highly similar formant values in the Brabantian accent, spoken around the cities of

Brussels, Antwerp and Leuven (Verhoeven, 2005, p. 246; cf. also Belemans et al., 2000, p.113). As well as spectral differences, differences in the use of duration can be observed. The durational patterns reported in Verhoeven and Van Bael (2002) on the basis of a reading task with 12 East-Flemish and 12 Brabantian speakers reveal that in the Brabantian accent the distinction between /i/ and /ɪ/ is made on a durational rather than spectral level. While East-Flemish speakers produced hardly any durational difference between these two vowels, the Brabantian speakers produced /i/ considerably longer than /ɪ/. Brabantian speakers also produced /a/ longer than /ɑ/, but this length difference was comparable to that found in Standard Dutch and East-Flemish.

1.3.3. Research questions and predictions

We formulate one main research question (Main RQ) and two sub-questions (RQa and RQb) that we aim to address in the current study:

Main RQ: Do we observe an effect of phonetic vowel variation due to regional accent on the intelligibility of vowels for L1 and L2 listeners?

RQa. Is this effect moderated by the type of target vowel? Specifically, do we observe a difference in intelligibility for vowels which were predicted to be "easy" versus "difficult"?

RQb. Is this effect moderated by the type of task? Specifically, do we observe a difference in intelligibility of regionally accented vowels in a task in which the vowels are embedded in isolated words (vowel identification task) compared to a task in which the same vowels are embedded in sentences (transcription task)?

For the main research question, we will examine the impact of two variables, namely target accent and listener group. Specifically, we will examine the role of the target accent, i.e. whether the Standard Dutch accent and the regional Brabantian accent have a different impact on intelligibility, and whether that impact is the same for both listener groups, those listening in their L1 and those listening in an L2. Secondly, we will examine the effect of the listener group, i.e. whether the impact is different for L1 and L2 listeners, and different for Standard Dutch and regionally accented Brabantian stimuli. We predict that Dutch vowels will be more difficult to identify for L2 listeners compared to L1 listeners (cf. Cutler et al., 2004, 2005) and that the difference will be larger for regionally accented vowels. Listening to an L2 is known to be difficult, even for advanced learners, and this difficulty is increased in non-optimal listening conditions, as is the case when the speaker has an unfamiliar

accent. While even short previous exposure to a regional accent may be sufficient for L1 listeners to shift or relax their perceptual boundaries between Dutch vowels, the L2 listeners may have more difficulty identifying regionally accented Dutch vowels compared to the acrolectal Standard Dutch vowels to which they are most exposed. Results in that direction would be in line with a study by Pinet et al. (2015) on the intelligibility of different English accents to native British and Mandarin speakers, which suggested that acrolectal varieties are generally more intelligible to both L1 and L2 listeners. The authors surmise that acrolectal varieties may share certain acoustic-phonetic features, which may enhance intelligibility.

With respect to the first sub-question (RQa), we predict that there will be differences between types of vowels for L2 listeners. On the basis of the comparison between Dutch /ɑ, ɪ, aː, i/ and its closest equivalents in French presented in section 1.3.2 (/i/ and /a/), we can formulate different predictions about the learning difficulties these vowels may present for French learners of Dutch on the basis of SLM-r (Flege & Bohn, 2021), and PAM-L2 (Best & Tyler, 2007). Our predictions are based on the type of (Standard) French that we believe is the closest to that of our target population of young speakers of Belgian French in higher education.

We first turn to the predictions for the perception of the Standard Dutch vowels by French listeners. In the framework of SLM-r (Flege & Bohn, 2021), the Dutch tense vowels /i/ and /aː/ may be regarded as sounds which are "identical" to the native French vowels /i/ and /a/. Although French /a/ is realized with less spread lips compared to Dutch /aː/ (Hiligsmann & Rasier, 2007, p. 31), the sounds are acoustically similar enough to use the French categories in Dutch. Different predictions are made for the lax vowels /ɪ/ and /ɑ/: although these lax vowels do not occur in French, they are, besides a difference on the tense-lax dimension, acoustically relatively similar to the French vowels /i/ and /a/. As such, they may—in SLM terms—be regarded as 'similar' sounds. Following the principle of Equivalence Classification, French learners of Dutch may classify these vowels as equivalent to their native vowel categories and fail to build new phonetic categories. Dutch pronunciation manuals for French-speaking learners indeed point out that the Dutch vowel /ɪ/ is often realized as a too closed and tense, half-long vowel [i.] by French learners (Hiligsmann & Rasier, 2007). Similarly, native French learners of Dutch are reported to confuse the vowel /ɑ/ with tense /a/ (Hiligsmann & Rasier, 2007), as the lax vowel /ɑ/ does not occur in Standard French in France or Belgium.

Approaching the perception of the four Dutch vowels by French listeners from the perspective of PAM-L2 (Best & Tyler, 2007), a similar distinction would be predicted between, on the one hand, Dutch tense /i/ and /a/, and on the other hand the Dutch lax vowels /ɪ/ and /ɑ/. The Dutch vowels /i/ and /a/ could be predicted to

be good or acceptable instances of the native French categories /i/ and /a/, which are acoustically similar. As such, categorization of these Dutch vowels would be predicted to be relatively easy. The lax vowels /ɪ/ and /ɑ/ would then be considered 'poor' instances of the L1 French categories /i/ and /a/, given that they mainly differ from these categories on one dimension, namely the tense-lax dimension. As a result, their categorization would be predicted to be more difficult.

In sum, regardless of the adopted model, the perceptual acquisition of Standard Dutch /i/ and /a/ is predicted to be 'easier' than the perception of lax /ɪ/ and /ɑ/, which would be more 'difficult'.

We now turn to the predictions for the perception of Brabantian accented vowels by Belgian French listeners. In Brabantian, /i/ and /a/ are realized as tense, long vowels [iː] and [aː]. Since vowel length is not a contrastive cue in French, all four Brabantian Dutch vowel realizations ([i], [a] representing the phonemic category of the lax vowels, and [iː] and [aː] representing the phonemic category of the tense vowels) can be considered "identical" in SLM-r terms, given their acoustic similarity to French /i/ and /a/. However, despite this acoustic match, the French listeners still need to split the vowels into different phonemic categories, and specifically map the tense realizations onto the phonemic categories of the lax vowels /ɪ/ and /ɑ/, absent in French. We therefore predict that, for the lax vowels /ɪ/ and /ɑ/, French listeners will categorise the regionally accented realisations [i] and [a] as /i/ and /a/, so that these regionally accented lax vowels will still be more difficult than the regionally accented tense vowels. It should be noted that, unlike SLM-R, PAM-L2 would make a different prediction for lax /ɪ/ for Standard Dutch and Brabantian: while /ɪ/ should show a Category Goodness difference from French /i/ for Standard Dutch, PAM-L2 would predict a Single Category assimilation for Brabantian, since Brabantian /ɪ/ is realized as a tense vowel. This situation should, according to PAM-L2, lead to better categorization performance by the L2 Dutch learners for /ɪ/ in the Standard Dutch accent than in the Brabantian accent.

In sum, Belgian French learners of Dutch listening to these Dutch vowels face two challenges. First, independently of whether they are listening to Standard Dutch or Brabantian Dutch, they need to distinguish between four different Dutch vowel categories where French has only two phonemic categories. In Standard Dutch, two of these vowels are closer to French vowels ("identical" in SLM-r terms) while the other two are acoustically further away ("similar" in SLM-r terms). Secondly, French speakers listening to Brabantian Dutch need to map the regional vowels which are acoustically "identical" to their French vowels to different phonemic categories. Since vowel length is not contrastive in French and actual duration is heavily de-

pendent on the phonetic context, both short and long Brabantian /i/ and /a/ can be considered "identical" to L1 French vowels. In other words, French listeners need to resolve the mismatch between the phonetic and the phonemic correspondence between the Brabantian and the French vowels by assigning the correct phonemic status (/ɪ/ and /ɑ/) to the Brabantian vowels which are phonetically identical to the French vowels representing the categories /i/ and /a/.

Concerning the second sub-question (RQb), we predict that listeners will be better able to understand regionally accented vowels when they occur in longer stretches of speech, as listeners then have more information on the regional accent of the speaker. We further predict that this advantage may be stronger for L1 listeners than for L2 listeners, as the former may have been more exposed to regional accents (and hence have more knowledge of sociophonetic features of these accents) and/or have more robust phonological representations, with clearly defined boundaries, which are at the same time flexible. Categories are considered to be flexible, when listeners can map a wide range of acoustic-phonetic variants of a particular sound onto the intended category and can shift boundaries between categories based on the input (Simon, 2025). A study by Best et al. (Best et al., 2009; cf. also Mulak et al., 2013) showed that 19-month, but not 15-month-old toddlers were able to recognize familiar words in an unfamiliar accent, suggesting that phonological constancy, or robustness of phonological representations, is indeed required for listeners to be able to relax category boundaries for the perception of unfamiliar accents. As the phonological representations of L2 learners keep developing as the learning process continues, L2 listeners are predicted to have more difficulty with the perception of accents to which they have not or only rarely been exposed, as regular exposure to variation is needed for flexible adaptation to accented speech (Bruggeman & Cutler, 2019).

2. Methodology

2.1. Participants

A total of 40 listeners participated in the study: 20 L1 Dutch listeners from East Flanders and 20 L2 Dutch listeners from the French-speaking part of Belgium, with French as their native language. All participants completed an online questionnaire about their socio-demographic background (including questions about age and gender) and linguistic profiles (including their proficiency in and use of different languages and language varieties) in-between the two tasks of the experiment (cf. Section 2.3). Participants reported no hearing, language, or learning problems. Note

that the background questionnaires, as well as the scripts and tasks used in this study are all available via Open Science Framework (OSF; https://osf.io/b5tms/?view_only=9b799e2bc83a4e7f9877cb07481d0d1f)

2.1.1. L1 Dutch listeners

Twenty L1 Dutch listeners (3 male, 16 female, 1 non-binary), aged 20-46 years (mean 28 years) were tested. Seven participants were still students (6 in the field of languages, linguistics and translation); the remaining 13 were graduates (9 in the field of languages, linguistics and translation). They all lived in East-Flanders and had never lived in any other region of Belgium. However, through the media and through contact with mobile speakers all L1 listeners are exposed at least to some extent to speakers with a Brabantian accent. As the Brabantian accent is used in the economic and cultural centre of Flanders (in and around the triangle Brussels-Antwerp-Leuven, see Figure 1), it is often regarded as more prestigious than the other Flemish accents and as such it is present in, for instance, entertainment programmes on television (Goossens 2000; Adank et al. 2004). To the question of how often they use regional language (i.e. East-Flemish) in conversations with their parents, participants' responses had a mean score of 3.95 on a scale from 1 ("always standard Dutch") to 7 ("always regional variation") (SD = 1.5; Min = 1: Max = 6). For the same question about conversations with their friends, the mean score was 3.7 (SD = 1.3; Min = 1; Max = 6). As noted in Section 1.3.2, the vowels examined in this study are highly similar in the Standard Dutch and East-Flemish accents, and different from those in the Brabantian accent.

2.1.2. L2 listeners

Twenty L2 (4 male, 16 female), aged 22-24 years (mean 23 years), participated. They all had French as their mother tongue, and they did not grow up with Dutch as one of their native languages. The region where they spent most of their childhood and teenage years differed between the participants (provinces: Walloon Brabant[<?>]: n = 1; Hainaut: n = 5; Namur: n = 4; Luxembourg: n = 5; abroad (Djibouti): n = 1). A total of 18 participants had only French as their L1, two participants were bilingual educated (French/German and French/Romanian). They were all enrolled in a bachelor (3rd year) or master program (1st or 2nd year) of Linguistics and Literature (n = 17), Multilingual Communication (n = 2) or Translation (n = 1) with Dutch as a major language. They started learning Dutch between 3 and 14 years old (mean age = 10). Four participants were exposed to Dutch before the age of 7 (at ages 3, 5, 5, and 6). However, in all cases, this early contact occurred through school, which indicates that this early learning was limited, given that language programs in French-

speaking schools do not offer in-depth instruction at that age. The duration of Dutch learning among participants ranges from 8 to 21 years (M = 13). Eight participants mentioned in the questionnaire they had never learned Dutch outside school, 12 indicated that they had learnt Dutch through courses, language stays, contact with Dutch speakers, etc. Eight reported having contact with Dutch beyond the school context (through friends, family, activities, etc.). For four of them, this contact occurs several times a month, for three it happens several times a week, and for one participant, there is daily contact. The results obtained for the listening comprehension part of the proficiency test Dialang (Lancaster University) indicate that their level varied from B1 ('independent user') to C2 ('proficient user') on the proficiency scale of the Common European Framework of Reference for Languages (CEFR, Council of Europe, 2020). The majority of the participants had a C2-level (n = 11); 2 participants had a B1-level, 3 a B2-level and 4 a C1-level.

With regard to contact with regional varieties of Dutch, none of the French speakers had lived in either of the two provinces where Brabantian is spoken (i.e. the province of Antwerp and Flemish Brabant) for longer than one month or gone to school in this region. In total, 11 of the 20 French-speaking participants reported not to be able to recognize regional accents in Dutch. Of the remaining 9 participants, 5 indicated they would be able to recognize the Brabantian accent. Twelve people reported they had no contact whatsoever with Dutch speakers outside their Dutch classes. Of the remaining 8 participants, 4 reported to have regular contact ('at least once a week') with a speaker from the region where the Brabantian accent is spoken.

In the French-speaking part of Belgium, the main television and radio channels are all French, but most people have access to Flemish and Dutch channels as well. As participants could also be exposed to the Brabantian accent (as well as other Belgian Dutch or Netherlands Dutch accents) through the media, we also asked them to indicate on a scale from 1 to 7 how often they used Dutch for watching films or TV and for listening to music or the radio. The mean scores were 3 and 3.7, respectively. Finally, the French-speaking participants were asked how well they understood speakers with a Standard Dutch accent and speakers with a regional accent from Flanders. The mean scores on a scale from 1 ("not at all") to 7 ("native-like") were 6.0 for Standard Dutch and 3.7 for regional accents. All 20 participants indicated they could understand Standard Dutch better than regional accents in Dutch. The mean score to the question "how well can you hear differences between regional accents in Flanders?" was 3.4.

2.2. Stimuli

All stimuli were produced by four native speakers of Dutch in Belgium: two speakers from East-Flanders (one male, one female) with Standard Dutch accents, and two speakers from Antwerp (one male, one female) with Brabantian accents. All stimuli were recorded in a quiet room with a Marantz PMD620 digital recorder and a Sony ECM-MS907 one-point stereo microphone, at a sampling rate of 44100 Hz. Speakers were instructed to clearly read aloud the stimuli presented in a self-paced slide show at a normal speaking rate.

After the recordings, individual sentences and words were saved as individual sound files (.wav), and peaks were equalized at .97 to normalize the amplitude.

The target words (see Table 1) were 16 monosyllabic Dutch words containing Dutch vowels /i/ (*n* = 4), /ɪ/ (*n* = 4), /a/ (*n* = 4) and /ɑ/ (*n* = 4).

Table 1

Minimal pairs used in the experiment

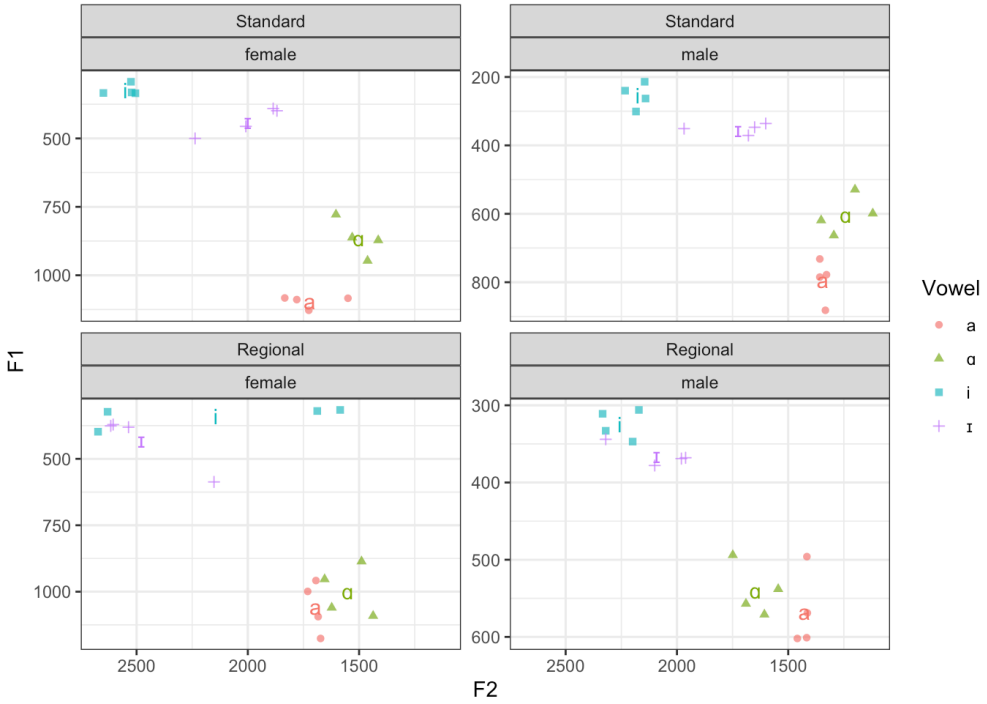
/a/- /ɑ/	**/i/- /ɪ/**
haak (hook) – hak (chop)	*biedt (offers)– bidt (prays)*
kaapt (hijacks) – kapt (cuts)	*piekt (peaks) – pikt (picks)*
taak (task) – tak (branch)	*vies (dirty) – vis (fish)*
zaak (case) – zak (bag)	*ziet (sees) – zit (sits)*

Target words were embedded in nonsensical sentences. The sentences all contained seven existing Dutch words, but the words did not make sense in the context of the sentence. Our choice to use nonsensical, i.e. semantically meaningless, sentences was motivated by our desire to minimize the effect of semantic predictability and was additionally motivated by Kang et al.'s (2018) study, which showed that performance on a nonsensical sentence transcriptions task was a strong predictor of listening comprehension (see Section 2.3.2 below for examples and more information on the nonsensical sentences in the transcription task). To ensure similarity between the nonsensical sentences while simultaneously avoiding repetition effects (i.e. hearing identical sentences from different speakers), the four speakers were presented with sentences made up of different permutations, with the same content words in a different order in the sentence. Each speaker was recorded reading three series of different permutations of the target sentences, in which the target vowels were presented with filler items containing the vowels /y/, /ɛ/, /e/, /u/, /ø/ and /oː/. The original stimulus list also contained items in which /i/ was followed by /r/ (e.g., *dier* 'animal'). As the coda /r/ significantly increased the duration of the preceding

vowel and no minimal word pairs were included with lax /ɪ/ preceding /r/, the participants' responses to these items were not included in the final analyses. Figures 4 and 5 present spectral and durational properties of the target vowels /a, ɑ, i, ɪ/ produced by the four speakers.

Figure 4

Spectral properties of target vowels in stimuli for the standard (top) and regional (bottom) speakers

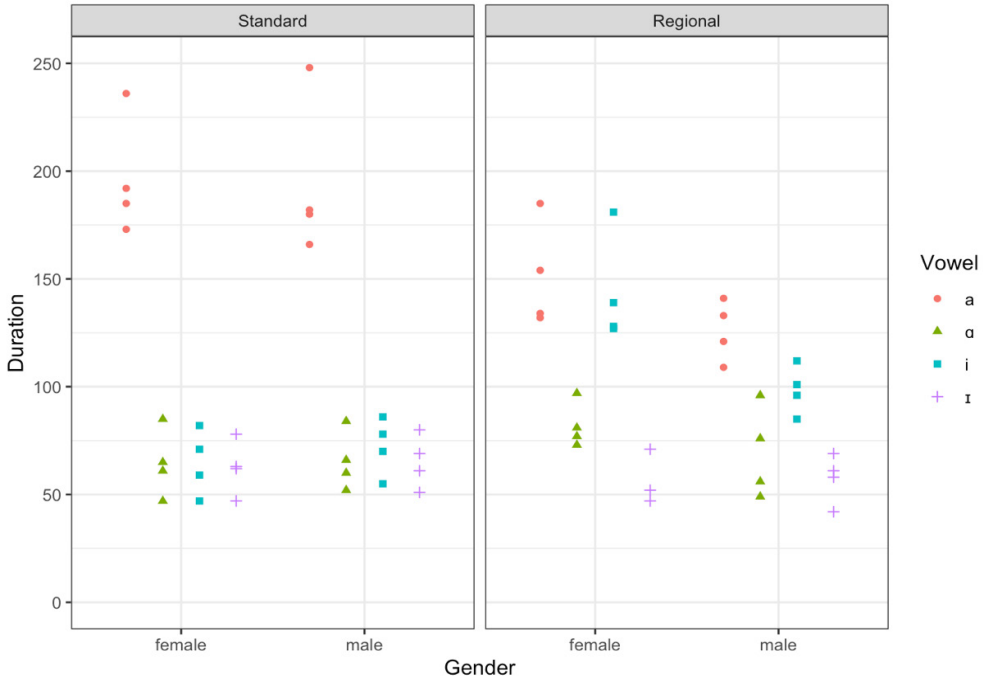


Note. F1 (y axis) and F2 values (x axis) were measured at vowel midpoint. Female speakers are displayed on the left, male speakers on the right. Vowel symbols in the graphs represent average values per speaker.

In spectral terms, /i/ and /ɪ/ show more overlap in the speakers of the regional accent, and especially in the female speaker, than in the Standard Dutch speakers, where the lax /ɪ/ is clearly more open and posterior. The same observation can be made for /a/ and /ɑ/, where the Standard Dutch speakers realize /a/ as clearly distinct from /ɑ/ in terms of vowel height, i.e. it is more open. The speakers of the regional accent produce a smaller F2 difference between the two vowels, showing a greater degree of spectral overlap between the vowels.

Figure 5

Durational properties of target vowels in stimuli (in ms) for Standard Dutch (left plot) and the Brabantian regional accent (right plot)



Note. Within each plot, the female speaker is presented on the left, the male speaker on the right.

All four speakers produced /a/ considerably longer than /ɑ/, though the difference was more marked for the Standard Dutch speakers. In line with descriptions of the Brabantian accent, Figure 5 shows that the speakers of the Brabantian regional accent produced a duration contrast between /i/ and /ɪ/, which was absent in the words produced by the Standard Dutch speakers.

2.3. Tasks and procedure

All participants performed two tasks: a vowel categorization task and a transcription task. In both tasks, blocks were mixed for accent, i.e. regional and standard items were presented together, in a randomized order.

2.3.1. Vowel categorization task

The vowel categorization task was built in Praat (Boersma & Weenink, 2025). Participants were aurally presented with the Dutch target words in isolation over headphones. The auditory stimuli were the monosyllabic Dutch target words excised from the nonsensical sentences read by the four Dutch speakers. On the screen, participants were presented with a grid containing 12 word boxes with keywords presenting all twelve Dutch monophthongs (see Figure 6). All keywords were monosyllabic words with a high frequency according to the SUBTLEX-NL database (Keuleers et al., 2010). The same grid was presented to all participants and throughout the experiment, i.e. the keywords had a fixed position on the screen, so as to make it easier for participants to find the keyword they were looking for. They were asked to click on the vowel they had heard after each auditory stimulus (*Kies de klinker die je hoort*, 'Choose the vowel you hear').

To familiarize participants with the procedure of the experiment, 16 test stimuli were played before the task started. Listeners identified a total of 171 audio stimuli, containing 63 target vowels (/i/ (n = 16), /ɪ/ (n = 15), /a/ (n = 16) and /ɑ/ (n = 16)). (Due to an irregularity in the design of the categorization task, one realisation of an /ɪ/ stimulus by the female regional speaker was missing from this task.) Between each of four blocks, participants were given the opportunity to take a short break.

Figure 6

Grid presented throughout the vowel categorization task

Note. All participants received this exact same vowel grid.

2.3.2. Transcription task

The transcription task was developed in SuperLab 5.0.5 (Cedrus Corporation, 2015). In the transcription task, participants saw nonsensical sentences on the screen, one at a time. In each sentence, two target words (or fillers) were left out and replaced by lines (e.g. *De dode reus __ op deze __,* 'The dead giant __ on this __'). In a text box underneath the sentences the participants were asked to type the two missing Dutch words (e.g. 'zit' and 'bek' in *De dode reus zit op deze bek,* 'The dead giant sits on this beak.'). They were told that all words were existing words, but that the sentences did not have any meaning. They were also asked to write what they thought they had heard, even if they were not sure which word they had heard or if they were unsure about the spelling.

All minimal pairs but one contained words belonging to the same word class (either a conjugated main verb or a noun), so that the position in the sentence could not bias listeners towards choosing either of the two members of the pair. The only exception is the minimal pair *vies* 'dirty' – *vis* 'fish', which contains an adjective and a noun, respectively.

The experiment started with 8 trial sentences to familiarize participants with the procedure, produced by the same talkers. Participants then completed four blocks of 22 sentences. Listeners never heard the same sentence more than once. After each block, they were given the opportunity to take a short break. In total, each participant transcribed 64 target words, containing /i/ (n = 16), /ɪ/ (n = 16), /a/ (n = 16) and /ɑ/ (n = 16). The transcriptions by the participants were coded by a native speaker of Dutch by assigning a number to each of the target vowels and the vowels that were used in the transcriptions. For each of the four target vowels, the phoneme-grapheme correspondence in monosyllabic Dutch words is transparent: <ie> represents /i/ (e.g. *ziet* 'sees'), <i> represents /ɪ/ (e.g. *zit* 'sits'), <aa> represents /a:/ (*zaad* 'seed') and <a> represents /ɑ/ (*zat* 'sat' or 'drunk'). A specific code ("88") was used whenever a participant transcribed a word that did not contain the target consonantal frame. This happened in 11 cases (6 in the L1 group and 5 in the L2 group). In all of these cases, the participant actually transcribed another word from the sentence (i.e. one that was actually already there one the screen, e.g. *de dode schoot schoot*… instead of *de dode schoot ziet*…. All 11 tokens were left out of the analysis.

2.4. Analysis

The full R-scripts (Bates et al. 2015) and dataset can be found via OSF: https://osf.io/b5tms/?view_only=9b799e2bc83a4e7f9877cb07481d0d1f.

2.4.1. Descriptive statistics

Descriptive statistics were calculated for the main independent variables (task type, variety, participant, language background and vowel difficulty) by converting the binary outcome variable per trial (correct vs. incorrect) into a continuous mean accuracy score per participant. As an intermediary step, averages were first calculated per vowel to correct the unequal number of times the /ɪ/ vowel appeared in the categorization task.

2.4.2. Logistic regression analysis

Inferential statistical analyses were carried out in R using the lme4 package to carry out a mixed-effects logistic regression with the responses on the test trials (correct vs. incorrect) as the dependent variable. Treatment-coded fixed effects include the task type (*categorisation* vs. transcription), the variety (*standard* vs. regional) and vowel difficulty ("*difficult"* vs. "easy") as within-subject variables and the language background of the participants (*L1* vs. L2) as a between-subjects variable (reference levels in italics). Two three-way interaction terms were included for the fixed effects to answer the main research question and the two sub-questions, one for task type, variety and language background, and a second for variety, language background and vowel difficulty. Random intercepts were included for participants, stimuli and speaker. The filler vowels were not included in the descriptive and inferential data analyses.

A series of planned post-hoc tests were performed using the emmeans package in R (Lenth 2022) for statistically significant terms in the model ($p < 0.05$). This package allows the comparison of predicted probabilities between variables while controlling for the influence of other variables in the model. Only custom-coded contrasts were included, as we are primarily interested in comparing interaction terms differing in only one value (e.g. L1-standard vs. L2-standard, but not L1-regional vs. L2-standard).The comparisons are reported in the form of odds ratios. That is, the post-hoc tests evaluate the ratio of the odds of responding correctly for one (combination of) variable(s) to the odds for another (combination of) variable(s). For instance, if the odds of the L1 group identifying the vowel in a stimulus correctly are 9 and the odds of the L2 group doing the same is 4, the odds ratio of 2.25 indicates that the odds of identifying the vowel correctly are 2.25 higher in the L1 group than in the L2 group.

3. Results

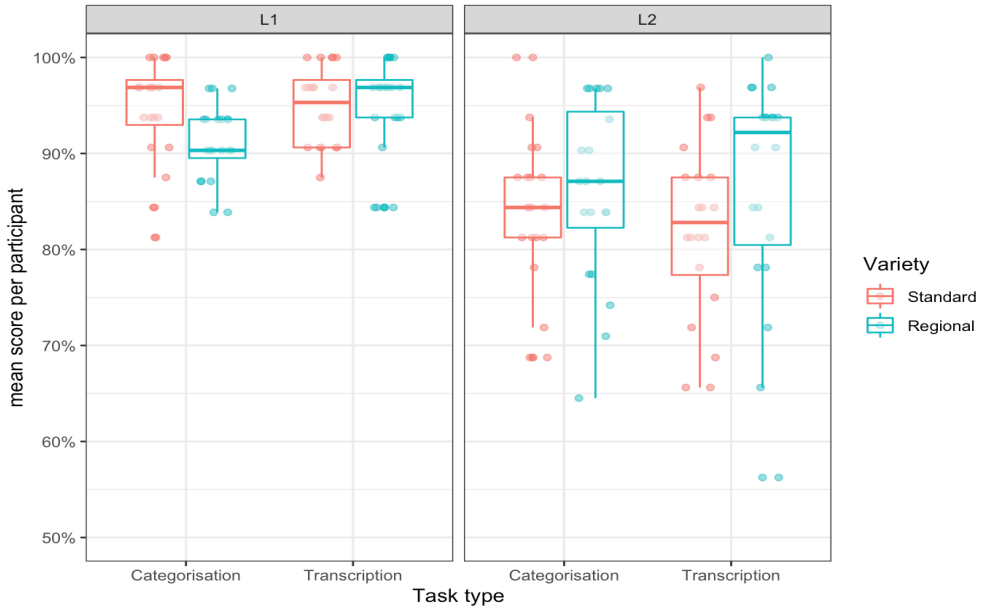
3.1. Descriptive statistics

Figure 7 and Table 2 present the participants' scores based on the variables task type, variety and language background. On average, performance in the L1 group is higher than in the L2 group, with the largest difference in means observed on the transcription task with the standard variety (13%) and the smallest difference on the categorisation task with the regional variety (5.16%).

Within the L1 group, performance was similar in most conditions, with the exception of the categorisation task with regional stimuli, where participants scored around 4% lower than in the other conditions. In the L2 group, the mean scores across combinations of task type and variety are similarly comparable, with the largest difference being a 4.69% difference between the categorisation and transcription of standard Dutch items. Overall, variation within the L2 group was substantially higher than in the L1 group.

Figure 7

Boxplots representing average scores per participant for the L1 group (left plot) and L2 group (right plot) on the categorisation and transcription tasks



Note. Each dot represents a participant's average score.

Table 2

Summary statistics (%) for performance on the categorisation and transcription tasks

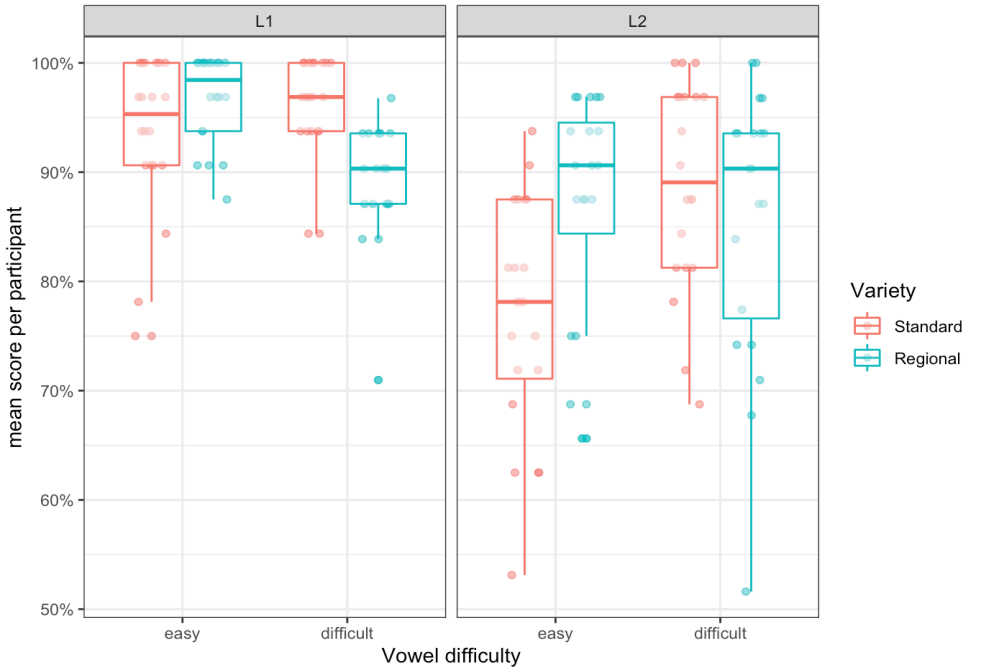
		L1			L2		
Task type	**Variety**	**mean**	**Sd**	**95% CI**	**mean**	**sd**	**95% CI**
Categorisation	Standard	94.53	5.35	92.03 - 97.04	83.75	7.83	80.09 - 87.41
	Regional	91.13	3.90	89.30 - 92.95	85.97	9.38	81.58 - 90.36
Transcription	Standard	95.00	3.98	93.14 - 96.86	82.03	9.06	77.79 - 86.27
	Regional	94.84	5.20	92.41 - 97.28	86.72	11.69	81.25 - 92.19

An examination of the results from the perspective of vowel difficulty (Figure 8 and Table 3) reveals similar scores across conditions for the L1 group, except for difficult vowels presented with a regional accent, where the scores are between 4.25% and 7.53% lower than in the other conditions. In addition, a substantial number of L1 participants showed ceiling effects, with 30% and 50% of L1 speakers correctly identifying all easy vowels in the standard and regional conditions respectively, and 40% when identifying difficult standard items. In contrast, no L1 participants achieved ceiling scores on difficult regional items.

In the L2 group, performance on easy and difficult vowels was more similar throughout, with high variation and larger confidence intervals suggesting much overlap across conditions. The most striking exception is the L2 group's lower performance on easy vowels presented in a standard accent, with a mean score that is between 8.93% and 12.03% lower than in the other conditions. On the whole, the data suggest more variable performances across participants in the evaluation of difficult vowels presented in a regional accent. Compared to the L1 group, ceiling effects are less obvious in the L2 group and limited to difficult vowels, for which 15% of the participants identified all standard vowels correctly and 10% identified all non-standard vowels correctly. None of the L2 participants identified all easy vowels correctly.

Figure 8

Boxplots representing average scores per participant for the L1 group (left plot) and L2 group (right plot) on the difficult and easy vowel categories



Note. Each dot represents a participant's average score.

Table 3

Summary statistics (%) for performance on the easy and difficult vowels

		L1			L2		
Vowel type	**Accent**	**mean**	**sd**	**95% CI**	**mean**	**sd**	**95% CI**
Easy	Standard	93.44	7.23	90.05 - 96.82	76.88	10.99	71.73 - 82.02
	Regional	96.72	4.12	94.79 - 98.64	86.88	10.76	81.84 - 91.91
Difficult	Standard	96.09	4.74	93.87 - 98.31	88.91	9.54	84.44 - 93.37
	Regional	89.19	5.57	86.59 - 91.80	85.81	12.66	79.88 - 91.73

3.2. Regression model

The regression model summarised in Table 4 revealed that the three-way interactions between task type, variety and the language background ($p = 0.442$), and between vowel difficulty, language background and variety ($p = 0.073$) are not statistically significant. As for the two-way interactions, the interaction involving language background and variety ($p = 0.006$), and the interaction involving vowel difficulty and variety ($p < 0.001$) were statistically significant.

In addition, statistically significant effects were observed for the main effects language background ($p = 0.002$) and variety ($p = 0.001$).

Other than the above-mentioned interaction between vowel difficulty and variety, none of the terms including vowel difficulty were statistically significant, neither the interaction between vowel difficulty and language background ($p = 0.108$), nor the main effect of vowel difficulty ($p = 0.447$).

Interestingly, none of the terms involving task type were revealed to be significant. In addition to the three-way interaction mentioned above, no significant interactions were observed for the interaction between task type and language background ($p = 0.414$) nor for the interaction between task type and variety ($p = 0.127$). No main effect was observed for task type either ($p = 0.693$), indicating that performance on the transcription task did not significantly differ from that of the categorisation task. Finally, a look at the random effects of the model reveals more variation per vowel and stimulus than per participant or speaker.

Table 4

Summary of the fixed and random effects in the logistic regression model

Fixed effects				
	Est.	**Std. Error**	***z***	***p***
(Intercept)	**3.479**	**0.453**	**7.679**	**< 0.001**
Task type (transcription)	0.1	0.254	0.395	0.693
Language background (L2)	**-1.014**	**0.33**	**-3.068**	**0.002**
Variety (regional)	**-1.426**	**0.435**	**-3.279**	**0.001**
Vowel difficulty (easy)	-0.365	0.48	-0.76	0.447
Task type (transcription): Language background (L2)	-0.246	0.301	-0.818	0.414

Task type (transcription):Variety (regional)	0.524	0.344	1.526	0.127
Language background (L2): Variety (regional)	**0.975**	**0.357**	**2.733**	**0.006**
Vowel difficulty(easy): Variety (regional)	**1.905**	**0.367**	**5.197**	**< 0.001**
Vowel difficulty (easy): Language background (L2)	-0.498	0.309	-1.609	0.108
Task type (transcription): Language background (L2): Variety (regional)	-0.32	0.416	-0.768	0.442
Vowel difficulty (easy): Language background (L2): Variety (regional)	-0.784	0.437	-1.795	0.073

Random effects

Groups	**Name**	**Variance**	**Std. dev.**
Participant	(Intercept)	0.283	0.532
Stimulus	(Intercept)	0.634	0.796
Speaker	(Intercept)	0.107	0.326
Number of obs: 5080, groups: Participant, 40; Stimulus, 16; Speaker, 4			

Note. **Bold** = statistically significant at $p < .05$.

The post-hoc tests in 5 summarise the planned tests for the interaction between language background and variety. The odds for responding correctly were 3.415 times larger (95% CI [2.272-7.038], $p < 0.001$) for participants in the L1 group compared to the L2 group when stimuli were presented in the standard variety. A similar – if smaller – difference was also observed between the L1 and L2 groups when stimuli were presented in the regional variety (OR = 2.620, 95% CI [1.483-4.629], $p < 0.001$). In addition, the odds for responding correctly were not significantly different when stimuli were presented in the regional variety compared to the standard variety in either the L1 group ($p = 0.910$), or the L2 group ($p = 0.892$).

Table 5

Post-hoc contrasts for the interaction between participant group and variety

Contrast	odds ratio	95% CI	SE	z ratio	p
L1-Std / L2-Std	**3.999**	**2.272-7.038**	**0.922**	**6.014**	**< 0.001**
L1-Reg / L2-Reg	**2.620**	**1.483-4.629**	**0.608**	**4.153**	**< 0.001**
L1-Std / L1-Reg	1.235	0.491-3.106	0.464	0.561	0.910
L2-Std / L2-Reg	0.809	0.345-1.900	0.282	-0.608	0.892

Note. **Bold** = statistically significant at $p < 0.05$.

Surprisingly, despite the significant interaction term involving vowel difficulty and language variety, none of the post-hoc comparisons revealed significant effects (Table 6). In all likelihood, the post-hoc analysis was underpowered for significant effects to be revealed. Indeed, a comparison of the corrected p-values with uncorrected p-values (Table 7), reveals significant differences for three out of four comparisons. More specifically, when presented with regional items, participants identify items with easy vowels correctly more frequently than those with difficult vowels (OR = 2.458, 95% CI [1.056-5.722], *p* (uncorrected) = 0.037). In addition, participants correctly identified easy vowels less frequently when those were presented in the standard variety than in the regional variety (OR = 0.469, 95% CI [0.230-0.958], *p* (uncorrected) = 0.038), while the opposite is true for items with difficult vowels, where vowels in the standard variety are correctly identified more frequently (OR = 2.130, 95% CI [1.052-4.312], *p* (uncorrected) = 0.036). Uncorrected p-values should of course be interpreted with caution, as there is an increased risk of Type I errors. However, their inclusion in the findings seems warranted in this case, if only as a more explorative way of interpreting the significant interaction between vowel difficulty and language variety in the model.

Table 6

Post-hoc contrasts for the interaction between vowel difficulty and variety

Contrast	odds ratio	95% CI	SE	z ratio	p value
Easy-Std / Difficult-Std	0.541	0.188-1.555	0.233	-1.426	0.413
Easy-Reg / Difficult-Reg	2.458	0.854-7.077	1.060	2.086	0.122
Easy-Std / Easy-Reg	0.469	0.192-1.146	0.171	-2.078	0.124
Difficult-Std / Difficult-Reg	2.130	0.881-5.150	0.767	2.101	0.118

Note. **Bold** = statistically significant at $p < 0.05$.

Table 7

Post-hoc contrasts for the interaction between vowel difficulty and variety (not corrected for multiple comparisons)

Contrast	odds ratio	95% CI	SE	z ratio	p value
Easy-Std / Difficult-Std	0.541	0.233-1.258	0.233	-1.426	0.154
Easy-Reg / Difficult-Reg	**2.458**	**1.056-5.722**	**1.060**	**2.086**	**0.037**
Easy-Std / Easy-Reg	**0.469**	**0.230-0.958**	**0.171**	**-2.078**	**0.038**
Difficult-Std / Difficult-Reg	**2.130**	**1.052-4.312**	**0.767**	**2.101**	0.036

Note. **Bold** = statistically significant at $p < 0.05$.

4. Discussion

In this study we addressed the question of how native and non-native listeners perceive sociophonetic variation due to different regional accents of speakers. Specifically, we aimed to examine how French-speaking learners of L2 Dutch perceive vowels produced in the standard variety as well as in a regional, non-standard accent of the target language, namely the Brabantian accent spoken in Antwerp. The results of the L2 groups were compared with those of a group of L1 Belgian Dutch listeners who do not have a Brabantian accent.

4.1. A comparison between L1 and L2 listeners' perception of standard and regional accents

Our main research question addressed concerns the potential differences in the perception of standard and regionally accented vowels for L1 and L2 listeners. Since the L1 French-speaking learners of Dutch are mostly exposed to Standard Dutch through instructed language learning, and have been exposed only relatively rarely to the regional Brabantian accent spoken in and around Antwerp, they may not have had an opportunity to acquire knowledge about the vowel variation in this regiolect. Their L2 phonological representations may not be as flexible as those of L1 listeners and they may hence have more difficulty mapping regionally accented realizations onto the intended lexical items. We thus hypothesized that the L2 listeners would receive lower scores on the perception tasks compared to L1 listeners and that the difference would be larger for the regionally accented vowels. The results revealed that the L1 listeners indeed performed better than the L2 listeners

on both standard and regional items. Ceiling effects were obtained for L1 listeners, but to a much lesser extent for L2 listeners, whose performance was overall more variable. The results also showed that, overall, performance did not differ across the standard and regional accents in both groups. Indeed, in contrast to our predictions, the L2 listeners did not experience more difficulty categorizing or transcribing the regionally accented vowels than the Standard Dutch vowels. These results suggest that a regional accent does not necessarily present an additional challenge for L2 listeners.

4.1.1. The effect of vowel type

A potential explanation may lie in the moderating effect of the specific type of vowels involved. In RQa we addressed the question of whether there is a difference in perception of vowels which were predicted to be "easy" versus "difficult". On the basis of SLM-r and PAM-L2, the four Dutch vowels /i/, /a/, /ɪ/ and /ɑ/ were divided into two groups. The vowels /i/ and /a/ were labelled "easy", since French has tense /i/ and /a/ in its vowel inventory, which are acoustically very similar to the corresponding Dutch vowels. As a result, French listeners of Dutch were predicted to perform well on the categorization of these vowels in Standard Dutch. By contrast, the Dutch vowels /ɪ/ and /ɑ/ were labelled "difficult", as French has no lax vowels in its inventory. As a result, it was predicted that French listeners may not create new perceptual categories for these vowels either, but would employ their L1 categories and map the lax vowels as poor instances of the closest French vowels /i/ and /a/. This would result in an incorrect categorization in the L2 Dutch task. The results revealed that the listeners were differently affected by vowel difficulty depending on the variety (regional or standard), and that this was the case for both L1 and L2 listeners. Although the results of the post-hoc analyses need to be interpreted with caution as only the tests with uncorrected p-values (in addition to the overall model itself – see Section 3.2) revealed significant differences, they suggest that "easy" vowels in the regional accent were more often correctly identified than "difficult" vowels in that accent. In addition, "difficult" vowels in the standard accent were correctly identified more often than "difficult" vowels in the regional accent, and vice versa for "easy" vowels, which were correctly identified more frequently in the regional accent. An explanation for these findings can be found in the acoustic cues and correspondences with L1 vowels. The 'easy' vowels in the regional accent are, in fact, almost identical to phonetic realizations of the L1 French vowels /i/ and /a/ and to the Standard Dutch vowels /i/ and /a/, i.e. the 'easy' regional vowels have the same spectral quality. In addition, in the case of /i/, the regional realization includes an additional cue, as it has a longer duration than in the standard accent, making it potentially easier to be identified. Previous research has shown that L2 learners often use duration as a cue, even when it is

not actually used to contrast categories in their L1. Cebrian (2006) conducted a perceptual assimilation and identification study with Catalan learners of English and observed that these listeners made greater use of duration, compared to L1 English listeners, even though Catalan vowels differ in spectral rather in durational properties.

In contrast, the difficult (lax) vowels were more difficult to identify in the regional accent, because the regionally accented vowels are spectrally close to the tense vowels in both French and Standard Dutch. The prediction that difficult vowels would be incorrectly mapped hence holds for both L1 and L2 listeners. Again, caution is warranted when interpreting the post-hoc tests, but at the very least these findings could be explored further in a future study, given the overall significance of the interaction term involving vowel difficulty and variety in this study.

4.1.2. The effect of task type

RQb addresses the potential effects of task type. Specifically, we examined whether there was a difference in the perception of Standard Dutch and regionally accented vowels in a task in which the vowels are embedded in monosyllabic isolated words (categorization task) compared to a task in which the same vowels are embedded in sentences (transcription task). We hypothesized that the perception of regionally accented Dutch vowels in the transcription task may be easier than in the vowel categorization task, as in the former task, listeners have more phonetic information available to them during the experiment to adjust their perception to the speaker's accent and/or to infer the regional accent based on previous exposure with this accent. As discussed in the literature review (Section 1.2.1), previous studies on the effect of short-term exposure show mixed results. We also predicted that, if an effect were to be observed, it would be stronger for L1 than for L2 listeners, since L1 listeners may be able to identify the speaker's accent as Brabantian when the auditory input consists of an entire sentence rather than just one target word, which might lead to different perceptual expectations. Note that in both tasks, Brabantian and Standard accented stimuli were presented together and randomized. This means that especially in the categorization task, listeners could not tune their ears to either of the accents. However, the results revealed no task effect, i.e. the embedding of the target vowels in longer stretches of speech did not facilitate vowel identification for either the L1 or the L2 listeners. The lack of a facilitating effect of additional input in the transcription task for L2 listeners could be the result of the limited exposure listeners had previously had to this accent. As discussed in the Method section, by far the majority of the French listeners reported they would not be able to recognize the Brabantian accent and more than half of the listeners claimed they never had contact with Dutch speakers outside of their Dutch classes. This indicates that they have had little oppor-

tunity to acquire knowledge about the way in which regional accents and Standard Dutch may differ in terms of phonetic variation. However, L1 listeners who had had experience with the Brabantian accent did not benefit from the additional input in the transcription task either. As discussed earlier, the L1 listeners, though living in East-Flanders, would all have been exposed to the Brabantian accent to some extent through contact with speakers of that accent or through the media. This may help to explain why the L1 participants performed well on the regional accents in both tasks. It would be interesting for future research to check whether our findings could be replicated with a less prestigious or well-known regional accent. Choosing which accent to use is complicated, as there are complex and evolving patterns of both overt and covert prestige among Flemish accents. Accents that were once considered less prestigious are now gaining popularity, for example, through popular music bands and influential actors and social media personalities (Grondelaers et al., 2020).

It should be noted that we did not ask either group of listeners whether they were able to infer the accents used in the tasks. While all listeners would undoubtedly have recognized Standard Dutch, it would have been interesting to know whether they could identify the Brabantian accent used in half of the stimuli. An additional explanation for the lack of a task effect could lie in the nature of the transcription task, which was in fact a fill-the-blank task. It is possible that participants only paid attention to the words that were missing in the sentences on the screen, ignoring the rest of the audio samples, which could give them hints about the speakers' accents.

What our results do show is that regional accents are not necessarily more problematic for L2 listeners than standard accents. The acoustic cues signalling contrasts and the correspondences with L1 vowels seem to be more important in listeners' success at identifying vowels than the standard versus regional accentedness per se. In popular discourse on Dutch as a Second Language, it has been suggested that regional accents in Belgian Dutch are highly problematic for L2 learners (cf. textbooks on L2 Dutch focussing on informal Belgian Dutch, Begine, 2015). While this may be true for morphological variation (in which unfamiliar clitics and suffixes may involve more extensive changes to word forms, as in phrases like *kom je?* [kɔm jə] 'are you coming?', realized as *komt ge?* [kɔmt χə] or *komde gij?* [kɔmdə ɣɛ^{i}]) and is probably a factor in lexical acquisition, it is possible that not all phonetic variation presents a challenge for L2 learners. In fact, our results showed that Standard Dutch vowels and vowels in the regional accent were overall equally difficult, even though the L2 learners had had little exposure to the regional accent. The fact that there was no task effect points in the same direction: familiarity with the regional accent, either through short additional input during the listening task or through previous exposure to the accent does not necessarily facilitate L2 vowel identification for either standard or regional items.

4.2 Limitations and further research

Of course, our study focuses on the perception and intelligibility of only four specific vowels in two accents, which is perhaps the main limitation of the study. This focus on a number of vowels allowed us to take a close look at how these vowels differed in the accents and varieties involved in the study and to examine the effect of vowel difficulty. However, the result of this methodological choice is that we are necessarily restricted in the claims we can make concerning intelligibility of regionally accented speech in general. Our discussion is based on the results we have found for the perception of four accented vowels for a group of relatively advanced L2 listeners.

A second limitation of the study is that we examined intelligibility of vowels in a categorization task without goodness-of-fit ratings and in a transcription task involving nonsensical sentences. As no goodness ratings were collected in the categorization task, the interpretation of the results is necessarily restricted to correct or incorrect identification of the target vowels. In order to fully understand the listeners' perceptual mappings and provide evidence in terms of SLM-r or PAM predictions, both goodness ratings and a cross-language categorization task involving mapping Dutch vowels onto French vowel categories would be needed. As far as the use of nonsensical sentences is concerned, although this choice is motivated on the basis of previous literature (see section 2.2), we are aware that the study results do not provide us with information on how phonetic variation due to regional accents might affect listeners in tasks involving more authentic speech data.

On a final note, the Belgian French participants included two adults who were raised bilingually as children (French-German and French-Romanian, see Section 2.1.2). While the model we used takes care of individual variation via random intercepts for participants, we acknowledge that additional language experience during childhood may mean more experience with dealing with phonetic variation and hence more flexible categories in these participants. Moreover, the Belgian French participants in the study came from different regions, meaning that there may also have been some regional variation in their own accents in French, which could have influenced their L2 perception. As regional differences may be bound to specific and relatively small regions and especially people in or having enjoyed higher education are often mobile, it is not a trivial task to make sure that listener groups are completely homogenous in terms of their own L1 accents. In order to fully understand the L1 systems of participants and their perceptual L1 and L2 patterns, all participants involved in the perception tasks should also partake in production tasks followed by acoustic analyses of their L1 vowels. Further research involving different listener groups and more authentic L2 speech would hence be valuable

to further our understanding of how phonetic variation due to accent may impact intelligibility.

5. Conclusions

This study on the perception of a regional Dutch accent by native listeners of (Belgian) Dutch and French revealed that phonetic variation does not necessarily present an additional challenge for advanced L2 listeners or hamper intelligibility. French listeners in Belgium, who are exposed to the Standard Dutch accent in their foreign language classrooms did not experience more difficulty categorizing or transcribing regionally accented Brabantian vowels than Standard Dutch vowels, though they were outperformed by native Dutch listeners on both tasks. Moreover, the study provided evidence that listeners' success at identifying vowels was dependent on the type of correspondence between L2 and L1 vowels, indicating listeners' reliance on acoustic cues familiar from their L1. No task effects were observed: the intelligibility of a regional or Standard accent was not increased for either native Dutch or L2 listeners when they were exposed to longer stretches of speech, as opposed to when words were presented in isolation. One possibility is that the longer exposure to the speakers' accents in the transcription task was not sufficient to enable listeners to perceptually adapt to the phonetic variation or to infer the accent. Future research on the effect of acoustic correspondences between specific L1 and L2 regional vowels in either enhancing or impeding the perception of accented vowels might prove to be fruitful.

Acknowledgements

The authors wish to thank Mathijs Debaene, Lisanne Versaevel and Mirjam Broersma for their valuable help at different stages of the research project, including their help with or advice on the experimental design and data collection.

Research funding

The research was financially supported by the Special Research Fund at Ghent University under the research grant code BOFSTG2018001201.

Ethics statement

Participants received a written information sheet and informed consent form. Informed consent was obtained from all participants, and they all received a voucher as compensation for their participation in the experiment. The project "Speech Intelligibility and foreign accent: New perspectives on the perception of Dutch as a Foreign Language" was approved by the Ethics Committee of the Faculty of Arts and Humanities, Ghent University.

References

Adank, P., Van Hout, R., & Smits, R. (2004). An acoustic description of the vowels of Northern and Southern Standard Dutch. *Journal of the Acoustical Society of America*, *116*(3), 1729–1738. https://doi.org/10.1121/1.1779271

Baker, W., & Smith, L. C. (2010). The impact of L2 dialect on learning French vowels: Native English speakers learning Québécois and European French. *Canadian Modern Language Review*, *66*(5), 711–738. https://doi.org/10.3138/cmlr.66.5.711

Bates, D., Maechler, M., Bolker, B., & Walker, S. (2015). Fitting linear mixed-effects models using lme4. *Journal of Statistical Software*, *67*(1), 1–48. https://doi.org/10.18637/jss.v067.i01

Battye, A., & Hintze, M.-A. (1992). *The French language today: A linguistic introduction*. Routledge. https://doi.org/10.4324/9780203417966

Begine, S. (2015). *Spoken Flemish: A survival guide for international students.* (n.p.). https://www.goestingintaal.be/product/spoken-flem/

Belemans, R., Goossens, J., Van Hout, R., Van Langendonck, W., & Weijnen, A. A. (2000). *Woordenboek van de Brabantse dialecten. 3: Inleiding; klankgeografie van de Brabantse dialecten* [Dictionary of the Brabantian dialects. Part 3: Introduction; sound geography of the Brabantian dialects]. Koninklijke Van Gorcum.

Bent, T., & Baese-Berk, M. (2021). The perception of accented speech. In L. C. Nygaard, R. E. Remez, & D. B. Pisoni (Eds.), *The Handbook of Speech Perception* (pp.428–464). Wiley. https://doi.org/10.1002/9781119184096

Best, C. T. & Tyler, M. D. (2007). Nonnative and second-language speech perception: Commonalities and complementarities. In M. J. Munro, & O. S. Bohn (Eds.), *Language experience in second language speech learning. In honor of James Emil Flege* (pp. 13–34). John Benjamins. https://doi.org/10.1075/lllt.17

Best, C. T., Tyler, M. D., Gooding, T. N., Orlando, C. B., & Quann, C. A. (2009). Development of phonological constancy: Toddlers' perception of native-

and Jamaican-accented words. *Psychological Science*, *20*(5), 539–542. https://doi.org/10.1111/j.14679280.2009.02327.x

Boersma, P., & Weenink, D. (2025). Praat: doing phonetics by computer [Computer program]. Version 6.4.35, http://www.praat.org

Booij, G. (1995). *The Phonology of Dutch*. Oxford University Press.

Bruggeman, L., & Cutler, A. (2019). No L1 privilege in talker adaptation. *Bilingualism: Language and Cognition*, *23*(3), 681–693. https://doi.org/10.1017/S1366728919000646

Cebrian, J. (2006). Experience and the use of duration in the categorization of L2 vowels. *Journal of Phonetics*, *34*(3), 372–387. https://doi.org/10.1016/j.wocn.2005.08.003

Cedrus Corporation. (2015). *SuperLab* (Version 5.0.5) [Computer software].

Chládková, K., & Podlipský, J. (2011). Native dialect matters: Perceptual assimilation of Dutch vowels by Czech listeners. *The Journal of the Acoustical Society of America*, *130*(4), 186–192. https://doi.org/10.1121/1.3629135

Council of Europe (2020). *Common European framework of reference for languages: Learning, teaching, assessment- Companion Volume.* https://www.coe.int/en/web/common-european-framework-reference-languages

Cutler, A., Weber, A., Smits, R., & Cooper, N. (2004). Patterns of English phoneme confusions by native and non-native listeners. *The Journal of the Acoustical Society of America*, *116*(6), 3668–3678. https://doi.org/10.1121/1.1810292

Cutler, A., Smits, R., & Cooper, N. (2005). Vowel perception: Effects of non-native language vs. non-native dialect. *Speech Communication*, *47*(1-2), 32–42. https://doi.org/10.1016/j.specom.2005.02.001

Dahan, D., Drucker, S.J., & Scarborough, R.A. (2008). Talker adaptation in speech perception: Adjusting the signal or the respresentations? *Cognition*, *108*, 710–718. https://doi.org/10.1016/j.cognition.2008.06.003

De Wilde, T. (2019). *Over taalbewustzijn en taalvariatie*. *Taalideologie bij docenten Nederlands aan Europese universiteiten.* [About language awareness and language variation. Language ideology of Dutch lecturers at European universities.] Academia Press.

Drummond, R. (2013). The Manchester Polish STRUT: Dialect acquisition in a second language. *Journal of English Linguistics*, *41*(1), 65–93. https://doi.org/10.1177/0075424212449172

Escudero, P., & Boersma, P. (2004). Bridging the gap between L2 speech perception research and phonological theory. *Studies in Second Language Acquisition*, *26*, 551–585. https://doi.org/10.1017/S0272263104040021

Escudero, P., Simon, E., & Mitterer, H. (2012). The perception of English front vowels by North Holland and Flemish listeners: acoustic similarity predicts and explains cross-linguistic and L2 perception. *Journal of Phonetics*, *40*(2), 280–288. https://doi.org/10.1016/j.wocn.2011.11.004

Flege, J.E. (1995). Second-language speech learning: Theory, findings, and problems. In W. Strange (Ed.), *Speech perception and linguistic experience: Issues in cross-language research* (pp. 229–273). York Press.

Flege, J. E., & Bohn, O.-S. (2021). The revised Speech Learning Model (SLM-r). In R. Wayland (Ed.), *Second language speech learning: Theoretical and empirical Progress* (pp. 3–83). Cambridge University Press. https://doi.org/10.1017/9781108886901

Floccia, C., Goslin, J., Girard, F., & Konopczynski, G. (2006). Does a regional accent perturb speech processing? *Journal of Experimental Psychology: Human Perception and Performance*, *32*(5), 1276–1293. https://doi.org/10.1037/0096-1523.32.5.1276

Fougeron, C., & Smith, C.L. (2009). Illustrations of the IPA: French. *Journal of the International Phonetic Association*, *23*(2), 73–76. https://doi.org/10.1017/S0025100300004874

Francard, M. (2010). Variation diatopique et norme endogène. Français et langues régionales en Belgique francophone. *Langue française*, *167*, 113–126. https://doi.org/10.2307/41559250

Ghyselen, A.-S. (2016). *Verticale structuur en dynamiek van het gesproken Nederlands in Vlaanderen: Een empirische studie in Ieper, Gent en Antwerpen.* [Vertical structure and dynamics of spoken Dutch in Flanders: An empirical study in Ypres, Ghent, and Antwerp.]. Universiteit Gent dissertation. https://doi.org/10.13140/RG.2.2.34145.10080.

Goossens, J. (2000). De toekomst van het Nederlands in Vlaanderen. [The future of Dutch in Flanders]. *Ons Erfdeel*, *43*(1), 3–14.

Grondelaers, S., Speelman, D., Lybaert, C., & van Gent, P. (2020). Getting a (big) data-based grip on ideological change: Evidence from Belgian Dutch. *Journal of Linguistic Geography*, *8*(1), 49–65. https://doi.org/10.1017/jlg.2020.2

Grosjean, F., Carrard, S., Godio, C., Grosjean, L., & Dommergues, J.-Y. (2007). Long and short vowels in Swiss French: Their production and percep-

tion. *Journal of French Language Studies 17*(1), 1–19. https://doi.org/10.1017/S0959269506002626

Hambye, P., Francard, M., & Simon, A.-C. (2003). Phonologie du français en Belgique. Bilan et perspectives. *La Tribune internationale des langues vivantes*, *33*, 56–63.

Hambye, P., & Simon, A.-C. (2012). The variation of pronunciation in Belgian French: From segmental phonology to prosody. In R. Gess, C. Lyche, & T. Meisenburg (Eds.), *Phonological Variation in French. Illustrations from three continents* (pp. 129–155). John Benjamins. https://doi.org/10.1075/silv.11

Hamers, J.F., & Blanc, M. (2000). *Bilinguality and bilingualism*. Cambridge University Press. https://doi.org/10.1017/CBO9780511605796

Hansen, A. B. (2001). Les changements actuels des voyelles nasales du français parisien : confusions ou changements en chaîne? [Current nasal vowel changes in Parisian French: confusion or chain shitf?]. *La linguistique*, *37*, 33–48. https://doi.org/10.3917/ling.372.0033

Hiligsmann, P. (2010). Moet Algemeen Nederlands nog steeds als norm fungeren voor het NVT-onderwijs in Franstalig België? [Does Standard Dutch still need to be the norm in Dutch as a Foreign Language Education in French-speaking Belgium?]. In E. Hendrickx, K. Hendrickx, W. Martin, H. Smessaert, W. Van Belle, & J. van der Horst (Eds.), *Liever meer of juist minder ? Over normen en variatie in taal* [Rather more or rather less? About norms and variation in language.] (pp. 215–229). Academia Press.

Hiligsmann, P., & Rasier, L. (2007). *Uitspraakleer Nederlands voor Franstaligen* [Dutch pronunciation for French speakers]. Wolters Plantyn.

Kang, O., Thomson, R., & Moran, M. (2018). Empirical approaches to measuring the intelligibility of different varieties of English in predicting listener comprehension. *Language Learning*, *68*(1), 115–146. https://doi.org/10.1111/lang.12270

Keuleers, E., Brysbaert, M., & New, B. (2010). SUBTLEX-NL: A new measure for Dutch word frequency based on film subtitles. *Behavior Research Methods*, *42*, 643–650. https://doi.org/10.3758/BRM.42.3.643

Kriengwatana, B., Terry, J., Chládková, K., & Escudero, P. (2016). Speaker and accent variation are handled differently: Evidence in native and non-native listeners. *PLoS ONE*, *11*(6), e0156870. https://doi.org/10.1371/journal.pone.0156870

Lee, S., & Shin, D. J. (2015). Estimating Korean EFL listeners' perception of English vowels with reference to cross-language labeling. *Studies in Phonetics, Phonology and Morphology 21*(2), 297–321. https://doi.org/10.17959/sppm.2015.21.2.97

Lee, S., & Cho, M. H. (2020). The impact of L2-learning experience and target dialect on predicting English vowel identification using Korean vowel categories. *Journal of Phonetics*, *82*, 100983–101002. https://doi.org/10.1016/j.wocn.2020.100983

Lenth, R. (2024). *emmeans: Estimated Marginal Means, aka Least-Squares Means* (Version 1.10.2) [R package]. https://CRAN.R-project.org/package=emmeans

Melguy, Y. V., & Johnson, K. (2021). General adaptation to accented English: Speech intelligibility unaffected by perceived source of non-native accent. *The Journal of the Acoustical Society of America*, *149*(4), 2602–2614. https://doi.org/10.1121/10.0004240

Mulak, K., Best, C., Tyler, M., Kitamura, C., & Irwin, J. (2013). Development of phonological constancy: 19-month-olds, but not 15-month-olds, identify words spoken in a non-native regional accent. *Child Development*, *84*(6), 2064–2078. https://doi.org/10.1111/cdev.12087

Munro, M. J., & Derwing, T.M. (1995). Foreign accent, comprehensibility, and intelligibility in the speech of second language learners. *Language Learning*, *45*(1), 73–97. https://doi.org/10.1111/j.1467-1770.1995.tb00963.x

Munro, M. J., & Derwing, T.M. (2020). Foreign accent, comprehensibility and intelligibility, redux. *Journal of Second Language Pronunciation*, *6*(3), 283–309. https://doi.org/10.1075/bct.121.02mun

Ockey, G. J., & Wagner, E. (2018). Assessing L2 listening: Moving towards authenticity. John Benjamins. https://doi.org/10.1075/lllt.50

O'Shaughnessy, D. (1981). A study of French vowel and consonant durations. *Journal of Phonetics*, *9*(4), 385–406. https://doi.org/10.1016/S0095-4470(19)31016-2

Pinet, M., Gan, Y., Evans, B. G., & Iverson, P. (2015). Intelligibility of British English accents in noise for second-language learners. *International Congress of Phonetic Sciences*, 1602–1605.

Price, G. (2005). *An introduction to French pronunciation* (2nd ed.). Blackwell. https://doi.org/10.1002/9780470774014

Shaw, J. A., Best, C. T., Docherty, G., Evans, B. G., Foulkes, P., Hay, J., & Mulak, K. E. (2018). Resilience of English vowel perception across regional accent variation. *Laboratory Phonology: Journal of the Association for Laboratory Phonology*, *9*(1), 1–36. http://doi.org/10.1016/S0167-6393(02)00105-X

Simon, E. (2025). *Second language phonology. Phonetic variation and phonological representations.* Cambridge University Press. https://doi.org/10.1017/9781009420648

Simon, E., De Clercq, B., Degrave, P., & Decourcelle, Q. (2022). On the robustness of high variability phonetic training effects: A study on the perception of non-native Dutch contrasts by French-speaking learners. In U. K. Alves & J. Alcantara de Albuquerque (Eds.), *Second Language Pronunciation* (pp. 315–344). Mouton de Gruyter. https://doi.org/10.1515/9783110736120-012

Taeldeman, J. (2009). Linguistic stability in a language space. In P. Auer & J.E. Schmidt (Eds.), *Language and space: An international handbook of linguistic variation* (pp.355-374). De Gruyter Mouton.

Tyler, M. (2019). PAM-L2 and phonological category acquisition in the foreign language classroom. In A. M. Nyvad, M. Hejná, A. Højen, A. B. Jespersen, & M. H. Sørensen **(**Eds.), *A sound approach to language matters – In honor of Ocke-Schwen Bohn* (pp.607–630). Aarhus University. https://doi.org/10.7146/aul.322.218

Vaughn, C. R. (2019). Expectations about the source of a speaker's accent affect accent adaptation. *The Journal of the Acoustical Society of America*, *145*(5), 3218–3232. https://doi.org/10.1121/1.5108831

Verbeke, G., Simon, E., Hartsuiker, R., Mitterer, H., & De Cuypere, L. (2024). Perceptie van een anderstalig accent: Een experimentele studie naar de perceptieve aanpassing aan een exogeen geaccentueerd Nederlands klinkercontrast. [Perception of a non-native accent: An experimental study on perceptual adaptation to a foreign accented Dutch vowel contrast], *Handelingen (KZM)*, *76*, 225–252. Universitaire Stichting. https://doi.org/10.21825/kzm.90450

Verhoeven, J. (2005). Illustrations of the IPA: Belgian Standard Dutch. *Journal of the International Phonetic Association, 35*(2), 243–247. https://doi.org/10.1017/S002510031300039X

Verhoeven, J., & Van Bael, C. (2002). Acoustic characteristics of monophthong realisation in Southern Standard Dutch. *Antwerp Papers in Linguistics - Phonetic Work in Progress*, *100*, 149–164.

Ying, J., Shaw, J. A., & Best, C. T. (2013). L2 English learners' recognition of words spoken in familiar versus unfamiliar English accents. *Interspeech*, *2013*, 2108–2112. https://doi.org/10.21437/Interspeech.2013-500