Combining research methods for an experimental study of West Central Bavarian vowels in adults and children

Katrin Wolfswinkler

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Katrin
Wolfswinkler

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Introduction*

Chapter I

Once you do know what the question actually is,

you'll know what the answer means.

DOUGLAS ADAMS (2012, P. 119)

1.1 German dialect situation

Contemporary Standard German (SG) is not based on a single protolanguage but goes back to diverse regional dialects. The German tribes did not have a common, universal language. This was only the result of a process of gradual linguistic accommodation that lasted many centuries, from the early Middle Ages (ca. 8th century) until the turn of the millennium (Zehetner, 1985). These dialects exist until today and are typically defined as being spoken within a certain geographical area, irrespective of their social status (Zehetner, 1985). They range on a linguistic continuum between basic dialects and the spoken standard with various stages of mixture in between, which are neither dialect-free standard nor pure dialect (Veith, 2005; Rowley, 2011).

Basic dialects at the one end of this continuum diverge from the standard most. Their communicative range is restricted as they tend to have a distinct grammar and phonology (Chambers & Trudgill, 1998) and are therefore often mutually unintelligible (Leopold, 1959; Rues et al., 2007). The standard language on the other end of the continuum has a geographically broader communicative range and, partly because it is the language used in schools and the media, it often has an increasingly larger influence on dialects (Besch, 1983; Zehetner, 1985). Between these two endpoints of a basic dialect and the standard language, a third level, referred to as regional variety, is usually distinguished which is neither dialect nor standard (Rowley, 2011). German regional varieties have characteristics of a dialect but are in

* Parts of this chapter are published in the *Journal of the International Phonetic Association* (Wolfswinkler & Harrington, 2021)

their local and communicative narrowness above the basic dialects and can vary until they are close to the standard (Zehetner, 1989). Regional varieties are mostly occurrences of language contact between Standard German with the spoken dialects. That is, whereas regional varieties are highly influenced by the standard, basic dialects show the greatest geographical differences and the least similarity with the standard (König, 1994).

The degree to which a basic dialect or regional variety is spoken also differs from region to region. While in Northern Germany basic dialects are rarely spoken, they are still common in the South (Kleber, 2011). Moreover, Standard German pronunciation is almost always influenced to some extent by the regional background of a speaker (Wiese, 1996). While there is a vast amount of literature on German varieties, almost all of these are based on impressionistic auditory phonological descriptions, mostly from old, immobile speakers from rural areas. Acoustically based phonetic studies on German dialects are rare (e.g., Bannert, 1976) and it is even rarer for them to take into account more mobile, young speakers who are highly influenced by the standard variety. Because due the increasing spread of, and contact with, SG even in rural areas, its influence has often resulted in a shift of certain dialectal features in the direction of SG (Reiffenstein, 1976; Scheuringer, 1990).

This dissertation is concerned with a description of the vowel system of a southern German basic dialect based on instrumental phonetic analyses as well as with vocalic changes that may be occurring in this dialect under the assumption that it is being increasingly influenced by the standard variety. This is performed by a combined longitudinal and apparent-time acoustic analysis of dialect-speaking adults and children from a rural area, as well as an inspection of the underlying articulatory patterns of the latter.

In this first chapter we give a general overview of the investigated dialect area (1.2), the dispersion of the variety of interest as well as its development in comparison to the Standard German variety (1.3). This is followed by a summary of the main systemic differences and equivalences between monophthongs and diphthongs of the dialect and the Standard in Section 1.4, also taking into account some relevant phonetic realizational differences between these varieties. This comparison between the varieties is important to understand the fundament for our predictions about the changes in progress in the dialect that are investigated in this thesis. Section 1.5 provides a short overview of sound change theories and in 1.6 the structure of the thesis will be outlined.

1.2 Bavarian

From a political point of view the Free State of Bavaria comprises besides the Bavarian variety (in so-called 'Old Bavaria')[1] also Swabian (in Swabia) and East-Franconian (in Upper-, Lower- and Central-Franconia).

From a linguistic point of view the Bavarian dialect is spoken in Old Bavaria, Austria (except Vorarlberg) and South Tyrol. The common Bavarian language area is subdivided into three major subvarieties: Central, North, and South Bavarian.

Central Bavarian is considered to be the most 'modern' of the Bavarian varieties, i.e., it has developed farthest away from the ancient forms. It is also the Bavarian variety that is most commonly spoken and it is the prototypical dialectal form that outsiders think of when they refer to 'the Bavarian' (Zehetner, 1989). It is spoken in Upper Bavaria, Lower Bavaria, southern Upper Palatinate, the Swabian district of Aichach-Friedberg, the northern parts of the State of Salzburg, Upper and Lower Austria, Vienna and the Northern Burgenland. Some markers of this sub-variety are that consonant weakening, assimilation and syllable reduction are most pronounced among the Bavarian varieties. In the scope of the consonant weakening the liquids /r/ and /l/ become entirely vocalic in post-vocalic position (Sections 1.4.7 below and 4.1 contain

[1] Old Bavaria comprises the three oldest parts of the Free State of Bavaria, i.e., Upper Bavaria, Lower Bavaria, and Upper Palatinate.

more information about the vocalization of post-vocalic /l/). Further, the Middle High German (MHG) diphthongs *ie*, *üe*, *uo* were preserved almost unvaried as /ia, ua/ (these diphthongs will be discussed in more detail in Section 1.4.3 below as well as in Section 3.1.1). In North Bavarian, on the other hand, these diphthongs changed to /ɛi, ou/. Furthermore, the post-vocalic lateral is maintained. It is mainly spoken in Upper Palatinate, but also partially in adjacent areas (small parts of Upper and Middle Franconia, Saxony, Upper and Lower Bavaria).

South Bavarian is hardly spoken in Bavaria but can rather be found in e.g., Tyrol, South Tyrol, Carinthia, Styria, and the southern parts of Salzburg and Burgenland. It is characterized by only little consonant weakening, little syllable reduction and also no vocalization of laterals. Zehetner (1985) refers to South Bavarian as ‘archaic’ variety that has preserved the historical forms best (p. 63).

The Central Bavarian dialect can be further subdivided into West and East Central Bavarian. The vocalized lateral is thereby a historical marker that separates these two parts on a linguistic level: the Central Bavarian post-vocalic vocalization of the lateral resulted in diphthongs which were maintained in the western part of Central-Bavaria but were monophthongized in the eastern part (Vollmann et al., 2015).

As this short summary of the Bavarian dialect area indicates, the term ‘Bavarian’ covers a large area with many geographical variations. The specific target dialect of this thesis is the variety spoken in the western parts of Central-Bavaria, i.e., West Central Bavarian (WCB). Since one aim of this dissertation was to examine a potential shift of certain dialectal features towards the standard, the following Sections (1.3, 1.4) provide a description of the investigated dialect in relation to SG.

1.3 West Central Bavarian and its relationship to Standard German

West Central Bavarian is a basic dialect spoken in the south of Germany around Munich and rural areas of Bavaria (Fig. 1)[2]. WCB extends to the west to around the river Lech and to the north just beyond the Danube. To the south, WCB extends beyond the Austrian border, but not as far as Innsbruck which belongs to the South Bavarian variety. To the east, WCB also extends beyond the Austrian border where it merges with East Central Bavarian, the latter also including Linz and Vienna (Schikowski, 2009; Kleber, 2017).

Fig. 1. A map showing some defining markers of the region in which WCB is spoken. The heads of the dashed arrows linked to R mark the location of recording sites near Altötting. The dashed red line marks the border between Bavaria and Austria.

WCB forms part of the Upper German dialects which in contrast to Central and Low German dialects were substantially affected by the Second German sound shift that took place between 600 and 800 A.D. (Kufner, 1960; Kleber, 2011). Moreover, WCB has preserved many

[2] Adapted from https://en.wikipedia.org/wiki/Austria–Germany_border

sounds from Middle High German which were lost in the standard (Pascoe, 1981; Zehetner, 1985). In contrast to WCB, SG has been extensively conditioned by Central German dialects (Schmidt, 2000; Kleber, 2011; Zehetner, 1989). For example, Luther's translation of the Bible was into a Central German variety (Kufner, 1957; Zehetner, 1985). These somewhat different historical developments are one of the reasons why there are not just phonetic, realizational but also many systemic (Wells, 1982) differences between the Standard German and WCB vowel system. While systemic differences mean no one-to-one correspondence between the phonemes of the two varieties, realizational differences imply that the phonemes do indeed map in both varieties but the phonetic realization does not.

In accordance with the properties of basic dialects described earlier, WCB is a variety with its own lexicon, grammar and vowel system (Bannert, 1973; Zehetner, 1989). Dialect speakers can typically shift speech production along the standard-dialect continuum depending upon their social status and relationship to the hearer. Hence, depending on the communicative situation, WCB speakers produce either a basic dialect (e.g., when talking to family or friends) or a regional variety of the standard (e.g., with outsiders or in more formal speaking situations; Zehetner, 1989). That is, while Bavarian dialect speakers can use the standard in order to be more widely understood, their pronunciation is still coloured in a way that provides strong cues to their dialect background (e.g., by the apical pronunciation of [r] typically of Bavarians speaking the standard as opposed to [ʁ] produced by many northern variety speakers of the standard). Speakers from northern parts of Germany (in which speaking in dialect is less common) sometimes even confuse the Bavarian-coloured standard with the Bavarian dialect (Rowley, 2011).

In the following, we begin by outlining the main characteristics of the WCB dialect. As the focus of this dissertation is on WCB vowels, the attention is on vocalic features of the dialect as well as the differences between SG and WCB which form the basis for the predictions about changes in progress in WCB analyzed in the present thesis.

1.4 The relationship between WCB and SG monophthongs and diphthongs

The overview of the mappings in Fig. 2 between SG and WCB for the monophthongs and diphthongs shows that SG has a more crowded monophthongal vowel space but five fewer diphthongs than WCB.

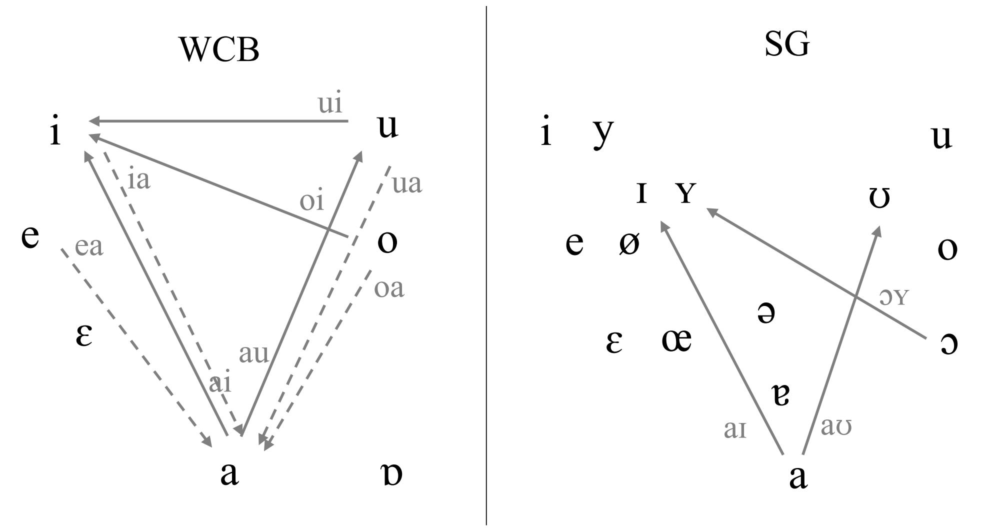


Fig. 2. WCB and SG monophthong phonemes with superimposed closing/level (grey, solid) and opening (grey, dashed) diphthong phonemes.

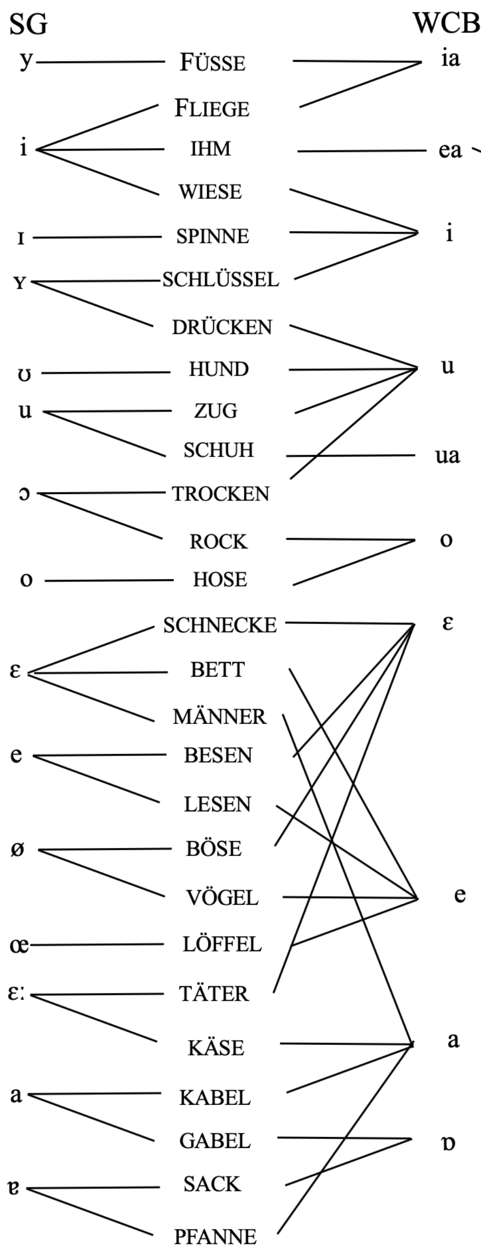
The former comes about principally because SG but not WCB contrasts (i) front rounded and unrounded vowels /i, y/, /ɪ, ʏ/, /e, ø/, /ɛ, œ/ and (ii) tense-lax pairs /i, ɪ/, /e, ɛ/, /a, ɐ/, /y, ʏ/, /ø, œ/, /u, ʊ/ that differ in both length and, with the exception of /a, ɐ/[3], in quality[4]. The greater

[3] These vowels are conventionally exclusively transcribed with /a/ in broad phonemic transcriptions of SG. However, especially the short variant is phonetically *central* in SG (see also Harrington et al., 2011; Hoole, 1987 for an articulatory analysis).

[4] In our description of WCB vowel phonemes in relation to SG we use broad phonemic transcriptions without quantity distinctions since in SG quantity differences are quality-inherent (i.e., tense vowels are long and lax vowels are short) and in WCB vowel quantity is traditionally not supposed to be linked with changes in quality but conditioned by a phonemic vowel-consonant length correlation which will be described in Section 1.4.1.

number of diphthongs in WCB is because of an additional set of opening diphthongs[5] with a mid-high or high first component and also, because WCB vocalizes domain-final /l/.

Fig. 3 shows the association between SG and WCB vowel/diphthong phonemes in terms of LEXICAL SETS which stand for word classes of the same type.



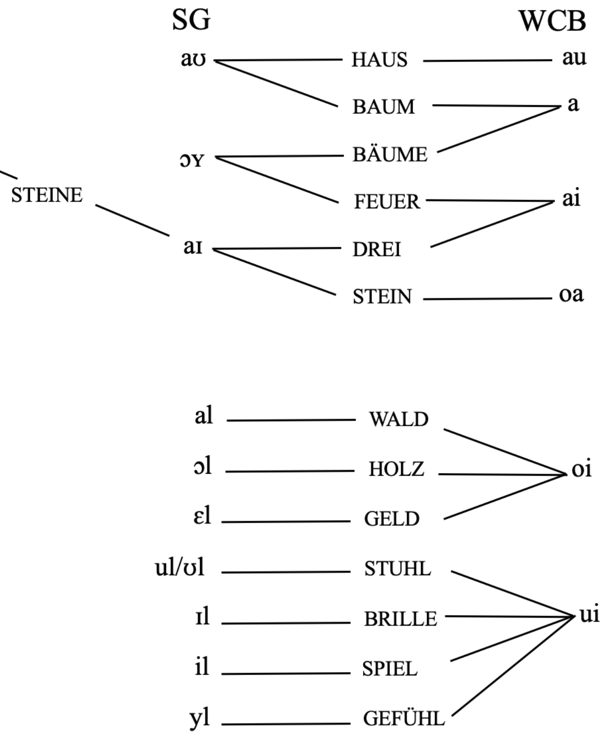


Fig. 3. Association between SG and WCB vowel phonemes exemplified by LEXICAL SETS (see Appendix A). Left: SG monophthongs. Right: SG diphthongs and vowels before /l/. The lines show correspondences between broad i.e. phonemic transcriptions. For example, the vowel phoneme in the first syllable of DRÜCKEN, HUND, ZUG, TROCKEN is /u/ in all four cases in WCB but /ʏ, ʊ, u, ɔ/ respectively in SG.

[5] We exclude from further consideration the opening/centering diphthongs that arise in both varieties due to pre-consonantal and word-final post-vocalic /r/ vocalization e.g., *wir* (‘we’) SG: /vɪə/, WCB: /mia/. Opening diphthongs in WCB due to /r/-vocalization all map to those that are not due to /r/-vocalization: e.g., WCB /mia/ has the same diphthong as in WCB FÜSSE und FLIEGE (see Fig. 3).

A lexical set and a SG-WCB association was only included in Fig. 3 if there are at least five words that match the corresponding pattern (see Appendix A for further examples).

It is very clear from Fig. 3, that there is no systemic equivalence (Wells, 1982) between any pair of SG and WCB monophthongs or diphthongs, meaning that there is not a single occurrence where there is a one-to-one correspondence between the phonemes of the two varieties.

Some further details on the salient differences in vowels between WCB and SG are summarised in the following seven points below.

1.4.1 Tensity[6] and length

SG has a phonemic opposition between tense and lax vowel (V) pairs that differ in quantity and quality. WCB on the other hand has a difference between short and long vowels that are inversely related to the length of the following consonant (C) (Kufner, 1957; 1960, Bannert, 1973; Capell, 1979; Seiler, 2009; Kleber, 2011). That is, long vowels are predictably followed by short consonants and short vowels by long consonants[7]. There is, for example, a distinction between Vː C [leːsn̩] ('to read') and VCː [mesːa] ('knife') (Kufner, 1957; Bannert, 1976; Pascoe 1981; Scheuringer, 1990). C can not only be any obstruent but also a nasal consonant (Kleber, 2017). Recent research by Kleber (2017) supports the conclusions in Bannert (1976) that neither vowel length nor consonant length on their own are phonemic: the phonemic opposition is instead between short vowels followed by long consonants (VCː) as opposed to long vowels followed by short consonants (VːC). The complexity here is that WCB vowel length by itself

[6] Tensity is sometimes referred to as tenseness.

[7] There are no phonetic voicing distinctions in WCB consonants: thus, the phonetic differences between [s] and [sː] in WCB /bɛːsn/ and /mesːa/ is one of length, not voicing (Bannert, 1976).

is allophonic (because it is predictable from consonant length) and so is WCB consonant length (because it is predictable from vowel length). However, the type of complementary length is unpredictable which means that words must be marked in the lexicon for whether they are of the form VCː or VːC.

There is no systemic equivalence between tense/lax pairs in SG and long/short vowels in WCB. For example, the first vowels in *Spinne* ('spider') and *Tisch* ('table') are both /ɪ/ in SG; but in WCB the former contains a short /i/ (followed by a long /n/) and the latter a long /iː/ (followed by a short /ʃ/).

1.4.2 SG front rounded vowels

Whereas SG has a phonemic opposition in the front vowel set between unrounded /i, ɪ, e, ɛ/ and rounded /y, ʏ, ø, œ/, there is no such rounding contrast in WCB (Wiesinger, 1990; Schikowski, 2009). At around the end of the 13th century, WCB rounded front vowels were unrounded and coalesced with unrounded front vowels of the same height (Kufner, 1957; Merkle, 1976; Zehetner, 1985). As a consequence, whereas SG distinguishes between unrounded and rounded front vowels of the same phonetic height (/i/ vs. /y/; /ɪ/ vs. /ʏ/; /e/ vs. ø/; /ɛ/ vs. /œ/) WCB does not. As Fig. 3 shows, it is not the case that the contrasts in SG ±round are simply neutralised in WCB. For example, WCB /i, y/ in the lexical sets WIESE and FÜSSE correspond to /i, ia/ in WCB. But as discussed in 1.4, there is no systemic equivalence. Thus, while the SG /ɪ, ʏ/ contrast can correspond to WCB /i, u/ in SPINNE and DRÜCKEN respectively, WCB /u/ also maps to SG /u/ in ZUG.

1.4.3 SG high vowels and WCB opening diphthongs

SG high tense vowels /i, y/ exemplified by FLIEGE and FÜSSE both map to WCB /ia/; SG /u/ exemplified by SCHUH is /ua/ in WCB[8] (Kufner, 1957; Wiesinger, 1990). Such differences between these varieties derive historically from changes of the MHG diphthongs *ie*, *üe*, *uo* that became long monophthongs in SG but were preserved as diphthongs in WCB (Mansell, 1973; Zehetner, 1985; 1989). Fig. 3 shows that there is no systemic mapping between SG high tense vowels and WCB opening diphthongs. Thus, whereas there is an /i ~ ia/ mapping for SG ~ WCB in FLIEGE, they both have monophthongal /i/ in WIESE. There may also be phonetic (realizational) differences between the varieties in words of the WIESE type in which both SG and WCB have monophthongs: according to Schikowski (2009), WCB /i/ is more centralized than SG /i/.

Some words exemplified by IHM, with an SG tense vowel /i/, map to a mid-high opening /ea/ diphthong in WCB. In all IHM words, SG /i/ and the corresponding WCB /ea/ are closed by a nasal consonant (Appendix A). The historical evolution of the vowel exemplified by IHM into WCB /ea/ rather than /ia/ could be explained with reference to studies showing that a nasal often causes a preceding high vowel to be lowered both synchronically and diachronically (Beddor, 1982; Hajek, 1997; Sampson, 1999; Carignan, 2019). WCB /ia/ can nevertheless occur before a nasal consonant, but only in words where SG and WCB differ in whether or not there is an intervening oral stop. Thus SG /fliːgŋ/ ('to fly') but WCB /fliaŋ/.

We know of no more than three words in which SG tense /y, u/ also map to WCB /ea/[9]. These are *Blume* ('flower'), *grün* ('green'), *tun* ('to do') that are /blumə, gryn, tun/ in SG but

[8] There is also an association from SG /ʊ/ to WCB /ua/, which is not shown in Fig 3. because it does not seem to be productive, occurring only in three words (*Futter* 'fodder', *Mutter* 'mother', *muss* 'must') to our knowledge.

[9] This SG /y, u/ ~ WCB /ea/ association is not shown in Fig. 3 because as far as we know, this mapping is very specific, occurring only in *Blume*, *grün*, *tun*.

/bleam, grean, dean/ in WCB. It is not clear to us why *Blume*, *grün*, *tun* which derive historically from Old and Middle High German *ua* or *uo* should have evolved into /ea/ rather than (following the tendency for high vowels to lower before nasals) lowering to /oa/.

1.4.4 /e, ɛ, ɛː/

Both SG and WCB have phonemic oppositions between /e, ɛ/ that are phonetically close to CV (cardinal vowel) 2 and CV3 respectively and in which /e/ is longer than /ɛ/. The mapping between the two varieties is not systemic, given that BESEN ('broom') has SG /e/ but WCB /ɛ/ and that MESSER ('knife') has SG /ɛ/ but WCB /e/ (Zehetner, 1978; Scheuringer, 1990; Stör, 1999; Schikowski, 2009). Earlier it was noted that WCB /i/ is slightly centralized. If so, it is possible that WCB /e/ is the most peripheral vowel in the WCB front vowel set (Schikowski, 2009). Whether WCB /e/ is more peripheral/fronted than SG /e/ is not known.

For historical reasons to do with the divergent way that MHG *ä*, *æ* developed in the two varieties (Zehetner 1985; 1989; Scheuringer, 1990), some SG unrounded mid vowels are WCB /a/. This applies predominantly to words with SG /ɛː/[10], exemplified by KÄSE, but SG /ɛ/ can map to WCB /a/ as well as exemplified by MÄNNER.

1.4.5 WCB open vowels

WCB has a phonemic opposition between two open vowels /a, ɒ/. Phonetically, WCB /a/ is often an open mid vowel; WCB /ɒ/ can vary along a back trajectory of [ɑ, ɒ, ɔ]. SG also contrasts two open vowels but they are of a phonetically similar central quality and differ principally in length. Thus, SG short /ɐ/ (*L<u>a</u>mm*, 'lamb') vs. SG long /a/ (*<u>lah</u>m*, 'lame'). Many

[10] SG /ɛː, ɛ/ have a similar quality but differ in length. The SG /e, ɛː/ and / ɛː, ɛ/ contrasts are not very productive. For many SG speakers, /e, ɛː/ are neutralised as /e/ (Kohler, 1995; Bose et al., 2016).

words in SG with short /ɐ/ (SACK) and with long /a/ (GABEL) map to WCB /ɒ/. By contrast, words either with SG short /ɐ/ (PFANNE) or SG long /aː/ (KABEL) that typically entered the vocabulary after around the 16th century map to WCB /a/.

1.4.6 SG closing diphthongs

WCB has preserved a distinction from Middle High German between two types of front closing diphthongs whereas SG did not (Zehetner, 1985). As a consequence, while STEIN and DREI both map to SG /aɪ/, they are distinct in WCB as /ai/ and /oa/ respectively (Zehetner, 1989; Scheuringer, 1990).

SG /aɪ/ can also map to WCB /ea/ in STEINE words that are always morphologically related to corresponding words of the STEIN set. Thus, both SG *Stein*, *Steine* ('stone, stones') contain the diphthong /aɪ/ in SG but are distinguished in WCB as /ʃt**oa**/ (with no final /n/ and according to Kleber, 2017, quite possibly a nasalized [oã]) and /ʃt**ea**na/ respectively. Similarly, *klein*, *kleiner*, *kleinsten* ('small, smaller, smallest') all have /aɪ/ in SG but /gl**oa**, gl**ea**na, gl**ea**nstn/ in WCB. The final nasal can no longer be the conditioning environment for this morphological alternation (see remarks on the IHM set in 1.4.3), because this type of WCB alternation can occur in other contexts, e.g. *heiß*, *heißer* ('hot, hotter') that are both produced with /aɪ/ in SG but as /h**oa**s, h**ea**sa/ in WCB. There is further evidence that this alternation is morphologically conditioned. For example, when *klein* inflects to *kleiner* due to gender agreement (rather than as above in comparative form) as in *ein kleiner Mann* ('a small man'), WCB has /gl**oa**na/ and not /gl**ea**na/.

SG /ɔʏ/ exemplified by FEUER maps with regularity to WCB /ai/. Consequently, minimal pairs such as *Feier*, *Feuer* ('celebration, fire') that are distinguished by /aɪ, ɔʏ/ in SG are homophonous and both map to /ai/ in WCB.

Most SG words with an /aʊ/ nucleus exemplified by HAUS map to /au/ in WCB. On the other hand, there is a context-dependent mapping of SG /aʊ/ to WCB /a/ before labials /p, f, m/. Thus SG /aʊ/ in BAUM is WCB /a/ (Kufner, 1957; Kleber, 2011). Whether this WCB HAUS/BAUM split has been phonologized and lexicalized or whether it is synchronically conditioned is not entirely clear.

1.4.7 WCB vocalization of laterals

The vocalization of post-vocalic laterals (Kufner, 1957; Zehetner, 1985; Wiesinger, 1990) is a salient characteristic of WCB (Rein, 1974; Scheuringer, 1990; Vollmann et al., 2015). Typically, the non-high vowel + /l/ sequence in SG (Fig. 3: HOLZ, GELD, WALD) is /oi/ in WCB and the SG high vowel + /l/ sequence (Fig. 3: BRILLE, GEFÜHL, SPIEL, STUHL) maps to WCB /ui/. The main exceptions according to Schikowski, (2009) are in certain loan words (e.g., *normal*, 'normally') and in words often used in religious contexts (e.g., *Altar*, 'altar'; *Moral*, 'morality') that are with domain-final /l/ in both varieties.

To sum up, whereas this section provides an overview of the most important WCB dialect features in relation to SG, one major concern was to highlight once more that the dialect and the standard variety differ substantially from each other and that the dialectal phonemes cannot be systematically derived from the standard forms. This comes about because the dialectal pronunciation does not depend on the standard but on the underlying Middle High German (MHG) realization of a sound. Since we can assume that WCB dialect speakers do not have active knowledge about MHG forms, the extent to and direction in which WCB differs from SG is stored in the speakers' lexicon.

Nevertheless, in the analyses of this thesis the interference of the standard pronunciation on WCB sounds is examined without referring to MHG sounds, because the assumption is that the standard language increasingly influences the WCB dialect irrespective and in spite of the divergent historical developments.

1.5 Sound change

There is quite recent experimental evidence for sound changes in German dialects due to the influence, and therefore in the direction, of the standard variety. Most of this research is based on apparent-time studies comparing old vs. young speakers of a given population. For example, Müller et al. (2011) investigated word pairs in East Franconian that differ in post-vocalic obstruent voicing in SG (e.g., *leiten/leiden*, /laɪtn, laɪdn/, 'to lead/suffer') but are homophonous with a voiced stop (both /laɪdn/) in the local variety. They found that such pairs were, however, only homophonous in older speakers of the dialect. Younger dialect speakers in contrast were beginning to distinguish between them, although not to the same extent as in the standard. Further, Augsburg Swabian has /ʃ/ in post-vocalic clusters that maps to two phonemes in SG (e.g., SG: /vɛst, vɛʃt/, *west*, *wäscht*; 'west, washes'; both are /vɛʃt/ in Augsburg Swabian). Once again, this contrast was shown to be more marked for younger than older Augsburg participants in both production and perception but not as marked as for standard speakers (Bukmaier, Harrington, & Klebert, 2014). Moreover, as discussed in 1.4.1 above, WCB but not SG has an inverse quantity relationship in which a short vowel is followed by a long consonant and vice-versa. Kleber (2017) found that this characteristic was more evident in older than in younger WCB speakers.

In general, the question of how and why sounds in an established speech system change has been a central part of historical linguistics for centuries. Since the 1960s, Labov and colleagues (Weinreich, Labov, & Herzog, 1968; Labov, Yaeger, & Steiner, 1972) started to use experimental phonetic techniques in order to study sound changes that are still in progress.

The main attempt for understanding sound change is twofold: on the one hand researchers seek the conditions that give rise to sound change and on the other hand for the requirements for its diffusion through a speech community (Ohala, 1993). Thereby, phonetic models of sound change rely often on the variation in speech production. There can be massive variation in the pronunciation of the - by definition - same sound between speakers, but also between the productions within a single speaker. One reason for this variability is the lack of precision of the articulators: speakers are physically not able to reach the exact same target every time. Also, linguistic contextual features such as prosody or coarticulatory effects can cause variation in a speech sound. The speech between speakers of the same language can also vary because of idiosyncratic features (e.g., speech rate and speech style) as well as sociodemographic features (e.g., age and gender) (Pinget, 2015). However, while speakers are highly variable in their production, listeners tend to be quite robust to these variations and are able to factor them out successfully. That is, although the properties of stimuli vary continuously, they are perceived remarkably solid. Variability is therefore an inherent part of the transmission between speakers and listeners (Stevens & Harrington, 2014). However, this production-perception system is, even if well-working, not entirely stable. As e.g., Labov (2001) argued, it is this variability in speech that provides the basis for sounds to change. Ohala (1993) claimed that sound changes originate in listeners' misperceptions. As indicated above, in speech perception, listeners normally compensate for contextual effects on segments (e.g., Fowler, 2005). According to Ohala (1981) the listener might occasionally be unable to correctly relate the coarticulatory variation to its source and update their cognitive model with the mismatched sound patterns. However, listeners are generally very good at compensating for coarticulatory effects and even if such a mini-sound-change occurs within an individual, it still has to clear the hurdle of spreading through a whole speech community. Ohala (1993) argues that this is the reason why sound change is rare (while at the same time variability in speech is so prevalent). According to his view sound change occurs accidentally and thus randomly and non-teleologically. Lindblom (1990; Lindblom et al., 1995) advanced a similar view about coarticulation and its role in sound change. Yet, whereas according to Ohala the communicative error causing sound change is on the side of the listener, Lindblom favors the role of the speaker in a speaker-listener interaction. In his Hyper- and Hypo-articulation theory he suggested that speakers vary their articulatory clarity according to the informational requirements of the listener. Speakers hyper-articulate when listeners require maximum acoustic information; and they hypo-articulate if they calculate that the listeners will be able to predict the word from the context. In hypo-articulated speech the listener typically does not focus on the signal as the word can usually be predicted from the context. In Lindblom et al.'s (1995) theory sound change comes about if the listeners' attention is exceptionally directed at the phonetic consistence of the signal during hypo-articulated speech. The hypo-articulated form can then happen to be added to the listener's lexicon. Both Lindblom's and Ohala's theories have in common that sound change is seen to occur when the listener decontextualizes speech. A further implication of both models is that less experienced listeners like children and L2 learners are the primary drivers of sound change, as they are most likely to make such perceptual errors (Ohala, 1993; Harrington et al., 2019b).

However, while both theories account for phonetic mechanisms initiating sound change the question of how and why a sound change spreads on community level remains unclear. Labov (1994; 2001), from a sociolinguistic point of view, argues that it is essential to investigate human communities and human interaction in order to fully understand how and why sound change takes place. Generally, in social dialectology the relative contributions of 'internal' (system-driven) and 'external' (contact-driven) factors have been increasingly addressed (McMahon, 1994; Croft, 2000; Torgensen & Kerswill, 2004).

External factors imply language or dialect contact due to e.g., speaker mobility (e.g., Clopper & Pisoni, 2006). Only fairly recently so-called 'extra-linguistic' factors have been added and are considered to be independent of external factors. Farrar & Jones (2002) define these as socipolitical and economic motivations. Torgensen & Kerswill (2004) added social-psychological criteria like a speaker's sense of identity and attitude towards a faced dialect to the definition. This implies that the prestige of a community and their language can be motivation for (or against) language change (Hay & Drager, 2010; Jannedy & Weirich, 2014). Linguistic changes such as vowel shifts, splits and mergers are considered to be motivated by the respective language system itself and are therefore called internal (Torgensen & Kerswill, 2004). Labov (1994) explains such changes with the "functional economy of the vowel system" (p. 117), meaning that vowels shift in order to avoid to merge with another vowel category and thereby sustain their ability to discriminate words.

However, the question of whether sound change is internally motivated or externally driven and which factors are prioritized when both motivations are competing remains a complex issue. Typically, models of sound change can be clearly divided into those that are concerned with the phonetic conditions that give rise to sound change (e.g., Ohala, 1993) as opposed to the social factors that cause the spread of a sound change on community level (e.g., Eckert, 2012; Labov, 2001; Milroy, 1992). The general consensus has been that while phonetic factors (especially coarticulation and reduction processes as outlined earlier) provide the conditions for a possible sound change, the spread of sound change throughout a community is determined by social factors (Harrington et al., 2019b). Labov's attempt to make sense of the seeming arbitrariness of the occurrence of sound change was by determining the degrees of conscious awareness on the part of speaker-listeners (Foulkes, Scobbie, & Watt, 2010). He categorized variables as stereotypes, markers, or indicators, in decreasing order of awareness. Different types of change may affect these different types of variables. In a similar context, Trudgill (1986) has elaborated the notion of ‘salience’, which can be defined as “a property of a linguistic item or feature that makes it in some way perceptually and cognitively prominent” (Kerswill & Williams, 2002, p. 1). With this conception Trudgill attempts to explain why certain features are adopted and others rejected in dialect contact. While Trudgill (1986) argues that salient features are usually the ones that undergo change, he simultaneously restricts this claim. He suggests that the adaptation of salient features is avoided if they are too ‘difficult’ to acquire, e.g., if they involve the learning of a new contrast, as well as in cases of ‘extra-strong salience’, i.e., if the features are not just consciously perceptible but overly strong markers of a dialect. From a phonetic point of view Garret and Johnson (2013) hypothesize that slight phonetic differences in production may be more likely to change than larger differences, because they would not be consciously detected by listeners and thus be simply included amongst already stored exemplars. This explanation favours therefore the idea that phonetically similar variants would be more likely to undergo sound change.

While in the present thesis the hypothesized direction of sound change is a shift of certain WCB features in the direction of the standard due to dialect contact, we seek to further investigate the social as well as phonological features that may have an influence on the extent of sound change.

We focused on children since it is assumed that the first four years of schooling are a particularly interesting time to study shifts in spoken accent as the new peer-group increases in influence relative to the parental environment. As mentioned earlier, according to Ohala (1993) innovations occur eventually, when people allow their pronunciations to fluctuate and make errors based on misperceptions. While this might be especially applicable for young children on the one hand, a crucial point for the spread of sound change, however, is social interaction. Yet, very young children are unlikely to be within an age group from which innovations can spread (Kerswill, 1996). Foulkes & Vihman (2015) found in a review of sociophonetic studies concerned with child productions and frequent errors, that early errors are highly unlikely to lead to changes since they diminish with time and most early processes disappear by around age three. Older children, however, as soon as they enter school and are part of social interaction, play a crucial role in transmitting changes in progress (Foulkes & Vihmann, 2015). Kohn & Farrington (2017) also reasoned that the influence of school may be critical to language change since it comes along with rapid changes in social circles and social identity formation, potentially also resulting in changes in linguistic performance.

1.6 This thesis

The thesis had three aims. The first was to document the phonological and phonetic correspondences between the vowels of Standard German and those of West Central Bavarian as outlined in 1.4. The purpose of doing so was to clarify the nature of the synchronic systemic differences between these varieties – i.e. those in which vowel phonemes contrast different sets of lexical items – and to separate these systemic differences at the phonological level as far as possible from phonetic realizational differences between the varieties. Although there is a large amount of literature concerned with descriptions of the Bavarian dialect, nearly all of it is based on impressionistic auditory descriptions (Zehetner, 1985; Merkle, 1976; Capell, 1979; Mansell, 1973a; Keller, 1961). The aim was thus one of language or (in this case) dialect documentation by combining previous linguistic descriptions of the dialect with a systematic measure of the defining vowel characteristics of WCB in order to provide an acoustically based analysis of the Bavarian vowel system.

The second aim was concerned with dialect contact leading to sound change: that is, to make use of these documented systemic and phonetic differences in order to predict the possible changes that should occur in WCB, under the assumption that this variety is being influenced by the standard.

The third aim was to determine whether the rate of sound change was affected by social and phonological properties of the speech sounds that were investigated, in particular whether sounds that are salient markers of a dialect are less prone to change (Trudgill, 1986; Auer, Barden & Grosskopf, 1998; Siegel, 2010) and to assess whether sound changes that result in mergers as opposed to new contrasts progress at different rates (Chambers, 1992; Kerswill, 1996; Evans & Iverson, 2007).

The concept of this thesis was to combine methods and approaches in order to address our aims from diverse angles. First, we combined synchronic and diachronic approaches in order to detect sound change. That is, we made use of both real-time longitudinal acoustic analyses of WCB primary school children at three consecutive timepoints as well as an apparent-time analysis, in which the data from the children recorded at the first time point of the longitudinal analysis is compared to those from WCB adults from the same region. Second, we combined these acoustic analyses with an articulatory analysis using ultrasound data of the tongue obtained from a subset of the same children as in the acoustic recordings.

However, because this was a study with children in which the amount of recording time that can be accomplished is restricted (due to e.g. maintaining the child's attention), the empirical part of the thesis addressed only a small subset of the possible systemic and realizational differences between the varieties outlined above. The possibilities for analyzing the potential influence of SG on WCB were also constrained by the extent to which it was possible to represent a suitable number of high frequency words that are likely to be known to children pictorially. The vocalic distinctions between WCB and SG relevant to the particular hypotheses will be presented in more detail in the introduction paragraphs of the respective chapters.

The empirical basis for the analyses in Chapters III and IV is described in Chapter II, comprising the methodological approaches mentioned above.

In Chapter III, six different acoustic analyses investigating predicted shifts from WCB towards SG are outlined. The focus was 1) on the phonemic vowel contrast of two open vowels (/a/ and /ɒ/) in WCB whereas there is just one open vowel quality in the standard (e.g., 'Kabel' *wire* and 'Gabel' *fork*, which is /k**a**:bel, g**a**:bel/ in SG and /k**a**:be, g**ɒ**:be/ in WCB). This opposition of open vowel categories in WCB was expected to merge and hence to be closer together for young than for old.

Further, on a WCB quantity correlation between a vowel and the following consonant which maps non-systematically to a quality contrast in SG. While SG has a phonemic opposition between tense and lax vowel pairs that differ in quantity and quality, WCB has no such quality distinction but a difference between short and long vowels that are inversely related to the length of the following consonant (long vowels are predictably followed by short consonants and short vowels by long consonants) (e.g., Bannert, 1976). There is evidence that this quantity correlation between the vowel and following consonant is weakened for younger speakers. Kleber (2017) showed a sound change in progress in which younger Bavarian speakers (20-30 years) produced a vowel length contrast independently of the following consonant length whereas older Bavarian speakers (50-80 years) stuck to the complementary length pattern in vowel plus consonant sequences.

Here it was tested 2) whether there was any evidence that WCB children make less use of these quantity distinctions while 3) quality differences in the vowel begin to emerge. The changes in vowel quality in WCB children might 4) further lead to a change in the most peripheral front vowel in the vowel system. The WCB /i/ is more centralized and retracted compared to SG /i/, whereby /e/ is the most peripheral front vowel in WCB (Schikowski, 2009). In case children begin to differentiate between tense and lax /ɪ, i/, the new quality distinction might push /i/ to replace /e/ as the most peripheral front vowel.

For WCB monophthongs we additionally predicted 5) the development of a rounding contrast in front rounded vowels. A process of unrounding in the 13th century caused an omission of rounded variants in the front vowel set in the dialect (Kufner, 1957). Given that SG has a phonemic rounding opposition in front vowels of the same phonetic height, we expected the children to reintroduce the rounded variants.

Changes were also expected in the realization of WCB diphthongs. WCB /ɪa/ and [aɪ] were analyzed because, as described above, they have a different mapping to Standard diphthongs and monophthongs, e.g., *Fliege* 'fly', *Füße* 'feet' and *Kirche* 'church' which are /fl**i**ːgə, f**y**ːsə, k**ɪɐ**çə/ in SG but /fl**ɪa**ŋ, f**ɪa**s, k**ɪa**x/ in WCB or words like *Feuer* 'fire' and *drei* 'three' which are /f**ɔɪ**ɐ, dr**aɪ**/ in SG but /f**aɪ**ɐ, dr**aɪ**/ in WCB.

We examined 6) the steepness of slopes in cases where there is a diphthong in the dialect but a monophthong in the standard, supposing a shift from the WCB diphthong to the corresponding SG monophthong. Further, we were seeking evidence of a merger of two different WCB diphthongs that map to the same SG diphthong as well as of a split of a single WCB diphthong that maps to two different diphthongs in SG.

In all six cases outlined above the analysis was of whether children diverge from adults and whether they do so increasingly in the second and third year of recordings.

In Chapter IV the WCB diphthongs resulting from lateral vocalization are further explored. In WCB the lateral /l/ is vocalized in syllable-final, post-vocalic position. This process resulted in the diphthongs /oi/ and /ui/ in the investigated dialect area for segments where there is V+/l/ in SG. In accordance with the assumptions in Chapter III we supposed a shift of young WCB speakers from vocalized /i/ towards a lateral as it is produced in the standard. Along the lines of the analyses performed in Chapter III acoustic recordings from WCB adults were compared to WCB speaking children which were again examined at three consecutive timepoints. In addition to the acoustic comparisons, articulatory data from ultrasound recordings of a subset of the children in the second year of recordings was explored with the aim to relate acoustic and articulatory patterns to the initiation of sound change.

In Chapter V we will conclude with an overview and summary of the findings from Chapters III and IV.

Method*

Chapter II

Abstract

The present chapter describes the corpus on which the analyses presented in Chapter III and IV are based and provides an overview of the methodological and instrumental approaches used for data collection.

One aim of the studies presented in this thesis was to systematically measure defining vowel characteristics of the West Central Bavarian (WCB) dialect for an acoustically based analysis of the Bavarian vowel system. Another was to investigate to what extent these characteristics are being preserved across generations and if there is a sound change in progress observable in which young speakers show more characteristics of Standard German (SG) than old on some Bavarian vowel attributes. In order to address these aims we conducted acoustic recordings of WCB speaking adults and WCB speaking primary school children which were then compared to each other with an apparent-time analysis, which has been shown to be a valid method for detecting dialect change. For a more accurate view of changes in progress we combined this apparent-time comparison with longitudinal data from the WCB children, obtained at annually intervals expanding over three years.

The acoustic data was enhanced by articulatory data gained from ultrasound recordings of a subset of the same WCB speaking children at two timepoints with one year interval.

* Parts of this chapter are published in the *Journal of the International Phonetic Association* (Wolfswinkler & Harrington, 2021)

2.1 Methodological approaches

2.1.1 Longitudinal and apparent-time studies

In the history of examining sound change research often relies on differences in language between speakers of different age groups at one specific point in time. This apparent-time procedure has been shown a valid analytical tool to supply evidence of language change in progress (e.g., Bailey, Wikle, Tillery, & Sand, 1991; Weinreich, Labov, & Herzog, 1968). However, this approach implies the assumption that people do not substantially modify the way they speak over their adult lifespan and each generation of speakers incorporates the state of the language as it was when they acquired it as children (Boberg, 2004). But the possibility that differences found this way reflect age-grading effects[11] rather than language change cannot fully be excluded (Bowie, 2005).

In addition, and as predicted by episodic models of speech (Johnson, 1997; Pierrehumbert, 2003, 2006), phonetic change to the accent of a community has been shown to occur within adults both over long (Harrington, 2006; Sankoff & Blondeau, 2007; Reubold & Harrington, 2015) and shorter (Harrington et al., 2019) time-scales.

Boberg (2004) reasons from the results of his study comparing apparent-time data on Montreal English with real-time data from earlier studies of the same community, that for an accurate view of language change both real- and apparent-time analyses are necessary.

Longitudinal phonetic changes are likely especially marked in young children (Kerswill, Cheshire, Fox, & Torgersen, 2013; Nardy, Chevrot, & Barbu, 2014; Trudgill, 2008). Therefore, in the present thesis apparent-time data is regarded in conjunction with real-time data. That is, we compared the speech of adult and child speakers of the WCB dialect to a given time point (apparent-time) as well as the speech of the same children longitudinally over three years (real-

[11] Age-grading refers to changes in speech over speakers' lifetimes due to aging. That is, some variations found in younger speakers may shrink as they grow older but are adopted again by the next generation of younger speakers (Boberg, 2004).

time). This combination of synchronic and diachronic approaches allows us to firstly seek for first clues to language changes in progress (by means of the apparent-time data) and secondly differentiate between linguistic differences that are based on speaker age and differences that truly reflect language change in progress (by means of the longitudinal data). Additionally, the synchronic comparison between child and adult speech was meant to confirm the vocalic patterns found in the child data and to verify the children as proficient dialect speakers. The adult speakers were chosen to be of an advanced age in order to provide a stable anchor to which the child productions can be related.

In general, (socio)phonetic analyses of child vowels are quite rare and especially longitudinal studies are restricted to a handful case-studies (Carter, 2007; Sankoff, 2004; Rickford & Price, 2013) or those involving larger groups (Kohn & Farrington, 2017; Nardy et al., 2014). The scarcity of such studies is largely for methodological reasons: both due to finding children whose caregivers agree to repeated recordings over several years and because of the inherent difficulty of factoring out phonetic changes due to vocal tract maturation with increasing age (Kohn & Farrington, 2017). As Kohn & Farrington (2017) pointed out the challenge is to normalise out acoustic correlates of physical change by finding normalisation procedures that reduce physiological variation while simultaneously maintaining sociolinguistic variation. In their study they were looking at vowels (F1, F2 as well as duration) of 20 African American children at four time points from ages 10 to 20 to describe developments and changes within their vowel spaces. They also used cross-sectional studies to confirm the observed patterns from their longitudinal data. Based on this comparison they argue that patterns of maturation are predictable and can therefore be addressed in normalization procedures. Kohn & Farrington (2012) found for example that Lobanov (1971) normalization efficiently aligned adult and child vowel spaces. As will be outlined in Section 2.2.3, this normalization approach is also applied in this thesis in order to make the acoustic data from children and adults comparable.

In another longitudinal study with children, Nardy et al. (2014) were looking at whether and how peers influence acquisition of social dialects in young children by means of 4- to 5-year-old French-speaking children. They found first evidence that sociolinguistic variables converged after one year of frequent contact and hence social interaction within the peer group had an influence on children's linguistic usage already at that early age. However, in their study they rely on auditory observations of sociolinguistic variables in speech rather than instrumental phonetic analyses.

2.1.2 Acoustic and articulatory measurements

Such instrumental phonetic experiments can have several shapes. In general, in experimental phonetics, variables can be analyzed using acoustic as well as articulatory methods. Each method has its own benefits as well as inherent limitations. Acoustic properties are generally readily accessible and provide reliable and comparable quantifications of the speech signal at the same time. However, most of the conclusions drawn from acoustic measurements rely on phonetic theory on how acoustics relate to articulation. Only seldom studies compare acoustic data and the corresponding articulatory data directly (although e.g., Scobbie, Lawson, & Stuart-Smith, 2012 presented ultrasound and acoustic data of Scottish English vowels; and Blackwood Ximenes, Shaw, & Carignan, 2017 compared vowel formants and corresponding articulation using electromagnetic articulography between North American English and Australian English). Even though articulatory measures are more complex to access as well as to process, they offer a greater level of quantitative accuracy over acoustic methods and can enhance acoustically based descriptions of speech. Therefore, for this thesis acoustic as well as articulatory data by means of ultrasound recordings was obtained. While the analyses in Chapter III are mere acoustically based, the study described in Chapter IV consults the articulatory data to test the findings of the preceding acoustic measures as well as to provide insight into the underlying articulatory patterns. In the following, the corpus on which the analyses in Chapters III and IV are based, the acoustic and articulatory methods for data acquisition as well as the approaches of processing the data will be described.

2.2 Experiment I: Acoustic recordings

2.2.1 Participants

As mentioned above, the approach for assessing the influence of SG on WCB vowels in Chapters III and IV was based on a combined apparent-time (Weinreich et al.1968; Bailey et al., 1991) and longitudinal study in children (Kerswill & Williams, 2000; Trudgill, 2008; Nardy et al., 2014; Mooney, 2020). For our apparent-time study, comparisons were made between older adults and primary school children. For our longitudinal study, the children were re-recorded 12 and again 24 months after the first recordings had been made when they had just started primary school. Recordings of both adults and children were conducted within the district of Altötting which is a rural area approximately 90 km east of the state capital Munich. The children were recorded from two separate schools located 14 km apart in the villages of Wald an der Alz and Burgkirchen an der Alz (cf. Fig. 1). The schools were selected to be in a non-urban setting in order to record from children who are proficient dialect speakers. Generally, inhabitants of WCB rural villages, just like the two where the recordings were made, tend to stay in/return to the area they were born and raised. Dialect usage is thus predominant and well-respected while SG pronunciation is a marker of an outsider. However, even though most of the teachers spoke WCB dialect, they used SG in class teaching since pupils are supposed to be taught in the standard. Within the recorded classes most of the children were dialect speakers. Nevertheless, the classes were not completely homogeneous and the WCB speaking children were together with a much smaller number of peers from other regions of Germany (and also from other countries). That is, even if the dialect is certainly present in school life, children are exposed to a greater amount of SG (and regional varieties of SG) as soon as they enter school.

The contact to the children was established via the principals of the schools who granted permission to attend parents' evenings prior to the start of the children's first school year in order to present the study and the experimental set-up (see Appendix D for the parental letter for recruiting children after parents' evening).

The adults included 22 WCB speakers (13 f, 9 m) who lived in the same villages as the children. One of the adult participants was excluded since she produced the materials in the South German coloured standard variety rather than WCB throughout the experiment. The age range of the remaining 21 speakers was 51 to 83 years (mean age of 60.6 years). All speakers were born and raised in the WCB region and had learned dialect from birth. They had no known speech or hearing impairments and wore no hearing aids. Nevertheless, some age-related hearing decline cannot be ruled out (especially amongst the oldest of the participants aged 73, 77, and 83 years).

The children included 21 (12 f, 9 m) WCB speakers and were recorded in their first year of attendance at primary school (average age 6.5 years). Parental questionnaires were used to ensure that both parents were WCB speakers and that the children had learned and spoke dialect from birth. The same children were re-recorded one and two year(s) later (i.e. at age 7-8 and 8-9 years). Two of the children moved away in the first school year and another two in the second school year. Hence 19 WCB speaking children (12 f, 7 m) remained for the second-year recording and 17 (11 f, 6 m) for the third-year recording. The data from one of the children with speech and hearing difficulties who had participated in the recordings from all three time points were not included in the analysis. The final count of analyzed children was therefore 20 (year 1), 18 (year 2) and 16 (year 3).

2.2.2 Experimental set-up

The design of the study involved productions of the same words for all participants of both age groups using a picture naming task. The picture naming task was used without any orthography.

This method was chosen to obtain dialectal, semi-spontaneous data while constraining the degree of spontaneity. Picture-naming and word repetition tasks have been found to be useful methods for eliciting single words and for controlling the context (Edwards & Beckman, 2008). There was no priming with the respective target words and vowels, neither orthographically nor orally. Only in the cases where the target words were verbs (i.e., *lesen* 'to read' and *beten* 'to pray') the experimenter asked "what does the woman/the man do?" before the production in order to make the participants produce a verb instead of a noun.

All words were presented as real pictures, predominantly on plain white background as exemplified in Fig. 4. Exceptions to this pattern were e.g., *lesen* 'to read' and *beten* 'to pray' (see also Fig. 4).

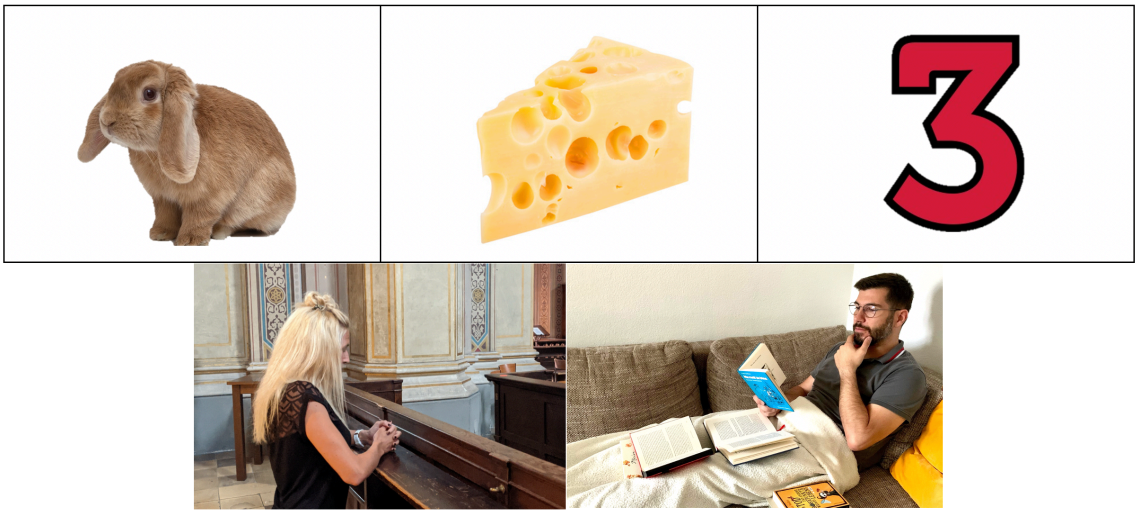


Fig. 4. Sample pictures used in the study. The items are: *Hase*, /hɒs/, 'rabbit' (top left); *Käse*, /kas/, 'cheese' (top mid); *drei*, /drai/, 'three' (top right); *beten*, /bɛtn/, 'to pray' (bottom left); *lesen*, /lesn/, 'to read' (bottom right).

Adult participants were tested in a quiet room in their homes and produced each word from a picture that was presented on a monitor. The children were tested individually in a quiet room in their respective schools. For the children, the production experiment was constructed as a game in which a human comic figure travelled through space (first year of recordings) or over a treasure map (second and third year of recordings). The game began with a picture of a figure at some starting point on the background of space/ a treasure map that moved across several landmarks (planets in the space setting or small circles in the treasure map setting). After approximately every 15th item, a picture with the figure on the respective background appeared again having advanced by one step (accompanied with some gaming sound effects), until the "goal" at the end of the experiment had been reached. This was done in order to ensure that the children maintained interest and motivation throughout the whole experiment.

The recordings were made with an audio interface (M-Audio Fast Track) and a condenser headset microphone (Beyerdynamic TG H54) and digitized at 44.1 kHz, using the *SpeechRecorder* software version 3.12.0. (Draxler & Jänsch, 2004). The pictures were displayed one at a time on a computer monitor. The participants were seated in front of the screen of a MacBook Pro (2016, 13 inch). The adults were instructed to produce the pictures in their dialect. In order to encourage the children to speak WCB naturally, the children interacted with the experimenter (the author, who is a WCB speaker from the same area) for some time before and during the picture naming task. There was no time pressure in producing the words which were advanced manually by the experimenter when the participant was ready. The total time to participate in the experiment was approximately 20 and 30 minutes respectively for adults and for children.

2.2.3 Data preparation and analysis

The recordings were manually segmented in order to identify the target words, given that the children tended to produce considerably more speech than just the targeted item. Target words were then automatically segmented and annotated with the Munich Automatic Segmentation System (MAUS; Kisler, Reichel, & Schiel, 2017). All subsequent analyses were carried out using the EmuDB system and emuR package in R (Winkelmann, Harrington, & Jänsch, 2017). Formants were calculated using the LPC algorithm in Praat (Boersma & Weenink, 2016) with the Burg algorithm. The analysis window had a length of 0.025 s and the ceiling of the formant search range was set to 7000 Hz for children, 5500 Hz for adult females, and 5000 Hz for adult males. Pre-emphasis was applied with a slope of +6 dB /octave for frequencies above 50 Hz. Vowel segment boundaries and formant errors were manually corrected. The correction of formants was especially necessary for the child speech data in which, e.g., a formant had been mis-tracked as a higher or lower formant number. The acoustic vowel onset and offset were typically defined as the onset/offset of periodicity and/or for the interval over which a formant structure was clearly visible. F1, F2 and F3 of each vowel were linearly time-normalised between the acoustic on- and offset to eleven data points and then smoothed to remove micro-perturbations using a 5-point median filter.

All data were speaker-normalised by converting formant frequencies into *z*-scores (Lobanov, 1971) in order to reduce the influences of anatomical differences in size and shape of the different speakers' vocal tracts. This was done with (1):

$$F^{*}_{i,j,k(t)} = [F_{i,j,k(t)} - \text{mean } F_{i,j}] \;/\; \text{sd } F_{i,j} \qquad (1)$$

in which $F^{*}_{i,j,k(t)}$ and $F_{i,j,k(t)}$ are, respectively, the normalised and raw formant frequency values of formant number j (j = 1, 2, 3) produced by speaker i in utterance k at timepoint t and where mean $F_{i,j}$ and sd $F_{i,j}$ are the mean and standard deviation of all formant values between the acoustic onset and offset for formant number j with respect to that speaker's /a/, /o/, and /e/ vowels. These were chosen, because they mark the WCB corner vowels, i.e. those with the most extreme F1 and F2 values. Durations for target vowels and their subsequent consonants were measured and normalised relative to the duration of the word in which they occurred.

The formant trajectories between the vowel's acoustic onset and offset of the first and the second formant were each decomposed into a set of ½ cycle cosine waves using discrete cosine transformation (DCT; see Harrington & Schiel, 2017 for formulas and details). For the analyses in this thesis, the first three DCT coefficients, k_0, k_1, k_2 were calculated which are proportional respectively to the mean, linear slope, and curvature of the trajectory. The DCT models the shape of a trajectory but does not represent duration.

The (logarithmic) distance d of a vowel $\vec{x}_i$ in a three or six-dimensional space of DCT coefficients to another vowel category $\vec{c}$ was calculated separately by speaker and is given (2):

$$d(\vec{x}_i) = \log\left(\sqrt{||\vec{x}_i - \vec{c}||^2}\right) \qquad (2)$$

where || denotes vector magnitude and $\vec{c}$ is the centroid of the vowel category to which the inter-Euclidean distances were calculated.

Statistical tests were carried out with a linear mixed effect regression model using the LMER function from the lmerTest package in R (Kuznetsova, Brockhoff & Christensen, 2017). For the analyses in 3.3.2, 3.3.3, 3.3.5, 3.3.6 and 4.3.1 the model was of the form (R notation) in (3):

dependent ~ *group* + *year* + (1 | *speaker*) + (*group* | *word*)) (3)

where *dependent* was the dependent variable, *group* a two-level fixed factor child vs. adult, *year* a four-level fixed factor for adults and children recorded in the first, second, and third years, *speaker* a random factor for the participant, and *word* a random factor for the word. The analysis for 3.3.4 extended (3) to include the vowel, *V*, as a fixed factor as in (4):

dependent ~ *group* + *year* + *V* + *group*:*V* + year:*V* + (*V* | *speaker*) + (*group* | *word*)) (4)

When *year* was significant in (4) or (5) (which means that adults and children recorded in their first three years potentially all differed from each other), the results of post-hoc *t*-tests are reported that were computed using the R package emmeans (Lenth, 2019).

2.3 Experiment II: Articulatory recordings

2.3.1 Participants

Ultrasound recordings were obtained of a subset of the same children who participated in the acoustic recordings. Approximately six months after the first acoustic recordings (in the middle of the children's first school year) and again 12 months later (in the middle of the children's second school year) a total of 17 children (10 f, 7 m) of the two schools located closely to each other were recorded to each timepoint (ages 6-7 and 7-8, respectively).

Accordingly, again all participants were native WCB dialect speakers with no known hearing or speaking impairments.

2.3.2 Experimental set-up

The task for the ultrasound recordings was identical to the picture-naming task in the acoustic experiment. At both timepoints of the ultrasound recordings the same items as in the acoustic task were embedded in the same gaming environment of a figure travelling through space (see 2.2.2 for a more detailed description).

This gaming environment was once again supposed to loosen up the experimental situation, helping the children to make it through the whole experiment on the one hand and to feel comfortable enough to speak in the dialect on the other hand. Nevertheless, it occurred that some children produced some items in SG instead of WCB. This was not just the case in the ultrasound session but also in the mere acoustic recording sessions but only within the child groups. The reason for this is that the children are not yet fully aware of the two speech systems they command and switching between the two varieties happens rather subconscious at that age. The adults on the other hand are able to consciously produce either WCB or SG and can therefore be simply advised to name the items in their dialect.

While these occurrences of code switching were unintended in the first place, they turned out to be a benefit for the analyses carried out in Chapter IV as they provided a direct insight into the differences between the WCB vocalized forms and their unvocalized counterparts in SG, in some cases even within the same speaker.

The recordings were made in an isolated room in the respective schools. The children were seated in front of a monitor displaying the same pictures to be named as in the acoustic recordings.

Midsagittal images of the children's tongues were recorded using a portable ultrasound system (Articulate Instruments Micro US) with a 10 mm microconvex probe that operated at minimum transmitter frequency. The frame rate was set at around 95 fps and synchronized to the audio via the high-speed Articulate Assistant Advanced™ system (AAA, v.2.17.03; Articulate Instruments Ltd., 2017a) which was remotely controlled via Ethernet from a 14" Lenovo Thinkpad (core i5, 7th generation). The reason why the ultrasound framerate can slightly differ per subject is due to the data acquisition rate depending on the scan settings which are usually custom fit to optimally capture a given speaker's vocal tract (Hoole & Pouplier, 2017).

For the recording sessions in the first year a probe setup similar to that described in Noiray et al. (2015) was used. The probe was mounted on a counterweighted microphone arm, positioned under the participant's chin and attached to the head with straps and a 3D printed cap. Water bottles were used as counterweights, allowing individual modulations to the participants.

For the second-year recordings the probe-holder system developed by Derrick et al. (2018) was applied, modified for the use with children. While placing the ultrasound probe in a microphone stand provides an adequate probe steadiness, the method of Derrick et al. (2018) offers an improved stabilization and free head movement at the same time with a child-friendly adjustable headset (see Fig. 5).

Since both of these approaches allow some freedom of jaw movement, a video system was used to monitor ultrasound probe movement relative to the skull. The video data was acquired both in profile and frontally. This was done with a Canon EOS 750 video camera placed in front as well as a mirror placed to the left side of the participant at the height of the child's head in order to provide both views in one video (cf. Noiray, Ries, & Tiede, 2015). In the second year at the second school the mirror was replaced by a second Canon EOS 750 video camera filming the participant from the side since with the new probe-setup the children had more freedom for movement and tended to move beyond the scope of the mirror.

The ultrasound video data was collected concurrently with synchronized audio, recorded via an omnidirectional condenser microphone (audio-technica ATR3350), that was placed at the probe holder under the participants' chin and connected to the Laptop via a Tascam USB 2x2 audio interface.

The speech signal was additionally recorded via the built-in video camera microphone and synchronization of both video signals (from ultrasound and the video camera) was performed through audio cross-correlation in post-processing.

In order to monitor the head position relative to the probe, blue dots were attached to rigid locations on the face and to the probe. Additionally, traces of the children's occlusal bite planes were obtained at the end of each session by asking them to bite on a flat plastic plane and press their tongue against it. This was recorded on video in order to provide a baseline for head position. Additionally, a calibration board was held into the camera, positioned at the (former) location of the participant's head and recorded on video at the end of each session in order to allow calibration of video frontal and profile views.

Figure 5 shows the whole set-up in the first recording year with the counterweighted microphone arm as probe holder, as well as the probe-holder system used at the second recording timepoint.

Throughout the experiment the pictures were displayed one at a time on the monitor and forwarded manually after every production in order not to create any time pressure. There was a beep at the beginning of every appearing picture, signaling that the software was ready to record. Therefore, the children were advised only to speak after the beep.

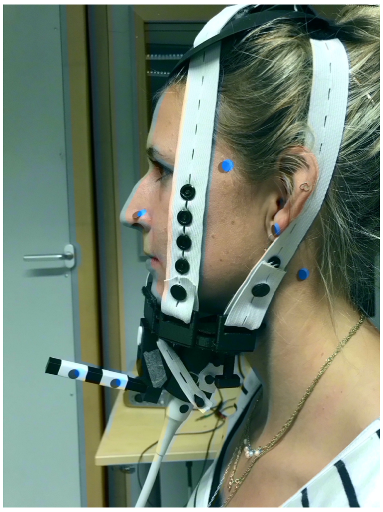


Fig. 5. Ultrasound recording set-up in the first year of recordings on the left and the probe-holder system used in the second year of recordings on the right.

Each session lasted approximately 45 minutes, including about 15 minutes for setting the participant up and fitting the probe and 30 minutes for utterance production.

2.3.3 Data preparation and analysis

As for the acoustic data obtained in conjunction with the ultrasound sessions, Praat (Boersma & Weenink, 2016) was used to manually mark the acoustic onset and offset of the segments of interest which will be described in further detail in Chapter IV.

The ultrasound images were processed in Matlab (MathWorks Inc. 2007). GetContours (Tiede, 2020) was used to import the marked segments in the form of Praat TextGrids, extract the corresponding frames from the ultrasound videos and trace the tongue contour in each frame by means of eleven anchor points. This process provided discretized representations of the tongue contours in terms of a series of *x*-*y* coordinate points which could subsequently be exported, displayed and analyzed in R.

Figure 6a and 6b present examples of the tongue contours of the sequence /uːl/ (SG pronunciation; 6a) and /ui/ (WCB pronunciation; 6b) in the word *Stuhl* from one speaker over time, displayed in R with ggplot2 (Wickham, 2016) on the basis of the extracted x-y coordinates.

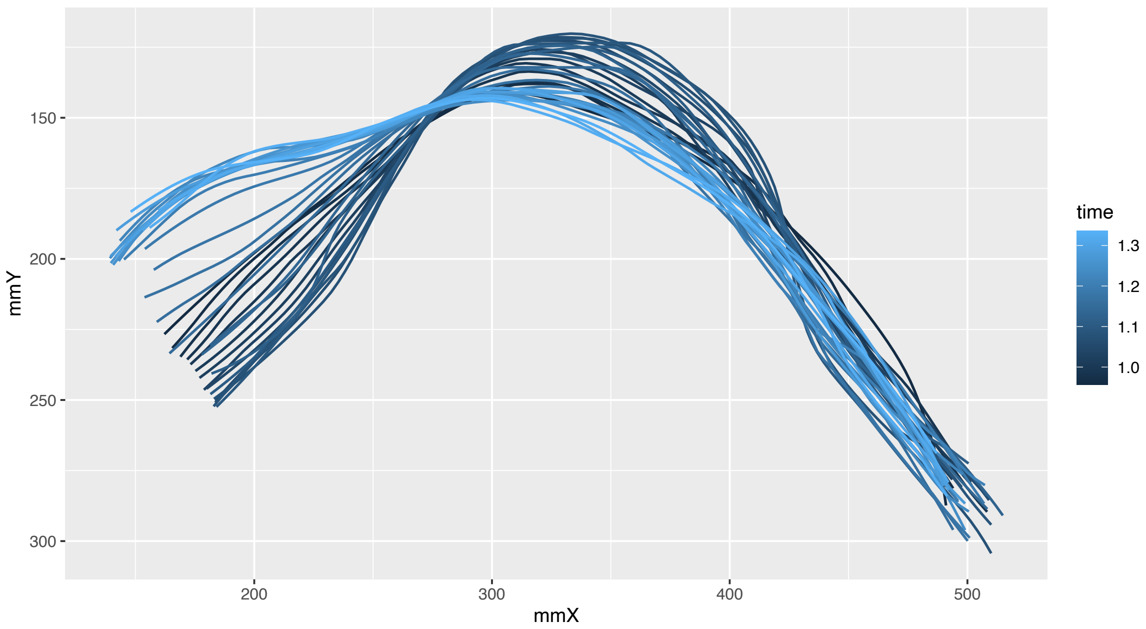


Fig. 6a. Tongue contours of SG /uːl/ within the word *Stuhl* over time. The tongue tip is to the left.

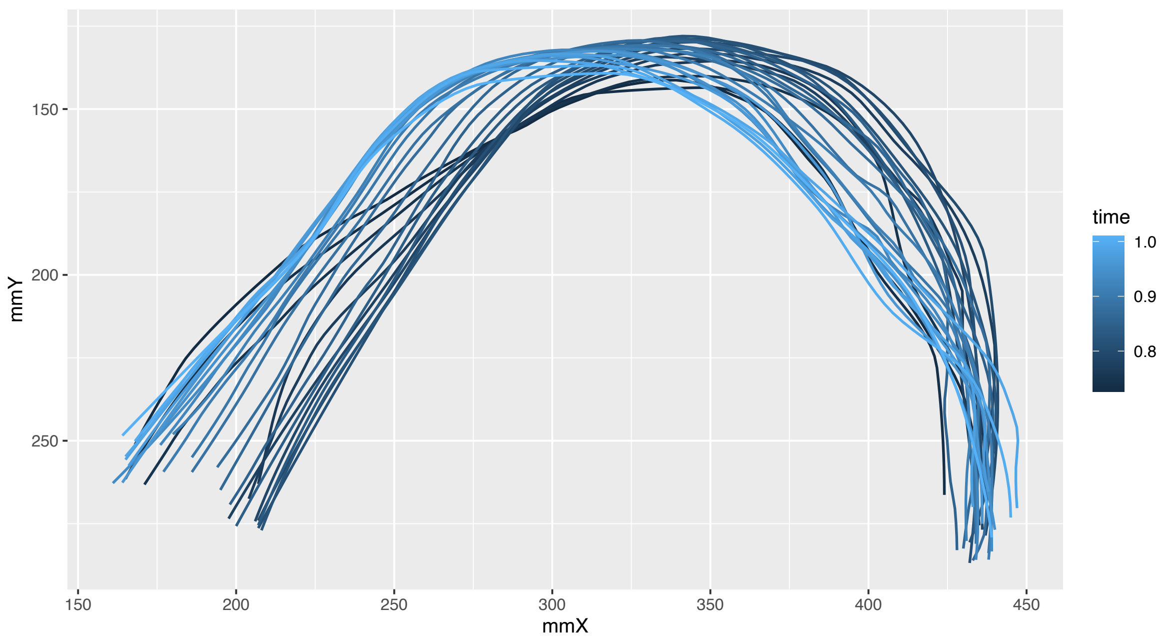


Fig. 6b. Tongue contours of WCB /ui/ within the word *Stuhl* over time. The tongue tip is to the left.

In order to quantify the tongue shape, we relied on the method of Menard et al. (2012), which focuses on fitting a triangle to the tongue contour and derives the extent and location of maximal inflection using the properties of the triangle. The advantage of this approach is that it is quite robust to probe movements. Most stabilization devices used for ultrasound recordings fixate the ultrasound transducer in relation to the head, prohibiting jaw movement in relation to the probe. With the headset used in our experiments, the probe is fixed to the jaw and not the head, allowing the jaw to move alongside with the probe. This implicates that the position of the palate moves relative to the probe. Many measures though rely on tongue position relative to the palate. However, Menard et al.'s (2012) method does not require correction for head and jaw movements relative to the probe since it is based on the shape of the tongue contour.
In sum, it provides a reliable measure of shape-related variables without objective spatial information (Dawson, Tiede, & Whalen, 2016) by extracting measures of angles, x and y coordinates of the highest point of the tongue, curvature degree, and curvature position.

Figure 7 demonstrates an example of a tongue contour extracted towards the end of the word *Stuhl*, selected from the same utterance as depicted in Figure 6a, together with the parameters gained from reshaping the contour into a triangle.

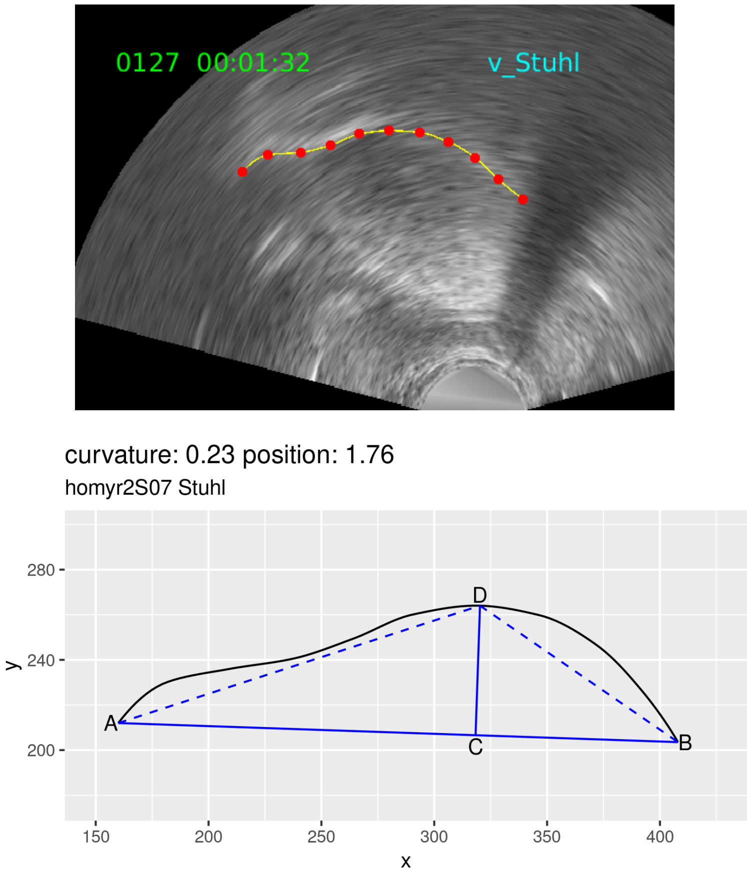


Fig. 7. On the top the fitted midsagittal contour of one frame towards the end of the word *Stuhl* with the tongue tip to the left. On the bottom the corresponding extracted contours, represented in *x*-*y* coordinates and the triangle used to obtain parameters.

The first and the last point of the extracted tongue contour were linked and formed the triangle base (AB). The highest point of the tongue contour relative to the base was considered the peak of the triangle (D). Measures of tongue curvature and tongue curvature position were determined from points A-D using (5) for curvature and (6) for position:

$$\frac{||CD||}{||AB||} \quad (5)$$

$$\frac{||AC||}{||CB||} \quad (6)$$

Tongue curvature is hereby defined as the ratio of the distance CD over the distance AB and position as the ratio of the distance AC over the distance CB.

2.4 Materials

In both experiments the same 58 pictures were presented, which were based on frequently occurring words (predominantly nouns) that are easy to visualize. They were also designed both in order to represent acoustically the WCB monophthong and diphthong spaces (Fig. 2) and for analysing the types of questions concerning a shift from WCB vowel properties towards SG as addressed in Chapters III and IV. The picturable words which are listed in Appendix B were either monosyllabic (26/58 words) or disyllabic (32/58 words) with trochaic stress. The word list included as far as possible words whose (target) vowels differ considerably between WCB and SG, so that the distinction between dialect or standard productions was clear and easily identifiable by native speakers.

The target vowels were in all cases in the initial syllable with primary lexical stress and included one of seven WCB monophthongs /ɒ/, /a/, /i/, /u/, /o/, /e/, /ɛ/ or five diphthongs /oi/, /ai/, /oa/, /ia/, /ua/ in a wide range of segmental contexts. Since the words were produced in isolation or at least most prominent when embedded in a phrase, the initial syllable was also nuclear accented. The words were presented in randomised order and repeated four times (resulting in 232 tokens per participant). The stimuli were blocked by repetition and randomisation was generated within each block automatically and therefore varied each time the experiment was run which led to a different order between speakers and also within the same speaker in the repeated recordings. While the acoustic recordings were generally completely accomplished, in the ultrasound sessions on average about 3 out of the 4 repetitions were completed.

The influence of Standard German on the vowels and diphthongs of West Central Bavarian[*]

Chapter III

Abstract

German varieties have repeatedly been shown to develop sound changes due to the interaction with the standard but what is the role of children in sound changes in progress?

We addressed this issue in an acoustic analysis of child and adult vowels of West Central Bavarian (WCB) that may be subject to an increasing influence by the Standard German (SG) variety. The study was a combination of longitudinal and apparent-time analyses: re-recordings from 20 WCB children in their first, second and third years of primary school at two schools in rural Bavaria were compared with those of 21 WCB adult speakers from the same area. The analysis was of whether children diverged from adults and increasingly so in their second and third years. Subjects produced stressed vowels in isolated mostly trochaic words in which WCB vs. SG differences were expected. Both adult/child and longitudinal changes in the direction of the standard were found in the children's tendency towards a merger of two open vowels and a collapse of a long/short consonant contrast, neither of which exist in SG. There was some evidence that children in comparison with adults were beginning to develop both tensity and rounding contrasts which occur in SG but not WCB. There were no observed changes to the pattern of opening and closing diphthongs which differ markedly between the two varieties. The general conclusion is that WCB change is most likely to occur as a consequence of exaggerating phonetic variation that already happens to be in the direction of the standard.

[*] A version of this chapter is published in the *Journal of the International Phonetic Association* (Wolfswinkler & Harrington, 2021)

3.1 Introduction

The West Central Bavarian dialect has often been a subject of research due to its numerous monophthongs and diphthongs that frequently differ substantially from the standard language. Although there is an extensive amount of literature concerned with descriptions of the dialect, nearly all of it is based on impressionistic auditory accounts (e.g., Zehetner, 1985; Merkle, 1976; Capell, 1979; Mansell, 1973a; Keller, 1961). While in the last decades systematic acoustic analyses on the Austrian side of the Bavarian dialect have been increasingly elaborated (e.g., Moosmüller 2007, 2010; Moosmüller & Scheutz, 2013), the German side remains largely unexplored (although see Kleber 2011, 2017 for recent empirical analyses concerning the correlation of duration in vowel-consonant sequences in WCB). The present study aims at contributing to a phonetically based description of the WCB dialect by systematically analyzing some of the defining properties of the WCB vowel inventory. A second goal of this research is an examination of sound changes that may occur within the investigated vowel categories conditioned by the increasing influence of Standard German. The WCB features as distinguished to SG that formed part of the present study are outlined below.

3.1.1 Vocalic distinctions between WCB and SG

The German language area is not homogenous but characterized by national heterogeneity within the German state. It is known to comprise several dialects, whereat the West Central Bavarian dialect is – along with the other Bavarian subvarieties – one of the regional varieties most divergent from SG. The different historical developments between SG and WCB (see Section 1.3) make it impossible to predict WCB surface forms from SG underlying forms (Pascoe, 1981), as the dialect has preserved many Middle High German (MHG) derivations and distinctions the standard has lost.

a. Open vowels

As mentioned in Section 1.4.5 one salient feature of WCB which forms part of the present study is the existence of (at least) two open vowel phonemes, whereas the standard exhibits just one. In the dialect, MHG *a* regularly became a back vowel (Scheuringer, 2004). While SG /a/ is retracted and raised to /ɒ/ in WCB in native German and old loan words (Scheuringer, 2004; Stör, 1999a) (e.g., *Gabel* /gabəl/ 'fork' is pronounced as /gɒːbe/), the dialect reintroduced open, front /a/ in loanwords that were borrowed after the 16th century (Kleber, 2011; Kufner 1957; Scheuringer, 1990) (e.g., *Kabel* /kabəl/ 'wire' is realized as /kaːbe/). This split into two open vowel phonemes in the early modern ages is seen as phonemic change induced by the influence of the common language (Kufner, 1957).

Additionally, front /a/ occurs in the dialect for MHG *ä, æ* where SG today uses /e, ɛ/ (Scheuringer, 1990; Zehetner 1985 and 1989), e.g., Käse /kɛːzə/ 'cheese' and *drehen* /dreːhən/ 'to turn sth.' are produced as /kaːs/ and /draːn/. Yet, there is no agreement on how many open vowel qualities exist in the dialect. Scheuringer (1990) argues that WCB back /ɒ/ can be realized with variation in both height and degree of rounding. He claims this variation to be dependent on quantity, familiarity as well as affectivity of a given word. Schikowski (2009) on the other hand remarks that the open vowel seems to be more retracted and raised the longer it is. However, since the present study does not aim at resolving the question of the potential number of WCB open vowels, we rely on the consensus of at least two open vowel qualities that are also distinctive and, therefore, distinguish therefore only between front /a/ and back /ɒ/ in the dialect.

b. Quantity and quality

Another characteristic WCB property of interest is the complementary length of a vowel and its following consonant (e.g., Seiler, 2009). In Standard German there is a phonemic tense/lax vowel quality contrast as well as a fortis/lenis contrast for consonants. Both contrasts come along with an additional distinction in duration: lax vowels are shorter than tense vowels (e.g., Jessen, 1993) and lenis consonants are shorter than fortis consonants (e.g., Kohler 1977). Independent of these differences in duration (and quality), tense/lax vowels and fortis/lenis consonants are freely combined in SG (Kleber, 2017). In the dialect, on the contrary, long vowels are always followed by short consonants and short vowels by long consonants (e.g., V:C /bɛːsn/ (*Besen*) vs. VC: /mesːa/ (*Messer*)) (Kufner, 1957; Scheuringer, 1990; Pascoe 1981; Bannert, 1976). Therefore, vowel length is considered to be allophonic in the dialect (Kleber, 2011) and phonetic differences in short and long vowels are no longer distinctive features (Kufner, 1957 and 1961; Bannert, 1972). Promoted by this phonemic vowel length contrast which makes quality distinctions needless, WCB long and short vowels do not vary much in tongue position (Capell, 1979). Hence, there is no such qualitative tense/lax distinction in WCB vowels as it is in the standard (Zehetner, 2006)[12].

To summarise, one consequence of the WCB complementary length pattern that is considered in the present study is that SG words like *Wiese* 'lawn' and *Spinne* 'spider' have a quality as well as a quantity contrast in the vowel (/viːzə/ vs. /ʃpɪnə/), whereas they are distinguished merely by quantity in WCB (/viːsn/ vs. /spinː/) (Zehetner, 1985; Schikowski, 2009). Kleber (2017) found in her study about this inverse timing pattern in WCB that younger Bavarian speakers, as opposed to older Bavarians, loosened up the co-dependency of vowel and consonant length and started to produce differences in vowel length independently of the following consonant length. Along the lines of these findings, one question of the present study is whether the change in the quantity correlations might give rise to the emergence of quality distinctions as an additional acoustic cue.

[12] Neither so for consonants. In WCB, consonants are generally devoiced (Zehetner, 2006). Therefore, there is no so-called qualitative lenis/fortis distinction but this contrast, too, is a mere quantity contrast (Bannert, 1976).

The primary lack of tense/lax quality distinctions in the dialect accounts traditionally for quality differences between SG and WCB /i/. In the dialect, /i/ is described as more centralized as compared to the standard close vowel. This conditions /e/ to be more peripheral than /i/ in the WCB vowel system (Schikowski, 2009). Spectral representations of the Standard German vowel space suggest (e.g., Pätzold & Simpson, 1997) that lax /ɪ/ is more central and lower compared to its tense counterpart /i/ and thereby even closer to /e/ than to /i/. As the WCB /i/ quality is assumed to lie somewhat in between SG tense and lax /i, ɪ/, an introduction of a quality distinction of the kind as it exists in the standard might cause the necessity for /i/ to move in a more peripheral position to be acoustically sufficiently distinct from /e/ as well as from the newly emerged /ɪ/.

c. Rounding

A further difference in the front vowel space between the two varieties that will be addressed in the present study is the SG rounding opposition. Standard German exhibits an additional set of rounded vowels in the front vowel space. In the dialect though, the front rounded /y, ʏ, ø, œ/ were affected by a process of derounding (Wiesinger, 1990). Towards the end of the 13th-century WCB front rounded vowels were derounded and coalesced with unrounded front vowels of the same height (Kufner, 1957), that is, e.g., /ø/ became /e/ and /y/ became /i/ (Zehetner, 2006 and 1985; Merkle, 2005). This resulted in the correspondence of words like SG *Schlüssel* (/ʃlʏsəl/ 'key'), *Vögel* (/føːgəl/ 'birds') and *Löffel* (/lœfəl/ 'spoon') being realized as /ʃlisːl/, /feːgl/ and /lefːe/ in WCB (cf. Fig. 3). The presence of rounding has been shown to be acoustically straightforward resulting in progressively rising F2 from back rounded to back unrounded, further to front rounded and finally to front unrounded (Lisker, 1989). Putting it the other way round, rounding has a lowering effect on formant frequencies since lip rounding lengthens the vocal tract (Raphael et al., 1979). However, this seems to be primarily the case for F2 and F3, while for F1 repeatedly no or only small differences could be found (e.g., Pols, Tromp, & Plomp, 1973 and Raphael et al., 1979 for Dutch vowels; Hoole, 1999 for German vowels). This points to the conclusion that lip rounding might not be the only articulatory difference between unrounded vowels and their rounded counterparts. Raphael et al. (1979) detected in their articulatory study of Dutch vowels via electromyography that the rounded variants were also produced with a lowered tongue position. This is in line with findings for Standard German vowels that have shown that the tongue position of rounded front vowels is centralized and lowered relative to their unrounded counterparts (e.g., Hoole, 1999; Harrington et al., 2011).

However, despite the complexity in the articulatory base that account for the differences in formant frequencies between rounded and unrounded vowels, at least the second formant has been shown to effectively differentiate unrounded vowels from their rounded counterparts. On these grounds, the present study is looking at F2 values of unrounded WCB vowels in words where the vowel in the corresponding SG word is rounded. If the Bavarian derounded variants give way to the influence of Standard German, then there might be a drop of F2 values in the WCB unrounded phonemes. However, the correlation between WCB unrounded and SG rounded variants is – as usual - not one-to-one. For instance, SG *könnte* (/kœntə/ 'could') is realized as /kant/ in WCB and SG *Füsse* (/fysə/ 'feet') as /fɪas/.

d. Diphthongs

The *Füsse* example above also displays a further salient distinction between the dialect and the standard: diphthongs. While SG has three falling diphthongs /aʊ/, /aɪ/, /ɔʏ/ (Wiese, 1996), the type and number of diphthongs fluctuate in WCB and vary from region to region (Bannert, 1976). Bannert (1976, p. 17-18) states that all Bavarian dialects have at least the opening diphthongs /ia, ua, ɔa/ and the closing diphthongs /aɛ, aɔ/ in common, in which all start and end in the respective monophthongal vowel qualities. There are several kinds of mismatches between SG and WCB in the diphthongal domain. Three of them are examined in the present investigation. First, instances where there is a monophthong in the standard but a diphthong in WCB. In general, SG tense /iː, yː, uː/ are realized as diphthongs in the dialect (Wiesinger, 1990; Kufner, 1957), e.g., SG *Fliege* (/fliːgə/ 'fly'), *Füsse* (/fyːsə/ 'feet') and *Schuh* (/ʃuː/ 'shoe') are /flɪaŋ/, /fɪas/ and /ʃʊa/ in WCB. The origin of this discrepancy between the two varieties lies again in the MHG derivation: the MHG diphthongs *ie, üe* and *uo* became (long) monophthongs in SG but were preserved as diphthongs in WCB (Mansell, 1973; Zehetner, 1985 and 1989). However, it needs to be mentioned that this process is again not unambiguous and it also happens that SG tense vowels remain long vowels in the dialect (e.g., SG *Wiese* /viːzə/ 'lawn' is /viːsn/ in WCB) or that SG lax vowels become diphthongs (e.g., SG *Licht* /lɪçt/ 'light' or *Futter* /fʊtɐ/ 'food' is /lɪaxt/ and /fʊada/ in WCB).

Second, we are looking at circumstances where one diphthong in SG maps to two different diphthongs in WCB. The investigated mismatches can all be traced back to the diphthong /aɪ/. While the dialect has preserved the MHG distinction between the so-called 'old and young ei' (Zehetner, 1985), SG did not maintain any differentiation. The consequence is that words with /aɪ/ in SG map to either /ai/ or /oa/ in WCB (e.g., SG *Stein* (/ʃtaɪn/ 'stone') is /ʃtoa/ in WCB whereas the diphthong in *drei* (/draɪ/ 'three') is equal in both varieties (Scheuringer, 1990; Zehetner, 1989)).

As a third, we are taking SG /ɔʏ/ into account, which maps with regularity to WCB /ai/ (e.g., *Feuer* 'fire' is realized with /ɔʏ/ in SG and /ai/ in WCB).

3.1.2 Sound change

There is general evidence that Standard German is superimposed on German dialects, causing sound change in the respective dialects (e.g., Müller et al., 2011 and Harrington, Kleber, & Reubold, 2012 for East-Franconian; Bukmaier et al., 2014 for Augsburg German). Within the WCB dialect, too, such an SG contact-induced sound change has been observed. Kleber (2017) reported a change in perception as well as production of the typical WCB dialect feature of complementary length in vowel plus consonant sequences (see Sections 1.4.1 and 3.1.1 b. above). She argued that dialect levelling accounts best for the observed changes of this kind. Dialect levelling is defined as a diachronic process during which regional varieties become more similar to either the standard (Trudgill, 1986; Kerswill, 2003) or a close variety (Hinskens, 1998) due to external factors like changing community structures as well as increased speaker mobility and language contact (Britain, 2010; Milroy, 2002). However, such speech accommodation processes in the sense of dialect levelling may not only be conditioned by external factors but can also be influenced by social-psychological factors like the prestige of a dialect (Kerswill, 2003). Nettle (1999) has argued that language change only occurs when the social conditions are suitable. The notion of prestige in the sociolinguistic field is often linked to the idea that linguistic change is led by individuals of higher status within a community (Labov, 2001). In this connection a distinction was proposed between changes 'from above' and changes 'from below' (e.g., Labov, 1966; 1994). A change 'from above' indicates a change affecting a particular linguistic variable above the level of a speaker's awareness. That is, speakers are consciously aware of and can comment upon an ongoing change. A change 'from below' on the contrary refers to a sound change below the level of a speaker's conscious awareness. However, the extent to which awareness of a social-indexical value of phonetic variation explicitly or implicitly may or may not shape the process of sound change remains a problematic matter (Foulkes & Docherty, 2006).

The suppression of local varieties by standard national varieties is no unique German phenomenon but has been reported for many other language contexts (e.g., Nylvek, 1992 and Boberg, 2004 for Canadian English or Kerswill, 2002 for British English). Regional isolation from supra-regional varieties has been considerably undermined as a result of a rise in travel, internal migration, electronic communication and general social and technological changes. Nevertheless, the sense of local identity and the people's wish to identify with local or regional rather than national sociocultural groups may be a powerful force for preserving old regional distinctions (Boberg, 2004).

Regarding the dialect situation in Bavaria, dialect usage in the southern parts of Germany is generally very common and in rural areas more prevalent than in the cities. Even if SG is referred to as the language of the townspeople and the school (König, 1994), speaking the local dialect in Bavaria is not stigmatised. It is also not the case that the dialect would be the register of the lower class as often assumed. In Bavaria, dialect colouring can be found in the speech of people from all walks of life (Zehetner, 1989). Indeed, studies have found that Bavarian speakers produce local varieties with the greatest degree of proficiency than anywhere else in Germany (e.g., Allensbacher Berichte, 1998, 2008). The same studies often report that Bavarian is one of the best-liked dialects in Germany and even the most 'sexy-sounding' (Rowley, 2011).

These influences of external (e.g., speaker mobility), extra-linguistic (prestige, identity and attitude) and not to forget internal (phonetically motivated) factors make it particularly hard to predict the linguistic variables where a sound change is most likely to arise.

3.1.3 Hypotheses

While in this thesis the hypothesized direction of sound change follows the principle of dialect levelling described above, the present study addresses the actuation question by focusing on six different analyses which were chosen according to three criteria. The first criterion is linked to WCB shifts towards SG that should be changes within a phonological category that are not perceptually overt and not commented upon, i.e., as mentioned above, changes 'from below' the level of consciousness in the sense often intended in social studies of speech (Labov, 1994; 2007; Wardhaugh & Fuller, 2015): this applies in particular to the predictions in H2 – H5 below. Secondly, others should be perceptually more salient, i.e. overt markers of WCB: this is so for prediction H1 and especially H6[13]. Thirdly, some WCB shifts towards SG should be along a trajectory of phonological reorganization: this is so for all analyses except H5.

The six analyses and associated predictions based on the idea that WCB is shifting due to the influence of SG were as follows:

(H1) WCB /ɒ/ (GABEL) which is a perceptible marker of WCB should begin to shift towards WCB /a/ (KABEL) since in SG the GABEL / KABEL sets are not contrastive and both map to /a/ (cf. Fig. 3).

(H2) There should be evidence of a collapse of the WCB contrast between VːC and VCː (see 3.1.1 (b.)) given that there is no such contrast in SG (see also Kleber, 2017 for some evidence that younger WCB adults are beginning to neutralize this distinction for short/long vowels preceding long/short oral stops).

(H3) If WCB is being influenced by SG, then there should be evidence of the emergence of a tense/lax contrast such that non-low, tense/lax vowel pairs are distinguished by quality, given that such an opposition exists in SG but not in WCB.

(H4) WCB should begin to show evidence of the development of a rounding contrast in front vowels, given that a ±round opposition exists in non-low front vowels in SG but not in WCB.

[13] Opening diphthongs are perceptually salient as shown by numerous printed signs e.g., https://www.merkur.de/bayern/griass-di-affaere-oesterreich-allgaeu-2452017.html with *Griaß di* (English: 'greetings to you'; the first word in SG is *Grüße*, /grysə/). The /oa/ diphthong is also salient, as shown e.g., by G. Holzheimer's translation into Bavarian of Saint-Exupéry's 'The Little Prince' as *Da kloa Prinz* (SG: *der kleine Prinz*); or equally the Bavarian band *Hoaß* https://www.hoass.de with their slogan: *mia san hoaß* (English: 'we are hot', SG: *wir sind heiß*, /haɪs/).

(H5) In 1.4.4, it was suggested that WCB /i/ is more centralized than its SG counterpart and may be less peripheral than WCB /e/. If there is an influence of SG on WCB, then WCB /i/ should front (and/or raise) relative to WCB /e/, given that in SG /i/ is typically fronted and raised relative to SG /e/.

(H6) WCB opening diphthongs /ia, ua/ exemplified by FLIEGE, FÜSSE in Fig. 3 might shift in the direction of the corresponding SG monophthongs. In addition, WCB /oa, ai/ exemplified by STEIN, DREI might show evidence of a merger, given that they both map to SG /aɪ/. There might also be a split of WCB DREI, FEUER given that both of these are /ai/ in WCB but /aɪ, ɔʏ/ in SG.

3.2 Method

3.2.1 Participants

To test the hypotheses H1 – H6, acoustic recordings from the 21 adult speakers as well as the 20 child speakers at the first year of primary school (and recordings), the 18 children from the second year and the 16 children from the third year from the corpus described in Chapter II were analyzed.

3.2.2 Materials

From the total of 58 different target words (see Section 2.3) a number of productions were completely excluded from further consideration in the present study. There were four reasons for doing so.

1. Some word types were completely excluded from further analysis because the children had so often produced a completely different word than the intended target item. This was so for *Heu*, 'hay' (produced as *Stroh*, 'straw') and *Licht*, 'light' (produced as *Lampe*, 'lamp').

2. *Kirche*, *Schnur*, and *Uhr* were also completely excluded since these are opening diphthongs that are derived diachronically or synchronically from a post-vocalic /r/ and are not the subject of the present investigation.

3. Some word types were completely excluded because they were so often produced in SG rather than WCB. These were *Besen, beten Ei*, *Futter*, *Hütte*, *Müll*, *Reh*, *Säge, Schnee, Schlüssel, Schüler*.

4. All other word types were retained but occasionally some tokens were removed because they were produced in SG and not in WCB.

The exclusion of words in (3, 4) was based on auditory criteria. In almost all cases, SG instead of WCB productions were very clearly perceptible either in the target vowel (e.g., the production of SG /aɪ/ instead of WCB /oa/ for *Ei*, 'egg') or in other consonants and vowels of the target word (e.g., SG /kabl/ vs. WCB /kabe/ for *Kabel*, 'wire'). The proportion of adult productions removed as a consequence of (3, 4) together was 14.1%; for children, the proportion of words removed due to (3, 4) together was 39.9%, 38.5%, 38.0% for years 1-3 respectively.

The final count of the number of word repetitions retained for analysis is shown in Appendix B.

3.2.3 Data preparation and analysis

As outlined in Section 2.2.3 the target words were automatically segmented with MAUS (Kisler et al., 2017), Formants were calculated with Praat (Boersma & Weenink, 2016) and subsequently smoothed, time- and speaker normalised. For the analyses the first three DCT coefficients (Harrington & Schiel, 2017), k_0, k_1, k_2 were calculated, representing the mean, linear slope, and curvature of a trajectory.

Inter-Euclidean distances were calculated in a three or six-dimensional space of DCT coefficients following equation (2) (Section 2.2.3).

This was used in e.g., 3.4 in order to calculate the distance of a speaker's F2 trajectory in the vowel of *Messer* ('knife') to the mean F2 trajectory to the same speaker's *lesen* ('to read') and *vice versa*. (7) which is the one-dimensional form of (2) was used in 3.6:

$$d(x_i) = x_i - c \qquad (7)$$

In 3.6, x_i was the DCT coefficient k_0 calculated for the F2 trajectory of any /e/ vowel and c was the mean of all the k_0 values calculated across the same speaker's /i/. Since k_0 is proportional to the trajectory mean, (7) was used to measure the distance between the F2 trajectory mean for any given /e/ vowel and the trajectory mean averaged across /i/ vowels produced by the same speaker.

Statistical tests were carried out with a linear mixed effect regression model of the form as given in (3) (for the analyses in 3.2., 3.3 and 3.5) and (4) (for the analysis in 3.4) in Section 2.2.3. The reported results were gained from post-hoc t-tests using emmeans (Lenth, 2019).

3.3 Results

We begin with some general comments about the WCB monophthong and diphthong space (3.3.1). We then assess whether WCB is being influenced by SG with respect to the six issues discussed in 3.1.3 and presented in 3.3.2 – 3.3.7 below. The main indicator of change will be evidence of whether the children's vowels were shifted towards SG compared with those of adults. Another indicator is whether such adult-child differences were more marked for children in their second year and even more in their third year of recording (henceforth year 2 and year 3) compared with the same children in their first year of recording (year 1). In general, speech tempo is unlikely to be a confounding influence, since word and vowel durations (for the data points shown in Fig. 8 below) are quite comparable. These were 488/499/502/490 ms (word duration) and 157/158/160/160 ms (vowel duration) for adults/year 1 children/year 2 children/year 3 children.

3.3.1 General overview

The plot of monophthongs extracted at the temporal midpoint in the F1 × F2 space in Fig. 8 (and their aggregates in Fig. 9) shows clear evidence of three front vowels /i, e, ɛ/, three back vowels /u, o, ɒ/ and an open vowel /a/. Consistently with some observations, /e/ is indeed more peripheral than /i/ at least based on F2. Based on the acoustic evidence and auditory impressions, /ɒ/ is slightly more open than [ɔ]. /o/ is the most peripheral back vowel. /u/ is more central than cardinal vowel (CV) 8 and possibly closer to [ʊ].

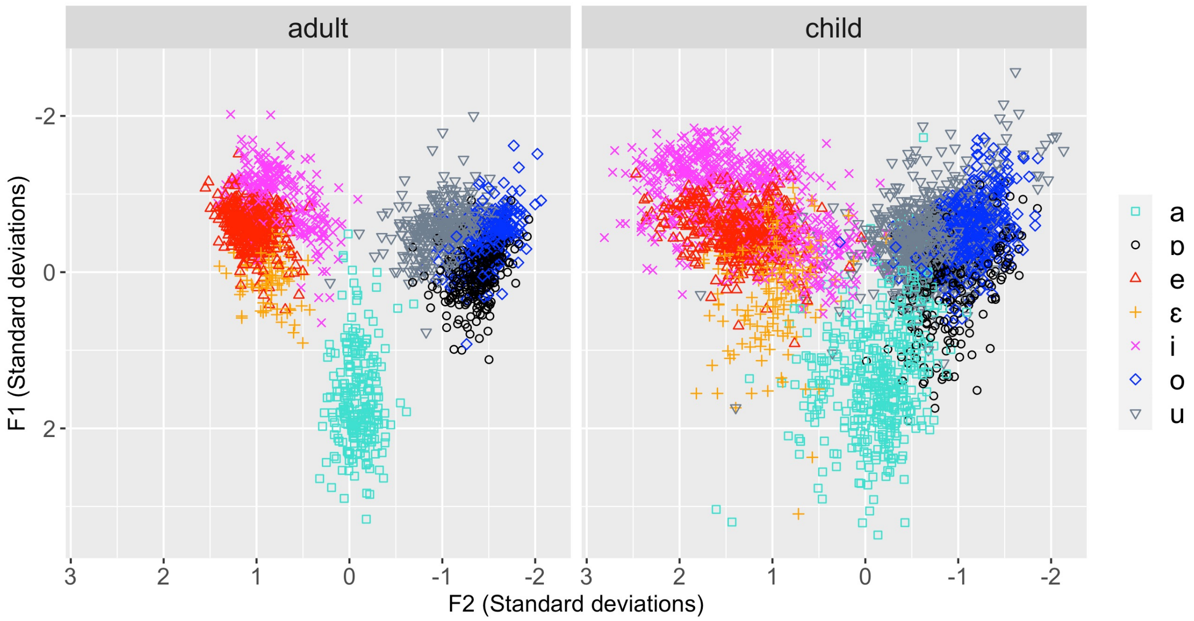


Fig. 8. The first two formants extracted at the temporal midpoint in monophthongs for adults and children.

There are unequivocally three level/closing diphthongs and three opening diphthongs (N.B.: /ea, au/ were not analyzed and hence not included in Fig. 9). The main divergence in quality for the diphthongs from the symbols used for the broad phonemic transcription are as follows: the second component of /ai/ is mid front, thus [aɛ]; the second component of /ui, oi/ is central of CV1 (and the first component of /ui/ is central of CV8), thus [ʊɪ, oɪ] respectively; the second components of the falling diphthongs of /ia, ua/ are phonetically mid central (and their first components central of CV1, CV8 respectively), thus [ɪə, ʊə].

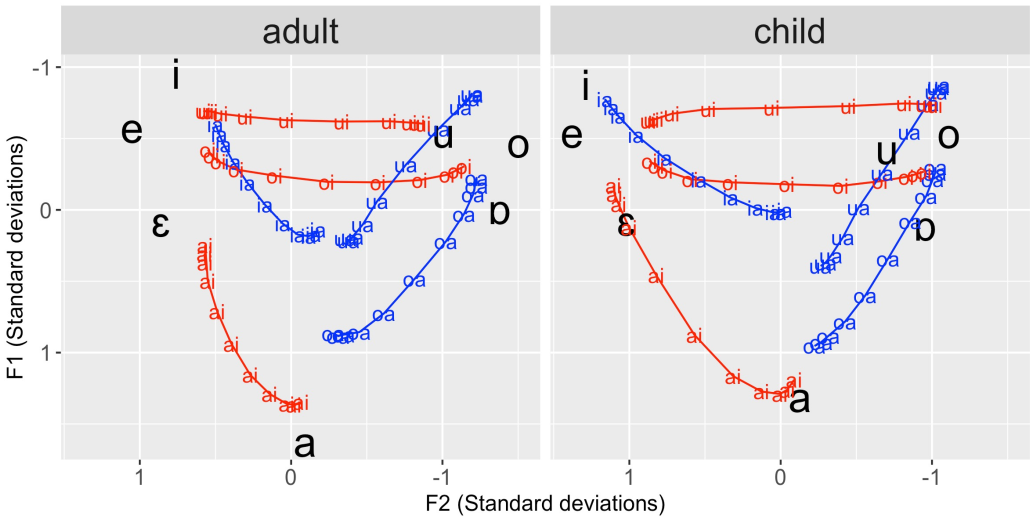


Fig. 9. Aggregated level/closing (red) and opening (blue) diphthong trajectories in the F1 × F2 plane superimposed on the mean positions (black) of the monophthongs in adults and children.

There are generally quite close correspondences in Figs. 8 and 9 between the adults and children, but also some visible differences. Two of these are analysed further in 3.3.2 and 3.3.6: these are that /ɒ/ is further from /o/ for children and that the difference along the F2 axis between /e/ and /i/ is greater for adults. In addition, Figs. 8 and 9 suggest for adults compared with children (i) a smaller separation between /e, ɛ/ (ii) a smaller distance of /u, ɒ/ as well as the first components of /ui, oa/ from /o/ and (iii) a more open /a/ (/a/ is further from the first component of /ai/ and from the second component of /oa/ in adults).

3.3.2 Open vowels

The difference between the positions of /ɒ/ and /a/ in the respective groups was assessed by calculating the inter-Euclidean distances in a six-dimensional F1× F2-DCT space between all /a/-vowels to the combined centroid of /ɒ/-vowels and *vice versa* separately by speaker following equation (2) (Section 2.2.3). The calculation was based on all /a, ɒ/ words shown in black in Appendix B. These included three /a/ words (*Kabel*, *Käse*, *Klasse*) and four /ɒ/ words (*Gabel*, *Glas*, *Hase*, *Sack*). The results (Fig. 10) show greater inter-Euclidean distances for adults than for year 1, year 2 and year 3 children. This finding is consistent with the evidence in Fig. 8 which shows that /ɒ/ is closer to /a/ in children than in adults.

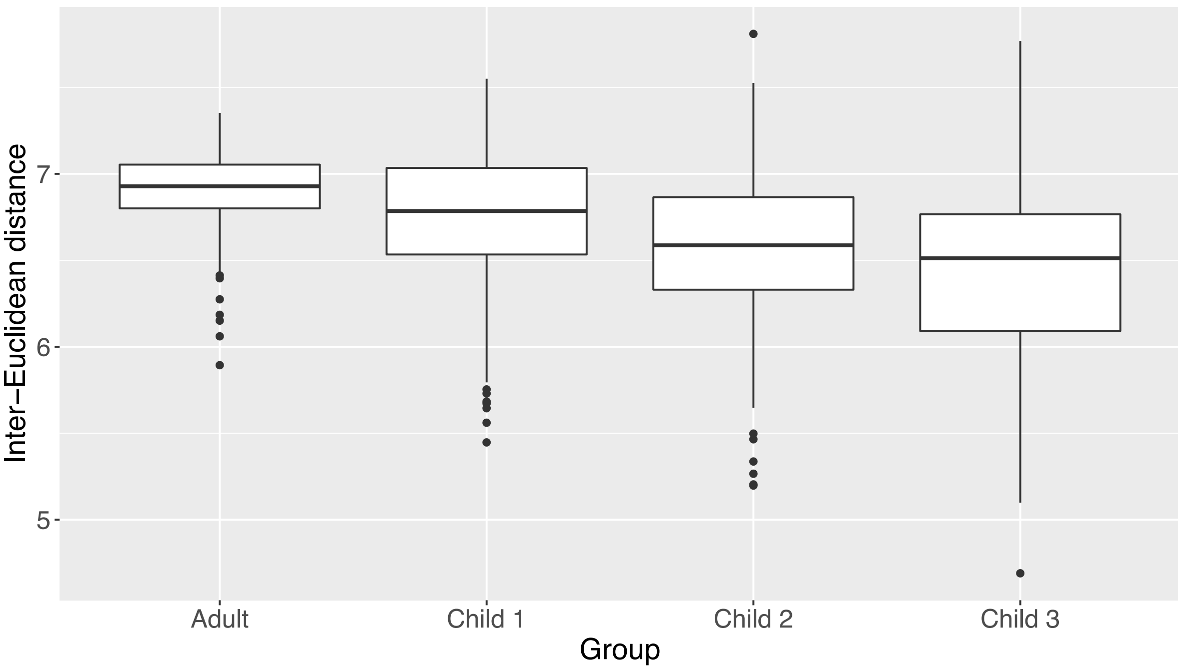


Fig. 10. Log. inter-Euclidean distance calculated in a 6-dimensional F1xF2 DCT-space between /ɒ/ and /a/ for adults and three groups of children recorded in their first (Child 1), second (Child 2) and third (Child 3) year of school attendance.

The results of the mixed model as in equation (3) (Section 2.2.3) with the Euclidean distances as the dependent variable showed a significantly higher inter-Euclidean distance (i.e., /ɒ/ positioned further from /a/) for adults compared with year 2 ($t_{40.1}$ = 3.2, $p < 0.05$) and year 3 ($t_{40.9}$ = 4.0, $p < 0.01$) children, as well as significant differences between year 1and year 2 children ($t_{1097.2} = 4.7$, $p < 0.001$), year 2 and year 3 children ($t_{1091.5} = 3.1$, $p < 0.05$) and year 1 and year 3 children ($t_{1103.5} = 7.3$, $p < 0.001$) in the same direction.

Even if the difference between adults and children from year 1 was not significant, the results combined with the evidence in Fig. 10 suggest a trend of a decreasing difference between /ɒ/ and /a/ from adults to year 1 to year 2 to year 3 children. Nevertheless, this result (as with all of those in this study) may well not be representative of the population of WCB children, given the small number of children that produced these words in year 2 (between 8 and 9) and in year 3 (between 5 and 7).

3.3.3 Long/short vowels

The purpose was to determine whether there was any evidence for a long vs. short vowel distinction that is phonetically conditioned by a following short vs. long consonant, and to assess whether any such relationship is differently manifested in adults than in children. We began by examining vowels for which there were short vs. long pairs of the same quality before /s/. There were four such words in the database. These included *Käse* and *lesen* that have a long vowel followed by a short voiceless consonant, thus [kʰ**aːs**], [l**eːs**n̩] and *Klasse* and *Messer* for which the vowel is short and the consonant long and voiceless thus [kl**as**ː], [m**es**ːɐ]. As shown in Fig. 11, older speakers showed a clear separation between Vː C and VCː based on quantity. In VːC, the vowel was long and /s/ short and *vice versa* for VCː. Fig. 11 shows that vowel duration separated VːC and VCː in children. Fig. 11 also shows that the overlap between VːC and VCː on consonant duration was, by contrast, greater for children than for adults.

Based on the results from Fig. 11, we tested whether there was a reduction in post-vocalic consonant duration in children when the preceding vowel is short. There were 11 available words in our database with phonetically short vowels.

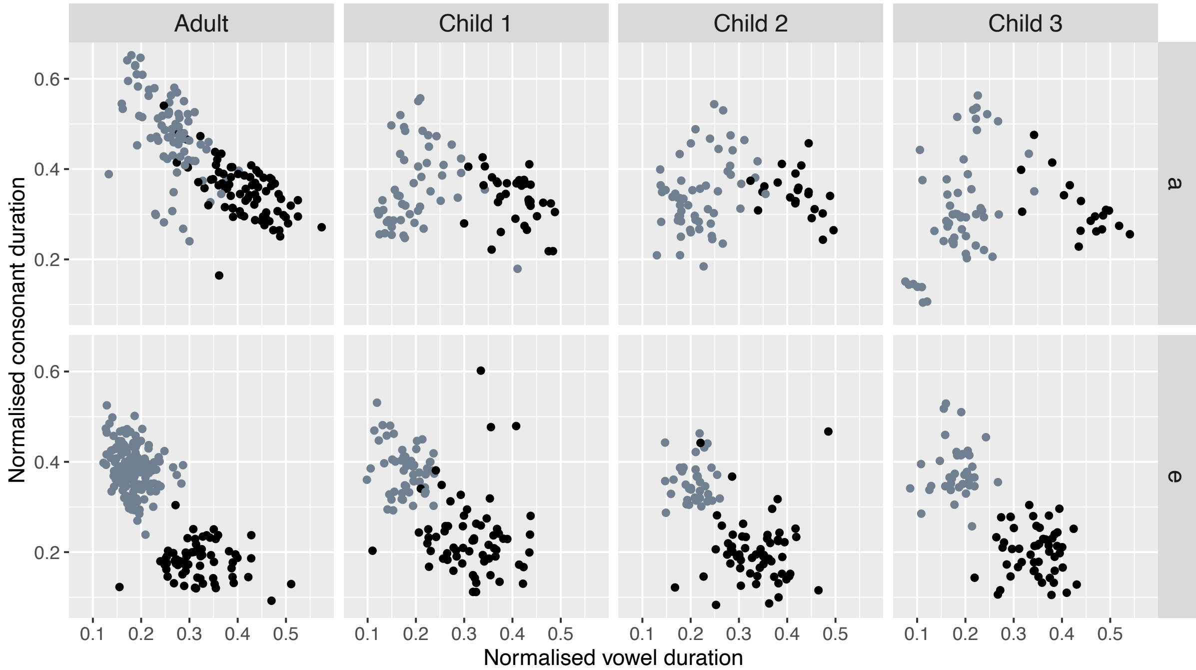


Fig. 11. Durations of the vowels /e/ and /a/ and the fricative /s/ as a proportion of word duration in phonetically short (grey) and long (black) vowels in two /a/ words (top) and two /e/ words (below) for adults, year 1, year 2 and year 3 children.

These were *beten*, *Butter*, *Hütte*, *Klasse*, *Löffel*, *Messer*, *Rutsche*, *Schlüssel*, *Schnecke*, *Spinne*, *Suppe*. However, we excluded from further consideration *beten*, *Hütte*, and *Schlüssel* because they were produced too infrequently (as explained in 3.2.2 and shown in Appendix B).

For the remainder, we measured the post-vocalic consonant duration from the acoustic onset to the acoustic offset of aperiodicity following the vowel in plosives and fricatives and between the acoustic onset and offset of /n/ in *Spinne*. Fig. 12 suggests a trend in which the post-vocalic consonant duration decreased from adults to children recorded in the first and then in their second year. In their third year, the duration seems to be at about the same level as for year 2.

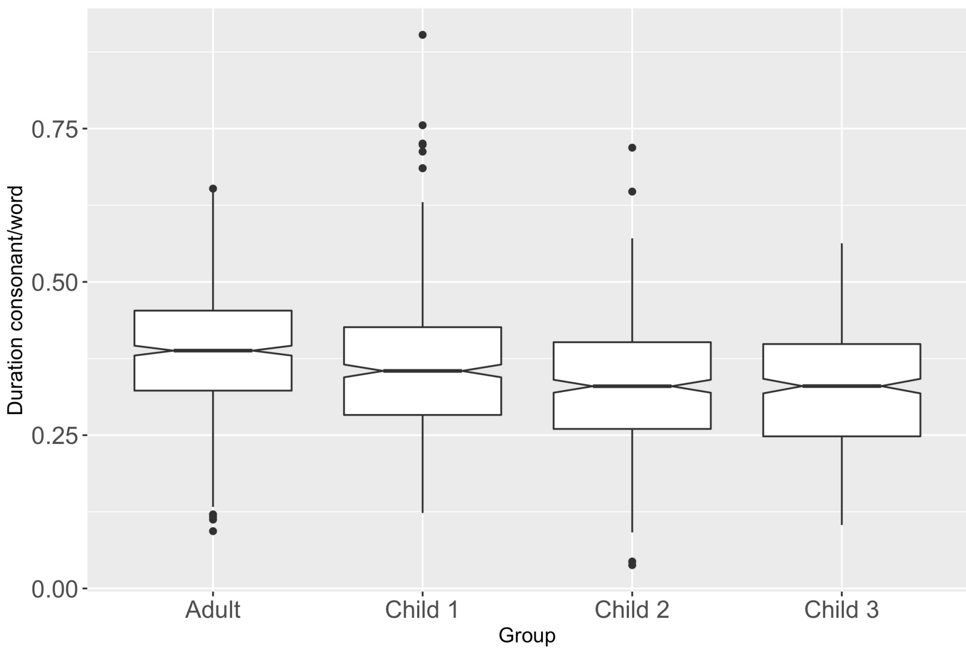


Fig. 12. Durations of the coda consonant normalised for word duration in several words that all have a preceding phonetically short vowel for adults and the children recorded in the first, second and third years.

The results of applying a linear mixed model as in equation (3) with the ratio of the consonant to word duration as the dependent variable showed no significant differences between adults and children in their first year, a significant difference between adults and children recorded in their second ($t_{12.3} = 3.1$, $p < 0.05$) and in their third year ($t_{12.4} = 3.4$, $p < 0.05$), and a significant difference between children recorded in their first and second year ($t_{1941.2} = 6.2$, $p < 0.001$) as well as between children recorded in their first and third year ($t_{1945.0} = 7.0$, $p < 0.001$). Consistently with Fig. 12, the difference between the children in their second and third year was not significant. However, these results, together with the evidence in Fig. 12, suggest a trend in WCB in which there was a decrease in the duration of the post-vocalic consonant after short vowels at least from adults to year 1 to year 2 children, while year 3 children range at a similar (low) level as for year 2.

3.3.4 Tensity

The focus in this section is on whether children are beginning to show evidence of an SG tense/lax contrast that does not exist in WCB. For this purpose, we compared words that have the same quality in WCB but which are tense and lax in SG. These included *Dieb*, *Wiese*, *Spinne, Tisch* which are all /i/ in WCB but which are tense /i/ (*Dieb*, *Wiese*) vs. lax /ɪ/ (*Spinne, Tisch*) in SG. They also included *lesen*, *Messer* and *Bett* which are all /e/ in WCB but tense /e/ (*lesen*) and lax /ɛ/ (*Messer, Bett*) in SG. Finally, *Rose*, *Hose*, *Rock, Stock* were also included which are all /o/ in WCB but tense /o/ (*Rose, Hose*) and lax (*Rock, Stock*) /ɔ/ in SG. No other sets of words in the database with sufficient numbers of speakers/repetitions that fulfilled these criteria (of the same quality in WCB but tense/lax in SG) were available.

In Standard German, F2 is typically higher in tense /i/ (*Dieb*, *Wiese*) than in lax /ɪ/ (*Spinne, Tisch*) and higher in tense /e/ (*lesen*) vs. lax /ɛ/ (*Messer, Bett*) while F1 is typically higher in tense /o/ (*Rose, Hose*) than in lax /ɔ/ (*Rock, Stock*). Such formant differences should be observable in WCB children, if children are being influenced by SG. There is some evidence from Fig. 13 that the F2 separation between such tense/lax pairs is greater for children than for adults in the front vowels /i, e/ but not for F1 in *Rose/Hose vs. Rock/Stock*. There seems to be no evidence of any longitudinal trend, i.e., the degree of separation between SG tense/lax pairs was about the same for data from the 1st, 2nd and 3rd year of child recordings.

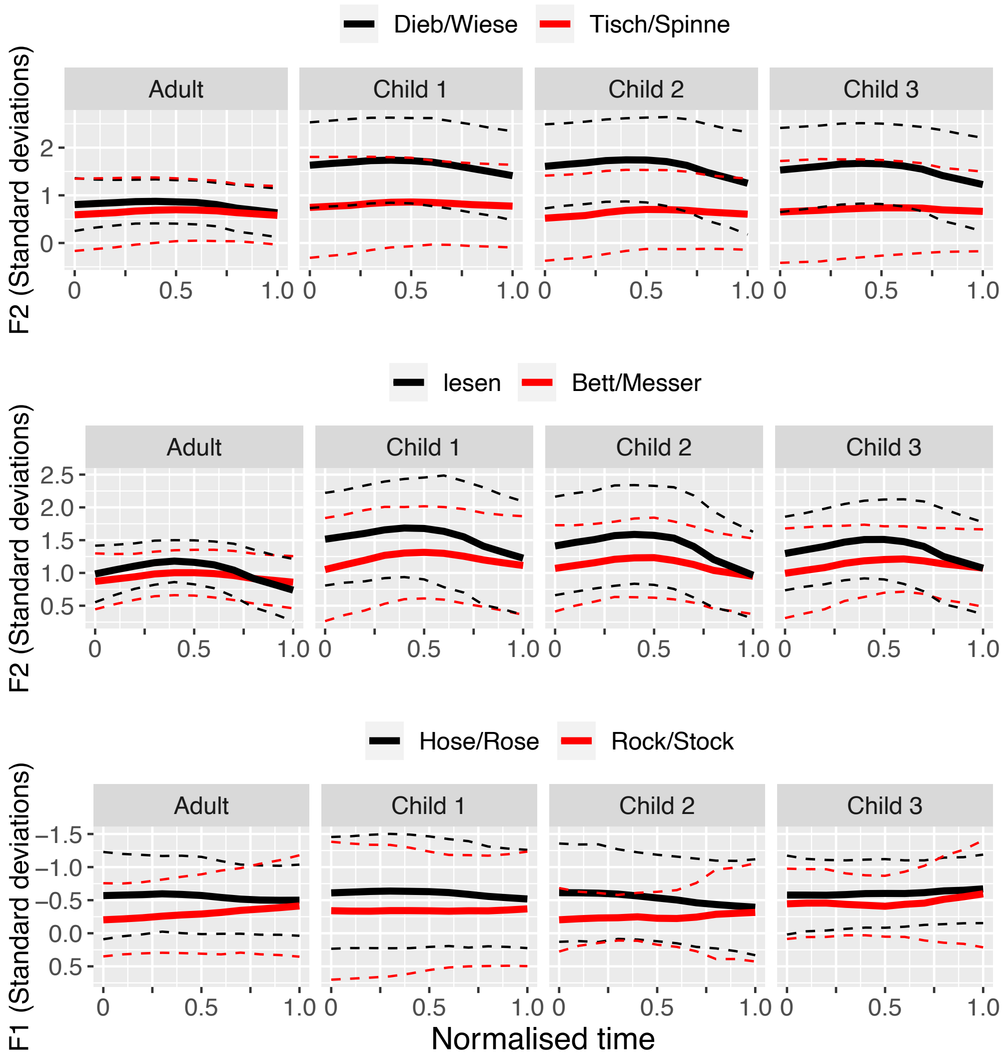


Fig. 13. F2 trajectories for /i/ (top) and /e/ (middle) and F1 trajectories for /o/ (bottom) aggregated by word and speaker group (adults; year 1, year 2 and year 3 children). Black/red correspond to tense/lax in Standard German. Solid/dashed lines: trajectories of the mean and at 1.96 standard deviations from the mean respectively.

In order to quantify these observations further, the inter-Euclidean distances between vowels corresponding to SG tense/lax pairs were calculated separately for /i, e, o/ and separately by speaker from equation (2) (Section 2.2.3). For /i/, (2) was applied twice: firstly, the Euclidean distances in a three-dimensional F2-DCT were calculated of all *Spinne/Tisch* vowels to the (combined) vowel centroid of *Dieb*/*Wiese*; and secondly in the other direction of all *Dieb*/*Wiese* vowels to the centroid of *Spinne/Tisch*. Exactly the same procedure was applied to /e/ (*lesen* vs.

Messer/Bett) and to /o/ (*Rose/Hose* vs. *Rock/Stock*) with the exception that the calculation was made in an F1-DCT space for /o/. Fig. 14 shows that these inter-Euclidean distances were greater for children than for adults, although only marginally so for /o/.

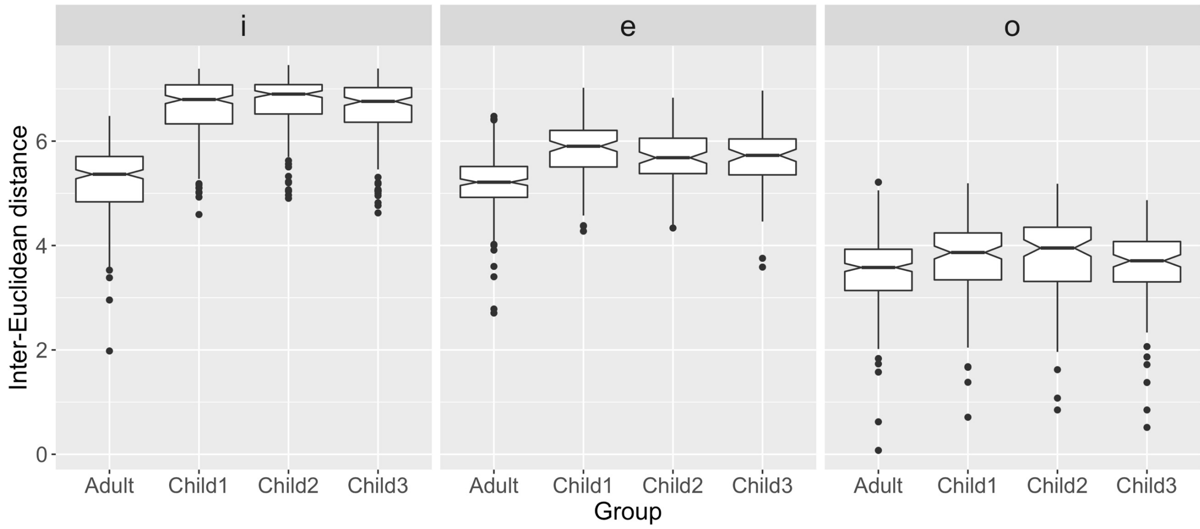


Fig. 14. Log. inter-Euclidean distance between vowels that are tense and lax in Standard German for adult speakers and three groups of children recorded in their first (Child 1), second (Child 2) and third (Child 3) years shown separately for /i, e, o/ vowels.

The results of applying a mixed model as in equation (4) (Section 2.2.3) showed significantly greater inter-Euclidean distances between adults and children in /i/ ($t_{17.7} = 9.1$, $p < 0.001$) and in /e/ ($t_{21.3} = 3.6$, $p < 0.01$) but not in /o/. Furthermore, there were no increases in the inter-Euclidean distance between children in their first, second and third year. There is therefore no evidence of a trend for vowels corresponding to tense/lax differences in SG to become more distant from each other longitudinally.

3.3.5 Rounding

The test for the development of rounding was applied to /e/ in *Bett*, *lesen*, *Messer* that are unrounded /ɛ, e, ɛ/ respectively in the standard (the −R group) as well as to /e/ in *Löffel*, *Vögel* that are rounded /œ, ø/ respectively in the standard (the +R group). There were insufficient numbers of words like *Hütte* and *Schlüssel* (WCB /i/; standard: /ʏ/) for a comparable analysis to be carried out for high vowels.

Lip-rounding lengthens the vocal tract and causes a lowering of formant frequencies and especially F2 in the case of (mid) front vowels (Lindblom & Sundberg, 1971; see also Fig. 2 in Vaissière, 2009). Fig. 15 shows that there were only minor F2 differences between the ±R groups for adults. But in children, F2 of −R vowels was higher than for +R vowels.

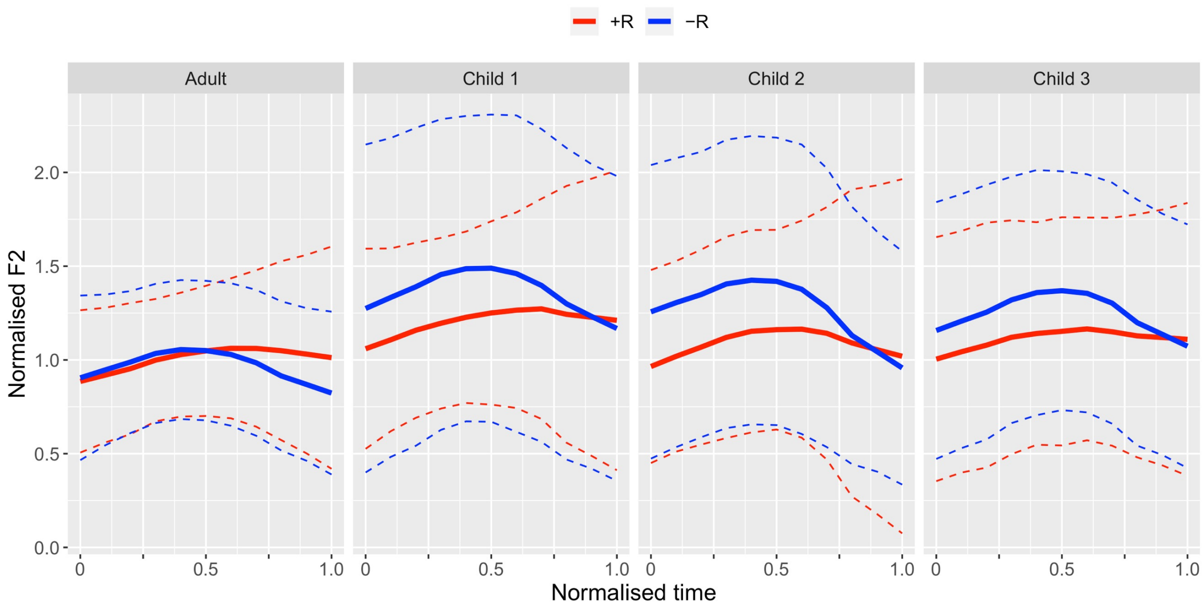


Fig. 15. Time-normalised F2 trajectories of WCB /e/ aggregated by whether they are unrounded (−R) or rounded (+R) in the standard and separately for adults, year 1, year 2 and year 3 children. Solid/dashed lines: trajectories of the mean and at 1.96 standard deviations from the mean respectively.

We further quantified these differences by calculating the inter-Euclidean distances from −R vowels to the +R centroid and from +R vowels to the −R centroid in an F2-DCT space using (2) and as always separately by speaker. The results of these calculations in Fig. 16 show a greater inter-Euclidean distance between ±R groups for children compared to adults.

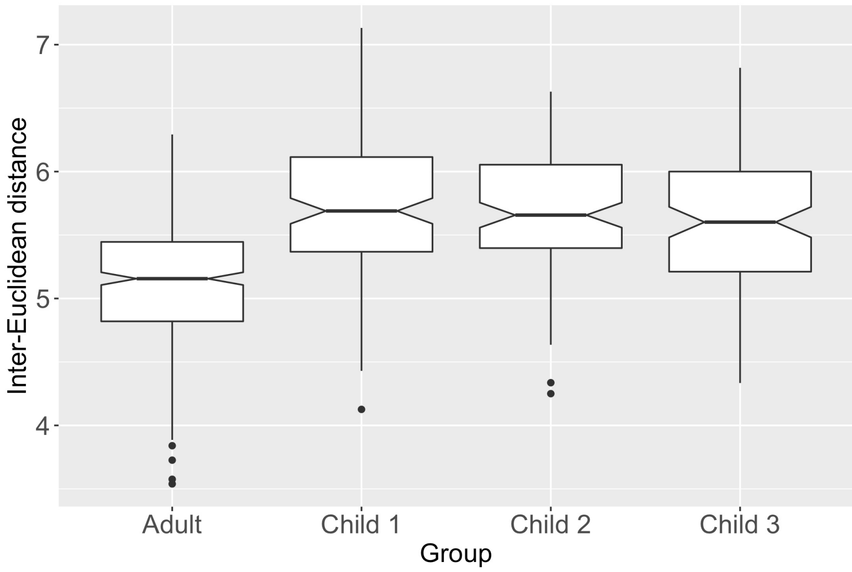


Fig. 16. Inter-Euclidean distance between WCB /e/ vowels that are rounded and unrounded in Standard German for adult speakers and three groups of children recorded in their first (Child 1), second (Child 2) and third (Child 3) years.

The results of applying a mixed model as in equation (3) showed significantly greater inter-Euclidean distances between adults and children ($t_{24.8} = 6.4$, $p < 0.001$) and, compatibly with Figs. 15 and 16, no differences between children in their first, their second and their third year of recordings.

3.3.6 Relative positions of /i, e/

The test was whether /e/ is fronted relative to /i/ in adults and whether this relationship is being reversed in children. The words available for this investigation were those in the /e, i/ sets in Appendix B. However, in order to avoid possible confounds, we removed from further consideration those words that we had found to be influenced due to tensity (3.3.3) and rounding (3.3.4) differences in the standard. The only remaining words were /e/ in *lesen* and /i/ in *Dieb*, *Wiese*.

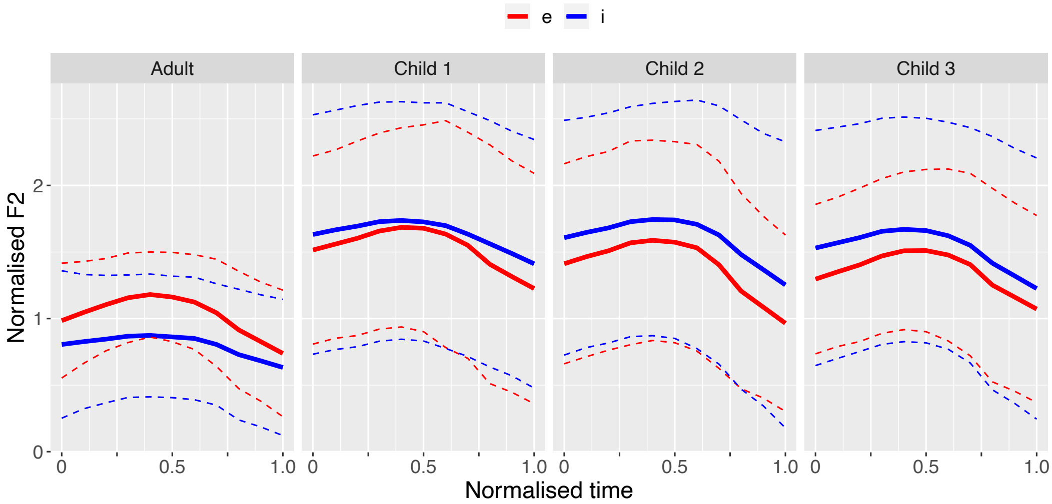


Fig. 17. Time-normalised F2 trajectories of /e, i/ vowels aggregated separately for adults, year 1, year 2 and year 3 children. Solid/dashed lines: trajectories of the mean and at 1.96 standard deviations from the mean respectively.

The F2 trajectories in Fig. 17 show that F2 of /e/ is lower in adults than in children. They also suggest a trend in which there is a progressive increase in F2 of /i/ relative to F2 of /e/ from adults to children in their first and then in their second and third year. The trend is, however, less apparent in the F2 difference between /i/ and /e/ in Fig. 18 calculated with equation (7) (Section 3.2.3). Quite the contrary, there even seems to be a trend of decreasing F2 differences from year 1 to year 2 to year 3 within the children.

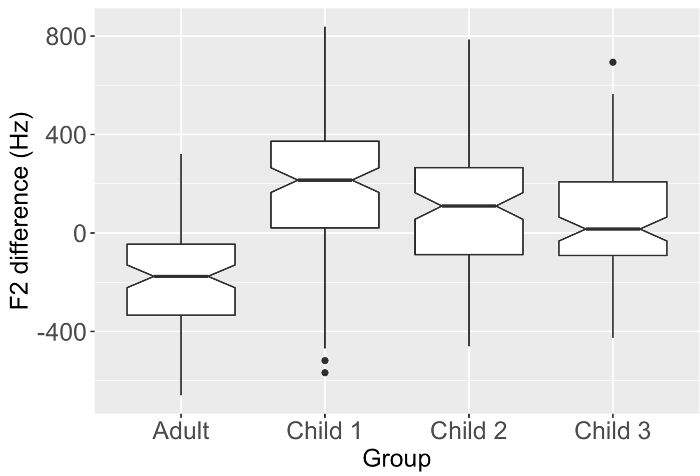


Fig. 18. The F2 difference between /i/ in *Dieb*, *Wiese* and /e/ in *lesen* calculated with (7) for adults and children in year 1, year 2 and year 3.

A statistical test using the equation in (3) with the dependent variable shown in Fig. 18 showed significant differences between adults and children for all of the recording timepoints ($t_{47.1}$ = 7.8, $p < 0.001$ for adults and year 1 children; $t_{50.0}$ = 5.5, $p < 0.001$ for adults and year 2 children; $t_{52.6}$ = 4.5, $p < 0.001$ for adults and year 3 children).

3.3.7 *Diphthongs*

The first hypothesis to be tested was that children might monophthongise the opening diphthongs /ia, ua/ because they are monophthongal /i, u/ in SG. The available words for this purpose were *Fliege*, *Füße* for /ia/ and *Schuh* for /ua/. As Fig. 19 shows there is no evidence to support this hypothesis.

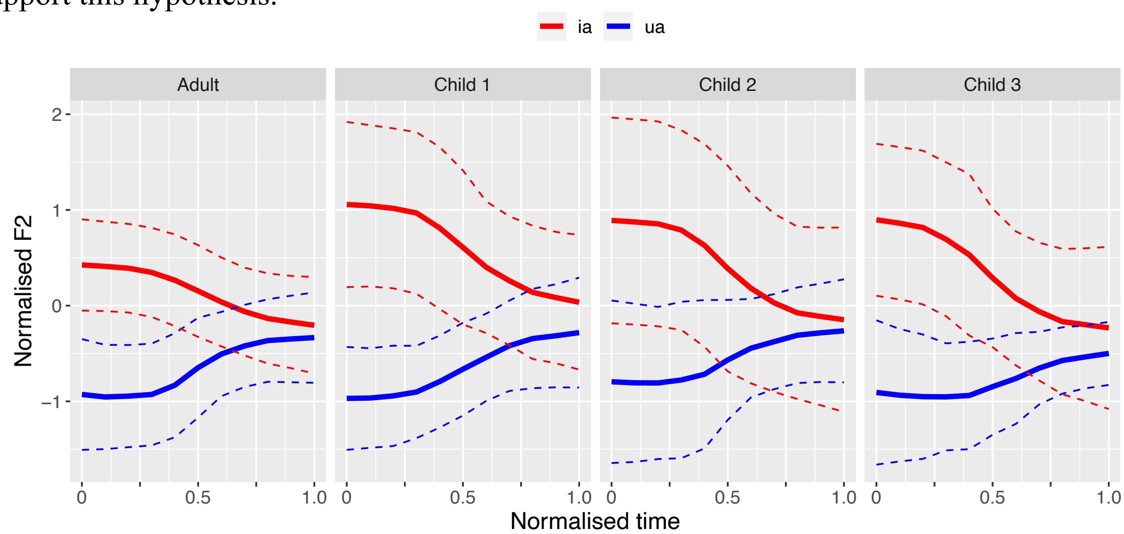


Fig. 19. Time-normalised F2 trajectories of /ia, ua/ diphthongs aggregated separately for adults, year 1, year 2 and year 3 children. Solid/dashed lines: trajectories of the mean and at 1.96 standard deviations from the mean respectively.

The second hypothesis was that the closing diphthongs would shift towards those in the standard. For this purpose, we tested whether words like FEUER and DREI (cf. Fig. 3) which have the same /ai/ in WCB are beginning to split under the influence of SG in which they are respectively /ɔʏ, aɪ/ and whether WCB DREI, STEIN which are /ai, oa/ are beginning to merge since these are both /aɪ/ in SG (Fig. 3). The test was carried out for (i) *drei*, *Wein* (WCB /ai/ ~ SG /aɪ/) (ii) *Feuer*, *Häuser* (WCB /ai/ ~ SG /ɔʏ/) and (iii) *eins*, *Leiter*, *Stei*n, *zwei* (WCB /oa/ ~

SG /aɪ/). There was no support for this type of influence of SG on WCB. That is, there is no evidence from Fig. 20 for a greater merger of (i) and (iii) (Fig. 20: red, orange) nor for a greater split between (i) and (ii) (Fig. 20: red, blue) in children than in adults.

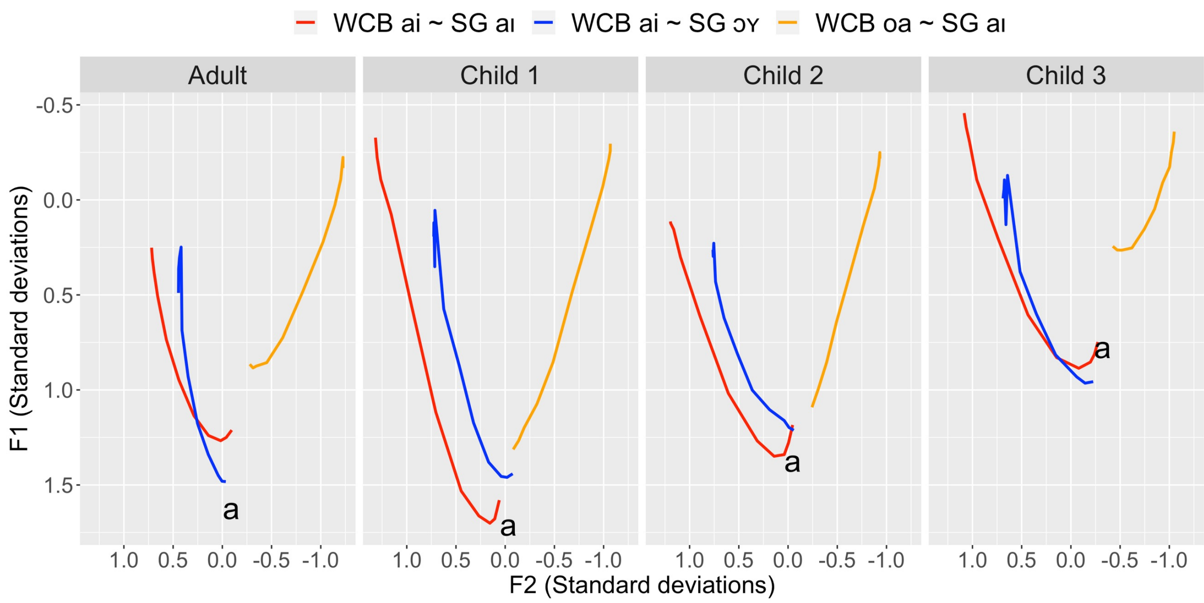


Fig. 20. Aggregated F1 and F2 trajectories for three types of diphthongs in adults, year 1, year 2 and year 3 children as well as aggregates of /a/-vowels as reference.

3.4 Discussion

The study has been concerned with establishing whether the vowels of West-Central-Bavarian are being influenced by those of Standard German. The question was addressed by using some of the known differences between the two varieties documented in Section 1.4 and outlined in more detail in Section 3.1.1 to predict the direction in which the vowels of WCB children and WCB adults might diverge, under the assumption that those of WCB children are influenced to a greater extent by the standard.

The analysis of WCB adults' speech showed many of the hallmarks of WCB that make it distinct and different from SG. These distinguishing WCB characteristics include in particular:

1) A contrast in words like KABEL and GABEL (cf. Fig. 3) between (i) an open central and (ii) an open, or half-open rounded vowel (Fig. 8).

2) The use of post-vocalic consonant length to distinguish V:C from VC: (Fig. 11).
3) Few or minimal quality differences between vowels that contrast in tensity in SG (Fig. 13, left panels).
4) Few or minimal quality differences between front vowels that contrast in rounding in SG (Fig. 15, left panel).
5) A phonetic fronting relationship between /i, e/ that is different from that typically found in SG.
6) (a) Opening diphthongs in FLIEGE and SCHUH that map to high SG monophthongs (Fig. 19); (b) no observable quality differences between diphthongs in DREI and FEUER that are distinct in SG (c) a distinction between the diphthongs exemplified by DREI and STEIN that are non-distinct in SG (Fig. 20, left panel).
7) High and mid-high diphthongs along a trajectory from back to front that map respectively to high and mid/low vowels before laterals in SG (Fig. 9).

The children's vowels were undoubtedly WCB as they were characterized by all of the attributes sketched in 1-7 above that had been found for adults. Thus, one of the main findings in this study is that the defining characteristics of WCB are being transmitted to the youngest generations, at least in a rural area like the one analyzed here. But in line with other studies showing that German dialects are being influenced by the standard (Scheuringer, 1990; Müller et al., 2001; Bukmaier et al., 2014; Kleber, 2017), many aspects of the children's speech data showed a shift towards SG. The strongest shift was for (1, 2) above, i.e., the approximation of /ɒ, a/ and the shortening of the post-vocalic long consonant. For both (1, 2), there were adult/child differences as well as a longitudinal trend in which these differences were more marked for children recorded in their third than in their second than in their first year. The next strongest shift was for (3, 4) that pointed to the development of SG tensity and SG rounding contrasts. Here there were adult/child differences but no longitudinal trend. The results for (5) concerning whether the fronting relationship in /i, e/ had changed, showed overall adult/child differences but no evidence for a longitudinal trend for this relationship to be increasingly reversed in children. There was no evidence that the children had shifted towards SG to a greater extent than adults in any of the diphthongs (6). Finally, there were no innovations introduced by the children that were not in the direction of Standard German.

Studies in the last 20-30 years have documented a variety of factors that are likely to cause the sounds of a dialect (D1) to shift when it comes into contact with another dialect (D2). Although the literature on dialect contact is by no means equivalent to the bidialectal[14] situation (Hazen, 2001; Oschwald et al., 2018) analyzed in the present study, it is interesting to consider whether the findings of the changes (in 1-5 above) and lack of change (in 6) are consistent with the predictions and results from these studies on second dialect acquisition. A summary of the main findings by which the sounds of D1 may or may not be modified by D2 are as follows.

i. *Exceptionless features are acquired more easily*. There is a large body of research showing that children are more likely to acquire the sounds of a new dialect if the change relating D1 and D2 apply to words with limited exceptions, i.e., if sounds from D2 are not conditioned by lexical, morphological, or phonological constraints (Payne, 1980; Chambers, 1992; Kerswill, 1996; Nycz, 2015, 2019) with respect to D1. For example, a British English speaker learning General American may readily adopt the American English production of an intervocalic /t/ as a flap because the context in which flaps occur is largely predictable. By contrast, Northern English speakers who have the same /ʊ/ vowel exemplified by the lexical sets FOOT and STRUT might be less likely to acquire the /ʊ ~ ʌ/ distinction that occurs in other varieties of English because of the complex (largely phonological) factors that condition the split (Wells, 1982).

[14] The term 'bidialectism' is derived from bilingualism and describes the ability of speaking a basic dialect that diverges substantially from the corresponding standard language in addition to the (regionally coloured) standard.

ii. *Mergers are more likely to be acquired than new contrasts*. Some studies show that D2 contrasts that do not exist in D1 are either not, or only incompletely, acquired (Chambers, 1992; Kerswill, 1996; Evans & Iverson, 2007). According to Labov (1994), mergers are often changes from below (the level of consciousness) and so may be more readily acquired than splits if D2 does not make a contrast that exists in D1.

iii. *Saliency/awareness influences D2 acquisition*. It has been repeatedly suggested (Trudgill, 1986; Auer, Barden, & Grosskopf, 1998; Siegel, 2010) that the shift towards D2 is influenced by whether sounds are salient and well-known markers of a dialect. Nycz (2013a, 2013b) showed that Canadians who had moved to the northern United States shifted only minimally the raised nucleus of the diphthong in words like 'about' precisely because this is known to be a typical marker of Canadian English (that is also commented upon in the media and by the public) that does not occur in most varieties of American English. In a longitudinal study of the 7-up series[15], Sankoff (2004) suggests that the Northern England speakers were less inclined to adopt the vowel close to CV5 (/ɑ/) in 'bath' that is a notable, salient marker of Southern English. Salience and its relationship to whether or not D1 shifts towards D2 may also be conditioned by the speaker's attitude towards the dialect that is being acquired (Niedzielski, 1999 for related perception studies; Walker, 2014; see also Hay & Drager, 2010; Jannedy & Weirich, 2014).

iv. *A sound in D2 is more likely to be acquired if it already exists in D1*. Payne (1976, 1980) was amongst the first to suggest that a sound of D2 is more readily acquired if it exaggerates a phonetic tendency that already exists in D1. Bigham (2010) showed that female Southern Illinois high school students' [o, u] that varied considerably along a

[15] In the film series knowns as "7 and Up" the British filmmaker Michael Apted interviewed 14 seven-year-old children in 1963. He re-recorded a subset of this group every seven years, the latest including a majority of the members of the original group at age 42 in 1999.

front-back dimension became more retracted after contact with Northern students who had a retracted [o, u]. This idea is central to the cognitive-computational model of sound change developed in Harrington et al. (2018). In their model, a sound from dialect D1 is attracted towards D2 if the variation of the sound in D1 is in the direction of D2. For example, Harrington & Schiel (2017) showed that D1 individuals (represented as computational agents) with a mostly retracted /u/ that was also sometimes fronted though due to coarticulation, shifted towards a more fronted variant as a consequence of contact with D2 individuals who only had a fronted /ʉ/.

Could any of the four points (i.-iv.) listed above explain why WCB children showed a greater tendency to shift towards SG on (1-5) but not on (6)? Complexity in the sense of (i.) is unlikely to explain the differences between (1-5) vs. (6). The structural relationships in Fig. 3 do not suggest, for example, that the mapping of WCB /oa, ai/ to SG /aɪ/ (in which there was no evidence of a shift towards SG) is any more or less complex than e.g., the mapping between WCB /i/ and SG /i, ɪ/ (where children did show a shift towards SG). Neither can (ii.) provide any coherent explanation for the pattern of shifts towards SG. This is because while (ii.) does predict the observed failure for WCB /ai/ to split into SG /aɪ, ɔʏ/ as well as the tendency of a merger of /ɒ, a/ to SG /a/ (1), it is not compatible with the observed tendency for WCB children's /i/ to begin to split into an SG-like /i, ɪ/ (3) nor for WCB children's /e/ to show signs of splitting into an SG /e, ø/ contrast (4).

With regard to (iii.), we have already noted that /oa/ and the opening diphthongs /ia, ua/ are markers of WCB that are commented upon by the media and public. Perhaps there was no shift towards SG because these diphthongs are such clear identifiers of WCB. However, this interpretation is inconsistent with the finding that the children showed a shift towards SG in both /ɒ/ (1) and in the rounding of front vowels (4). Moreover, both WCB /ɒ/ and the WCB production of unrounded vowels exemplified by VÖGEL (Fig. 3) are also known (and commented upon) markers of WCB[16]. While there is evidence from Central German dialects that salience of certain dialect features can just as well lead to a conscious drop of the very (e.g. the hardening of dialectal lenited plosives in the Upper Saxonian Vernacular; Auer, Barden & Großkopf, 1998) due to low prestige of the assimilating variety, this does not seem apply to the dialect situation in Bavaria (see Section 3.1.2). As Auer, Barden & Großkopf (1998) concluded from their study on long-term dialect accommodation in a Central German dialect setting, salience might be a necessary but at the same time insufficient predictor for the loss or acquisition of dialect features, since it does not indicate the attitudinal polarity that might guide the direction of a shift in one way or another.

(iv.) predicts sound change if SG characteristics already exist in WCB. The potential relevance of (iv.) to the observed shifts towards SG is the following.

1. As Fig. 8 shows, the orientation and spread of /ɒ/ towards /a/ is greater than in the other direction. In terms of the model of Harrington et al. (2018), /a/ (and by implication SG /a/) is an attractor for WCB /ɒ/ (because the distribution of WCB /ɒ/ already contains some variants that are quite /a/-like).
2. In a hypoarticulated/casual speaking style, long consonants are more likely to shorten than short consonants to lengthen (e.g., van Son & Pols, 1999). Thus, the shorter C in SG is an attractor for the long Cː in WCB (which may tend to drift towards C in faster/hypoarticulated speaking styles).
3. In a hypoarticulated/casual speaking style, vowels are often centralized, i.e. are less peripheral (Lindblom, 1990; van Bergem, 1993; van Son et al., 1994). Thus, it can be

[16] For example, *an*, *hat*, *Stadt*, SG: /ɐn, hɐt, ʃtɐt/ (‘on/at’, ‘has’, ‘town’) are often written with ‘o’ to identify WCB as in E. Hürlimann’s caricature of Bavarian *Eahm schaug **o*** (SG: *ihm schau an* literally ‘to him look at’ i.e. ‘look at him’) or the song by ‘Isar Mafia’ *Sie **hod** mein’ Style (mei’ **Stodt**’)*. WCB front unrounded vowels in words exemplified by VÖGEL are sometimes written with ‘e(e)’ e.g.: *So neu und so **schee***! https://www.mei-schee.de/de/ (‘So new and so nice!’ SG: s*chön*, /ʃøn/).

expected that hypoarticulated WCB /i, e/ shift in the direction of more centralized qualities. For this reason, SG /ɪ/ which is a centralized mid-high vowel is an attractor for WCB /i/ in SPINNE and SG /ɛ/ for WCB /e/ in BETT.

4. A similar explanation as in 3. can be made with regard to lip-rounding. It has been shown for SG (e.g., Hoole, 1999; Harrington et al., 2011, Fig. 8) that /y, ø/ have centralized and lowered tongue position relative to /i, e/. Thus, SG front rounded vowels are also attractors for WCB /i, e/ in words exemplified by FÜSSE, BÖSE respectively.

(iv.) may also be relevant to account for the lack of shift towards SG in the opening and closing diphthongs in (6):

6a In a more hypoarticulated speaking style, high opening diphthongs may well monophthongise (e.g., Standard British English /pʊə, pɔ/, 'poor': Lindsey, 2019) but not as far as we know towards vowels with CV1 and CV8 qualities that characterise SG WIESE and SCHUH. Thus SG /i, u/ are unlikely to be attractors for WCB /ia, ua/.

6b There is no phonetic reason that we can think of why the phonetic orientation towards SG /ɔʏ/ should be greater for WCB /ai/ in FEUER than in WCB /ai/ in DREI. There is therefore no SG attractor to encourage WCB /ai/ in FEUER and in DREI to split into SG /ɔʏ/ and SG /aɪ/ respectively.

6c For a similar reason as in (6b), SG /aɪ/ cannot be an attractor for WCB /oa/ because there is no reason why a falling diphthong /oa/ (exemplified by STEIN) should be phonetically oriented towards a rising /aɪ/ diphthong.

The analysis points to the general conclusion that a shift was most likely for WCB sounds when variation is phonetically directed towards or encompasses those of SG. This is also the outcome that is predicted by the cognitive-computational model of sound change developed in Harrington et al. (2018). According to this model, a sound from a dialect D1 is an attractor for a sound from dialect D2, if the sound in dialect D1 is skewed towards that of D2. This model can be applied to the present data on the assumption that the phonetically quite tense vowel in

WCB SPINNE can also be undershot and centralized in a more casual speaking style or faster speaking rate. Since the vowel in SG-SPINNE is lax and more central than its WCB counterpart, then (because of undershoot/centralization) WCB SPINNE encompasses variants that are already in the direction of its SG counterpart. Therefore, SG-SPINNE acts as an attractor because WCB-SPINNE is skewed towards it according to the model in Harrington et al. (2018). From another perspective, the reason why WCB children begin to make a split of WCB /i/ in the direction of SG /i, ɪ/ is because, when they hear SG speakers produce SPINNE with a lax /ɪ/, WCB children consider it to be a possible (albeit outlier) form of WCB SPINNE. Following the exemplar model in which words and phonological knowledge are statistical generalisations over remembered speech signals (Johnson, 1997; Pierrehumbert, 2003), WCB children might then readily absorb perceived SG productions into their own cognitive representations of SPINNE. This does not happen for WCB /i/ in WIESE, because, even though WCB WIESE can no doubt also be reduced and centralized in hypoarticulated speech, these reduced and centralized forms are not skewed towards SG WIESE which is tense /i/. For a related reason, WCB /ai/ in both FEUER and FEIER did not split into SG /ɔʏ, aɪ/ because the phonetic variation in WCB FEUER is unlikely to overlap very much with the phonetic range within which SG /ɔʏ/ is produced.

This type of change that has been observed in this study is sometimes called ‘automatic’ which Siegel (2010) contrasts with changes that are ‘socially motivated, arising from an unconscious desire for social approval from one’s interlocutors’. This first type of non-socially motivated, automatic change has also recently been found in the accents of (English speaking) winterers isolated together in Antarctica for a prolonged period of time (Harrington et al., 2019a) and in studies showing Canadians’ tendency to unmerge cot/caught as a consequence of contact with speakers of New York City English which Nycz (2016) considers to be driven by ‘automatic accommodative processes’. The basis for these types of automatic changes is likely to be spontaneous imitation (Delvaux & Soquet, 2007) which can take place in the absence of any social motivation to do so (Nielsen, 2011; 2014; Pardo et al., 2012). Imitation is the mechanism in episodic models and associated computational implementations (Wedel, 2006; Harrington et al., 2018; Todd, Pierrehumbert & Hay, 2019) that causes memorised exemplars of words to be updated depending on the type of phonetic variation to which an interlocutor happens to be exposed. Trudgill (2008) reasons that New Zealand English in its earliest stages was shaped in particular by children's 'innate tendency to behavioural coordination' (see also Fowler et al., 2008; Sebanz, Bekkering, & Knoblich, 2006), i.e. by an automatic, non-socially driven imitation of the range of spoken accents that they heard. We suggest that a similar kind of non-social, but probabilistic (rather than as in Trudgill, 2008, deterministic) mechanism is likely to be the cause of the shift in children's WCB as a consequence of their greater contact to SG speakers compared with that of the older generation analyzed here.

We emphasise that there are many caveats to these conclusions. In particular, the study is based on such a small number of words per condition. This applies in particular to the conclusions about open vowels (3.3.4) that were based on only seven words, rounding (3.3.5) based on only five words, and the relative positions of /e, i/ (3.3.6) based on only three words. The very limited scope of this study in this regard was a necessary consequence of combining an analysis of breadth across the WCB monophthong/diphthong space with the practicalities of the limited recording time that could be allocated per child. Thus, the possibility must also be considered that we may be observing word by word diffusion (Phillips, 1984; Trudgill, 1986; Bybee, 2002) rather than shifts to entire phonological categories.

Furthermore, the possible influence of maturation on changes in speech production cannot fully be factored out in a data sample as analyzed in the present study. In general, children have been found to have a larger vowel space as well as more variable and longer vowels compared to adults (e.g. Lee, Potamianos & Narayanan, 1999). However, while most of the previous studies reporting larger vowel spaces in children only compared raw values (Vorperian & Kent, 2007; Flipsen & Lee, 2012), the present study applied a normalisation procedure (Lobanov, 1971) that has been shown to effectively align adult and child vowel spaces (see Chapter II, Section 2.2.3). In addition, Pettinato et al. (2016) found in their study on the vowel space area of children and their ability to hyperarticulate, that the main difference between the vowel productions of adults and children is not in situations of hyperarticulation (which might by trend apply to experimental situations as given in the present study) but rather in the inability of children to use articulatory shortcuts typical of casual speech, i.e. the ability to hypoarticulate when appropriate. Also, concerning repeatedly found differences in vowel duration between children and adults (e.g., Chermak & Schneiderman, 1986; Smith, 1994), a comparison of absolute vowel and word durations of adults and children to all timepoints did not reveal noticeable discrepancies between the age groups in our data (see Section 3.3).

The realization of vocalized laterals in West Central Bavarian – an acoustic and articulatory analysis

Chapter IV

Abstract

The aim of the current study was to investigate the West Central Bavarian (WCB) front vowel that resulted historically from /l/-vocalization in post-vocalic position which might shift towards a more consonantal pronunciation as in Standard German (SG), in which the lateral is still fully present. To do this, acoustic data from WCB speaking adults and primary school children at three subsequent timepoints was analyzed and additionally put in relation to articulatory data from a subset of the children.

In accordance with our findings in Chapter III, a shift was expected for words that are acoustically similar between WCB and SG and especially in the productions of children. While our data showed that the WCB and SG pronunciation of the vocalized /l/ vs. /l/ are acoustically as well as articulatory separable, no shift in the expected direction was observable. That is, there was no systematic difference between words that are acoustically similar between the two varieties and those that are more divergent, neither in the productions of the adults nor in those of the children. The general conclusion is that, in this case, internal factors motivated by general principles of vowel change might play a more decisive role in inducing a shift than external factors like dialect contact.

4.1 Introduction

Previous research has shown an increasing influence of the standard on German varieties, causing various sound changes in the respective varieties (Scheuringer, 1990; Müller et al., 2011; Bukmaier et al., 2014; Kleber, 2017) by which German dialects are shifting towards the standard. These changes were shown to be driven by younger people which are more exposed to the standard than older generations. Our investigations in Chapter III have suggested a sound change in some WCB monophthongs of dialect speaking children (as compared to adults) towards SG categories in cases where variations of WCB phonemes are already in the direction of the standard, i.e. when the sounds of the two varieties were similar enough to permit a gradual change from one category to another.

Along the lines of these findings, the assumption investigated in this chapter was that there might be a sound change in progress in which the production of the WCB vocalized lateral shifts towards an actual consonantal lateral (as in SG) in words where the two varieties are acoustically similar. Therefore, the present study examines the acoustical properties of the post-vocalically vocalized lateral in the WCB dialect by means of a combined longitudinal and apparent-time acoustic analysis of dialect speaking adults and children at three different timepoints. In addition, the acoustic patterns are compared to articulatory data gained from ultrasound recordings of the children at one time point. However, our acoustic-articulatory comparisons will be largely qualitative and tentative, since especially the articulatory analyses are based on a very small dataset.

In the following sections at first, the historic sound change of /l/-vocalization in WCB will be described. Then, occurrences of /l/-vocalization as common sound change in other languages of the world will be presented. As will be laid out, the possible sound change which will be investigated in this chapter is rare or less often described regarding two points: First, it goes in the opposite direction as the more often described /l/-vocalization since we expect a vowel moving towards a lateral. Second, the lateral-vowel continuum is between a clear /l/ and a front vowel, in contrast to a more described dark /l/ and back vowel. After an overview over the general acoustical and articulatory properties of laterals our hypotheses will be described.

4.1.1 /l/-vocalization in WCB

As outlined in Chapter I (Section 1.4, Fig. 3) there is no systemic equivalence between SG and WCB phonemes due to their divergent historical roots. While the dialect has preserved many sounds from Middle High German (MHG) these were lost in the standard. One salient characteristic of the Bavarian dialect (as opposed to SG and other German dialects) (Rein, 1974; Vollmann et al. 2015) is the vocalization of post-vocalic laterals (Kufner, 1957; Zehetner, 1985; Wiesinger, 1990). MHG /l/ after vowel became a palatal approximant (Rein, 1974) which also influenced the preceding vowel in different ways. Hence in the present-day dialect the vocalized form occurs post-vocalically, in absolute final position (e.g., *Stuhl* /ʃtui/) or before a coda consonant (e.g., *Holz* /hoits/) and is independent of the surrounding vowels. This means that the Bavarian vocalization process was not dependent on the quality of the preceding vowel (it happened after every vowel) but is positionally restricted. The lateral persists in the dialect after consonants (e.g., *Rudel* WCB /rudl/), word-initially (e.g., *lesen* WCB /lesn/) and between two vowels that are actually produced (e.g., *alle* WCB /ɒle/). This creates word pairs like e.g., *malen* vs. *Maler* which is /m**a**ː**l**ən, m**a**ː**l**ɐ/ in SG and /m**oi**n, m**a**ː**l**ɐ/ in WCB, respectively (Rein, 1974; Merkle, 2005).

From the vocalization process new diphthongs emerged that were until then not part of the WCB diphthong inventory (see Section 1.4, Fig. 3) (Kufner, 1957; Bannert, 1976). While the lateral was vocalized towards a high open vowel the preceding vowel became rounded and retracted (Capell, 1979; Bannert, 1976), resulting in the diphthongs /oi/ and /ui/ in which /oi/

occurs in words with SG non-high vowels before /l/ (e.g., *Holz* /hoits/) and /ui/ in words with SG high vowels before /l/ (e.g., *Stuhl* /ʃtui/)[17].

However, there are fully integrated loan words to which the above rules do not apply and V+/l/ survives in the dialect (e.g., *normal* /noɐmal/). Schikowski (2009) argues that because /l/ is associated with SG pronunciation, its persistence is most likely the stronger the area is related to an SG associated area such as Church, science or business.

Historically, the process of /l/-vocalization is dated around the 13th century, initiating in the cities (i.e., Munich for West-Central-Bavaria and Vienna for East-Central-Bavaria) and spreading across the rural areas. To this date the vocalization of the lateral was seen as a symbol of modernity, being promoted by the cities (cf. Vollmann et al., 2015). However, at no point in time vocalized /l/ occurred interregional which gave and still gives the process a strong social and local designation (Batliner, 1979).

4.1.2 /l/-vocalization in other languages of the world

Generally, the vocalization of laterals is a well-known and common sound change tendency that is predominantly found in post-vocalic and syllable final position, presumably because of the "well-known trend for consonants to strengthen syllable-initially and not to strengthen or to undergo articulatory reduction syllable-finally" (Recasens & Espinosa, 2005, p. 6). Depending on the vowel context as well as on the quality of the lateral itself, /l/ is either velarized towards an /u/-like quality or palatalized towards an /i/-like quality. Most of the research describing /l/-vocalization is concerned with English varieties (see Hall-Lew & Fix, 2012 for a detailed list). Apart from English, diachronic vocalization has been reported also for e.g., Catalan, Provençal,

[17] This description applies to the investigated WCB dialect area. Within the Central-Bavarian dialect area there are various dialect variants generating slightly different diphthongs as a result of the vocalization process. See Kufner (1974), p. 23 for a table of various vocalization diphthongs in several vowel contexts for different dialect areas.

and Italian dialects (Recasens, 1996), Occitan (Müller, 2011), Dutch (Jongkind & van Reenen, 2007), Swiss German (Leemann et al., 2014), Mehri (a southern Arabian Semitic language, Johnstone, 1975) and Polish (Nagórko, 1996). Nearly all of this research refers to a velar lateral becoming a back rounded vowel which is according to Hall-Lew & Fix (2012) the realization most likely to vocalize. In varieties in which both dark and clear /l/[18] appear it is claimed that vocalized /l/ always develops from the velarized/dark variant of the lateral (e.g., Lawson et al., 2011; Johnson and Britain, 2007). Strycharchzuk, Derrick, & Shaw (2020) even state /l/-darkening to be the diachronically preceding process to l-vocalization. This is supported by the proposition of Johnson and Britain (2007) who argue that /l/-vocalization could only be found in English varieties that have a dark /l/ and not in varieties in which the quality of the lateral is relatively lighter (such as Irish English). Therefore, the WCB case of a palatalization of the /l/ up to a completely vocalized /i/ is rare. Besides the predominantly English-based descriptions of the vocalization of dark /l/, also in Germanic languages a velarization towards a completely vocalized /u/ is most common (e.g., Dutch /out/ for *alt*). While there is evidence from some Romanic languages that also a clear lateral can become vocalic, the WCB process is quite different. In Italian for example the vocalized /i/ occurs predominantly after consonants (e.g., piazza) whereas in Bavaria only the post-vocalic position is affected. Additionally, there is no vocalization in Italian after a velar vowel (e.g., alto, dolce) while the vocalization in WCB is independent of the vowel context. The main difference to French /l/-vocalization is that in WCB the lateral persists between two vowels (e.g., alle) whereas in French it does not (cf. Giese, 2021). Rein (1974) argues that from a phonetic point of view, the vocalizations appear to be a consequence of coarticulation in Romanic languages, resulting in either /i/ or /u/ depending on

[18] We will use the terms 'clear' and 'dark' to refer to particular resonance qualities evident in the liquids.

a palatal or velar context, while in Bavarian the post-vocalic lateral palatalizes independent of the surrounding vowels.

4.1.3 Articulatory and acoustical properties of /l/

From an articulatory point of view both clear and dark /l/ are produced with two lingual constrictions, one anterior and one dorsal in conjunction with a lateral lowering (e.g., Gick et al. 2006; Lin, Beddor, & Coetzee, 2014). The dark /l/ is additionally typified by a retraction of the tongue dorsum towards the velum (Hall-Lew & Fix, 2012). Further, EPG data indicated differences in closure fronting in dark vs. clear /l/. That is, the alveolar closure for dark /l/ was found to be more anterior (e.g., in New York City American English) than that for clear /l/ (e.g., in Italian) (Recasens & Farnetani, 1990) suggesting that a more anterior closure may contribute to velarization. Despite the differences in tongue body configurations clear and dark varieties of /l/ differ in respect of their temporal organization. In contrast to clear /l/, for the production of dark /l/ tongue dorsum lowering precedes tongue tip raising which is even reinforced in utterance-final position (Sproat & Fujimura, 1993). These differences cause the period of articulatory closure to be longer for dark /l/ while the period of acoustic closure is longer for clear /l/ (Recasens & Espinosa, 2005). In general, it has repeatedly been observed that children's articulatory movements become more stable over time leading to a decrease in variability (e.g., Chermak & Schneiderman, 1986; Smith, 1994). Interestingly, Redford & Oh (2017) subsumed referring to studies on speech motor development and early child phonology that children's speech is slower and more variable than adults' speech until age 12, whereas at the same time language-specific temporal patterns are mostly already acquired by three years of age.

Acoustically, laterals inhibit consonantal as well as vocalic features. The alveolar constriction has a lowering effect on F1, giving /l/ a consonantal attribute in the sonagram. Additionally, the lateral opening causes antiresonances (Zhang & Espy-Wilson, 2004) that soften the amplitude of the formants as compared to vowels. However, these antiresonances are far less pronounced than in nasals and also due to the lateral opening the /l/ exhibits a clear formant structure that bears resemblance to the spectral appearance of vowels (Machelett, 1996). Due to the comparatively flexibility of the tongue dorsum, laterals are prone to coarticulatory effects (Recasens & Espinosa, 2005; Recasens, Fontdevila, & Pallarès, 1995; Hall-Lew & Fix, 2012). This results in quite variable formant values depending on the vocalic and consonantal context. While F1 and F2 offer a wide range of possible values, F3 is, because of the antiresonances, mostly weakly pronounced and therefore hardly visible in the sonagram (Fant, 1970).

The perception of /l/-vocalization is supposed to be linked to the articulatory reduction in tongue tip raising (Strycharczuk et al., 2020; Lin et al. 2014; Recasens & Espinosa, 2005). According to Proctor (2009) liquid vocalization is straightforward as the vocalized form is the natural output if the tongue tip gesture is not completed. Recasens & Espinosa (2005) argue that simply defining vocalization as the lack of articulatory closure might be too simplistic. Since /l/ is an articulatory complex segment, it exhibits alongside the acoustic variations also a huge variability in production. There are e.g. productions without apical contact that are nevertheless not vocalized as they still maintain a velar constriction (Wrench & Scobbie, 2003).

These acoustic as well as articulatory variabilities make it particularly hard to measure a lateral and the change within the lateral towards a vowel with a single method. Therefore, the techniques previous studies have used to measure the presence of /l/-vocalization are many, even though a single reliable method has not yet been found. Most studies of /l/-vocalization rely on perceptual coding techniques but since those impressionistic coding methods are very subjective it is questionable how reliable they are within and across data sets (Dodsworth, Plichta, & Durian, 2006).

4.1.4 Aims and hypotheses

Our attempt to account for the complexity of measuring a post-vocalic lateral and its vocalized variants was to combine articulatory and acoustic data.

In terms of acoustic methodology previous research has not yet agreed on a definite measure since a vocalized token is supposed to resemble its vowel counterpart in large parts. In the present study the matter of investigation is the discrimination between a clear /l/ and a high vowel (i.e., /i/) and particularly the steps of vocalization or rather de-vocalization in between. While the endpoints of the continuum, with a consonantal lateral on the one end and a fully vocalized /l/ on the other end, are expected to be straightforward (e.g., a clearly lower F2 for the lateral due to the dorsal constriction (Lin et al., 2014)), the completely vocalized variant is supposed to look the same as the high front vowel. The main aspect here would be to seek for variants whose F2 values are located between these two endpoints which could hint towards a change from an accomplished vocalization back to a more consonantal pronunciation.

However, F2 supposedly reflects the place of articulation but also coarticulatory effects and thus seems to be quite sensitive (Recasens, 1996). So even if acoustic measures manage to determine slight differences it is hard to capture such a complex sound as a lateral with all its potential intermediate stages towards (or away from) vocalization. At this point, articulatory methods offer a greater level of quantitative accuracy and provide the possibility to capture slight changes and/or differences in the tongue configuration that might not (yet) be visible or not clearly interpretable in the acoustic signal.

The general aim of the study was to investigate whether there is any evidence observable for a continuous change from a front vowel to a clear lateral acoustically as well as articulatory and if we can relate acoustic and articulatory patterns to the initiation of sound change. As we found in Chapter III, a shift within WCB sounds towards SG is most likely when there is variation within the dialect (e.g., due to hypoarticulation) that is phonetically already directed towards SG sounds. In the case of the WCB /l/-vocalization this might cause a continuous shift in the dialectal production of V+/l/[19] from a front vowel to a clear lateral (just as it is in the standard) in such cases of ambiguity in the mapping from production to perception.

Therefore, the hypotheses were:

(H1) There might be a shift of WCB vocalized /l/ towards a consonantal /l/ in words that are acoustically similar to SG.

(H2) This shift might be even more pronounced in children as compared to adults.

More specific, the prediction is that in words like *Holz* and *Stuhl* which are acoustically similar between the two varieties (WCB /h**oi**ts/ vs. SG /h**ɔl**ts/ and WCB /ʃt**ui**/ vs. SG /ʃt**u**:l/) we expect to find acoustically as well as articulatory a greater variability within the production of the vocalized /l/ as marker for an ongoing change and a thereby destabilized vowel category. In case of a sound change these differences are expected to be more pronounced for children as compared to adults and increasingly so for children in their third vs. their second vs. their first year in school.

For words like *Geld, Spiel* and *Brille* (WCB /g**oi**d/ vs. SG /g**ɛl**t/, WCB /ʃp**ui**/ vs. SG /ʃp**i**:l/ and WCB /br**ui**n/ vs. SG /bʁ**ɪl**ə/) on the other hand no such variations are expected. Within these words the by vocalization induced diphthong in WCB and the V+/l/ sequence in SG are acoustically very different and form clearly distinct categories which does not give reason to expect a gradual approximation towards the standard in neither age group.

[19] Henceforth we will use V+/l/ to describe the analysed segments of interest. The term comprises therefore the actual vowel plus lateral production in SG as well as the diphthongal pronunciation in WCB.

4.2 Method

We used acoustic analyses and ultrasound imaging to test the hypothesis stated in the introduction: (H1) there might be a shift of WCB vocalized /l/ towards a consonantal /l/ in words that are acoustically similar to SG and (H2) this shift might be more pronounced in children compared to adults and even more so within children as they grow older.

Acoustically such a shift is supposed to cause a lowered F2 in the vocalized /l/ as well as increased variation in the very, particularly in the words that are similar between the two varieties. For the ultrasound data, our general aim was to investigate how such a continuum from a front vowel to a clear lateral looks like in terms of articulation.

4.2.1 Participants

For the acoustic analyses we resorted to the corpus described in Section 2.2. Similar to the analyses in Chapter III acoustic recordings of adults and primary school children were compared in an apparent-time approach, combined with a longitudinal comparison of the children who were re-recorded 12 and 24 months after the first recordings.

As to the articulatory analyses, only a subset of the recordings from the ultrasound sessions described in Section 2.3 will be presented. In the present study we were looking at ultrasound data of 16 (out of 17) children obtained in the second year of recordings, i.e., in the second year of primary school. One child had to be excluded because the tongue contour was hardly recognizable on the ultrasound images.

4.2.2 Materials

The 58 stimuli from the wordlist (cf. Section 2.4 and Appendix B) were designed to allow for investigations of a large range of research questions (as outlined in Chapter III) as well as to elicit key features of the WCB vowel system (cf. Section 1.4). In the present study we concentrated on a subset of the recorded items allowing a comparison of occurrences where in

WCB the lateral is usually vocalized with an unambiguously produced lateral as well as with a high vowel (whereto the vocalized variant points).

The analyzed words listed in Table 1 consisted of five words with a post-vocalic clear lateral in SG and a diphthong (due to vocalization) in WCB as well as one item with a high vowel and one item with an actually produced lateral in both varieties as comparison baselines.

Table 1: List of words analyzed acoustically and articulatorily in the current study.

Target phoneme	Word	SG	WCB	English translation
	Holz	/h**ɔl**ts/	/h**oi**ts/	wood
	Geld	/g**ɛl**t/	/g**oi**t/	money
V+/l/	Stuhl	/ʃt**u**ː**l**/	/ʃt**ui**/	chair
	Brille	/bʁ**ɪl**ə/	/br**ui**n/	glasses
	Spiel	/ʃp**i**ː**l**/	/ʃp**ui**/	game
/i/	Wiese	/v**i**ːsə/	/v**i**ːsn/	lawn
/l/	Müll	/mʏ**l**/	/mʏ**l**/	waste

The five words of the V+/l/ group that are prone to vocalization in WCB were further subdivided into words that are acoustically similar between WCB and SG and in which sound change is expected on the one hand, and words that are acoustically highly divergent between the two varieties and therefore no approximation from WCB towards SG is expected on the other hand. In this connection, *Holz* and *Stuhl* were in the set of words which are acoustically similar while *Geld*, *Brille* and *Spiel* were assigned to the acoustically divergent group.

As apparent in Table 1 and also described above (Section 4.1.1), the vocalization results in any case (i.e., independently of the preceding vowel) in the diphthongs /oi/ and /ui/ in the dialectal pronunciation while in the SG pronunciation the lateral is preceded by diverse vowel qualities in our wordlist. Hence the criteria for assigning a word to the acoustically similar group was based on the similarity of the phonemes surrounding the lateral in the two varieties. Further, in the acoustic speech corpus as well as in the data obtained in the articulatory sessions the words from the V+/l/ group were labelled as whether the item was pronounced in WCB or in SG. This classification was determined on auditory criteria. The auditory judgements were additionally established on the basis of acoustical properties which will be presented in more detail in Section 4.3.

The whole wordlist was presented in randomised order and repeated four times (232 tokens per participant in total, 28 for the current analysis). However, since the experiment was designed as picture naming task and especially in the ultrasound sessions not every child completed the whole experiment with all four repetitions, not all items were produced equally often. The final count of word repetitions as well as the respective portion of WCB and SG pronunciation incorporated in the analysis is shown in Appendix C.

4.2.3 Data preparation and analysis

The data from the acoustic recording sessions used for this study was processed as described in Section 2.2.3. For the analyses, the inter-Euclidean distance of the F2 trajectories between the second half of the diphthong (i.e., the vocalized /l/ from /oi/ or /ui/) to the same extract (time point ≥ 0.5) of either the baseline /i/ (from *Wiese*) or the baseline /l/ (from *Müll*) was calculated in a three-dimensional space of DCT coefficients, separately for each word and separately per speaker (as given in formula (2), Section 2.2.3). Figure 21 illustrates exemplary the extract on which the distance calculations were based.

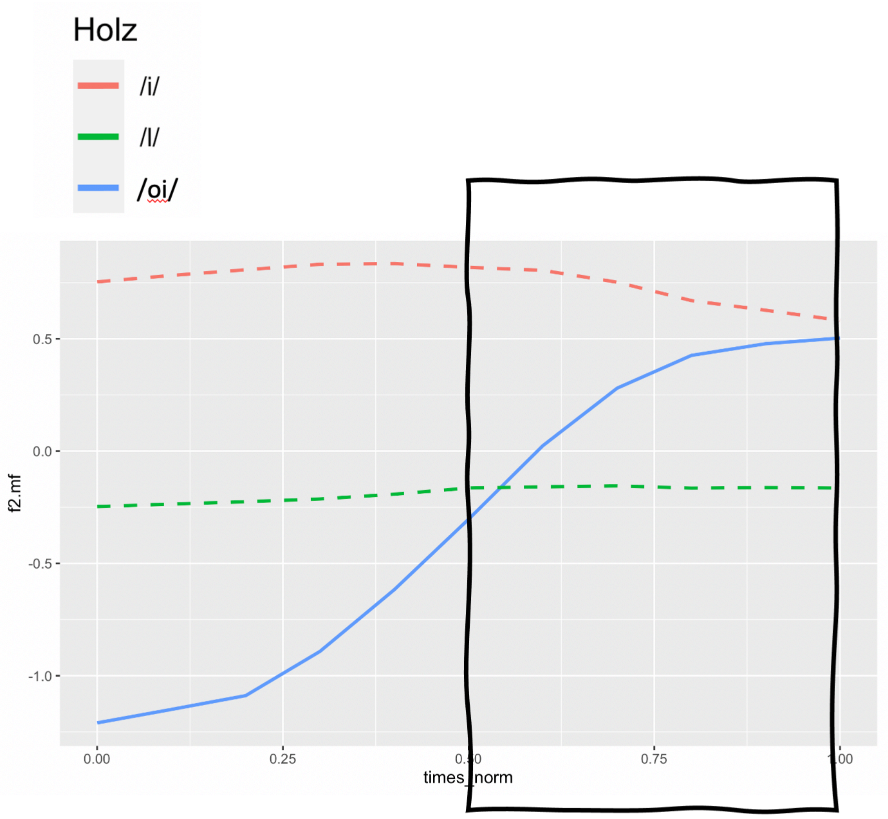


Fig. 21. F2 trajectories of /oi/ in *Holz* (blue), /i/ in *Wiese* (red) and /l/ in *Müll* (green). The black frame highlights the section of the trajectories of which the inter-Euclidean distances from /oi/ (blue) to either /i/ (red) or /l/ (green) were calculated (i.e., from time point 0.5-1.0).

As for the data of the ultrasound session, Praat (Boersma & Weenink, 2016) was used to mark the acoustic onset of the vowel and the acoustic offset of the lateral subsequent to the vowel if produced in SG or the acoustic on- and offset of the diphthong if produced in WCB. In the baseline words acoustic on- and offset of /i/ in *Wiese* and /l/ in *Müll* were marked. The annotated Praat segments were subsequently imported in Matlab and used to extract the corresponding frames from the ultrasound videos as described in Section 2.3.3. The target segments (V+/l/ or diphthong) were further segmented, once again based on acoustics: the acoustic data corresponding to the ultrasound recordings was linearly time-normalised and the contour from the frame at the relative timepoint 0.8 was extracted.

This time-point was chosen since in the V+/l/ group we were interested in the tongue gesture towards the end of the segment where either /i/ (in the case of vocalized WCB pronunciation) or /l/ (in the case of non-vocalized SG pronunciation) or potentially a combined gesture (in cases of sound change) was articulated. As for the baseline words, the frame at time-point 0.5 during /i/ from *Wiese* /v**i**:sn/ and /l/ from *Müll* /mʏ**l**/ was used for analysis. From the target contours measures of tongue curvature and tongue curvature position (Menard et al., 2012) were calculated (see Section 2.3.3).

The normalised orthogonal projection *op* of a contour $\vec{x}_i$ in a two-dimensional space formed by the parameters for tongue curvature and tongue curvature position was calculated in order to determine the relative distance of any V+/l/ segment to the baseline /i/ and /l/ phonemes of the children as anchor points as visualized in Fig. 22. The orthogonal projection (see Stevens, Harrington, & Schiel, 2019 for further details) which was calculated across all speakers is given by (8):

$$op(\vec{x}_i) = 1 - 2\frac{(\vec{x}_i - \vec{c}_a) \odot (\vec{c}_a - \vec{c}_o)}{(\vec{c}_a - \vec{c}_o) \odot (\vec{c}_a - \vec{c}_o)} \qquad (8)$$

where $\vec{x}_i$ is the position (vector of 2 values) of any V+/l/ sequence to the relative timepoint 0.8 in a two-dimensional space formed by the curvature parameters, $\vec{c}_a$ and $\vec{c}_o$ are the centroids (means) of the same parameters of all /i/ and /l/ vowels produced by all of the speakers at timepoint 0.5, and $\odot$ is the scalar (inner) product of two vectors. Informally, (8) expresses in a single value the relative proximity of a given phoneme's tongue shape (encoded as curvature and position parameters) to the mean tongue shapes of /i, l/: the closer the (vocalized) lateral is in this parametrised articulatory space to /i, l/, the closer the values of the orthogonal projection are to +1 and −1 respectively, as in our case, the vowel-production has a greater curvature value and a lower position value than the lateral-production.

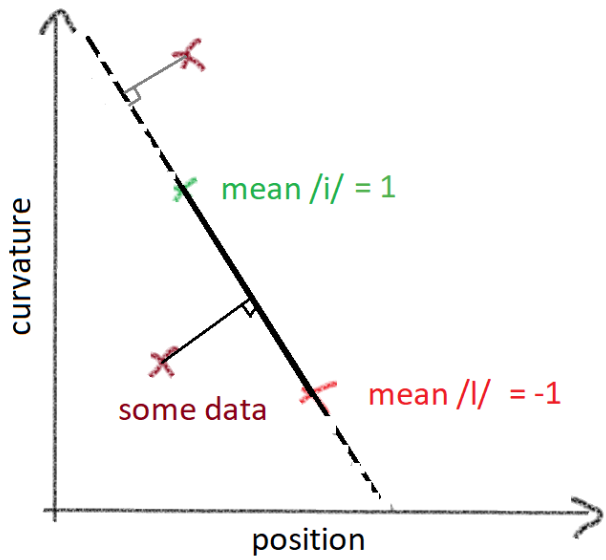


Fig. 22. Exemplary visualization of the calculation of the orthogonal projection. *Position* on the x-axis and *curvature* on the y-axis represent the parameters based on which the orthogonal projection was carried out. The mean values of /i/ (green) and /l/ (red) are the anchors which were assigned to the values +1 and -1, respectively. The orthogonal projection projects the data points of the target words to the closest point on the line drawn through the anchor points.

Referring to our hypotheses we would expect the *op*-values for WCB *Holz* and *Stuhl*, that are acoustically similar to SG, to be lower than for *Geld*, *Brille* and *Spiel*, as the articulatory patterns are expected to be closer to /l/ in the similar words. Accordingly, the WCB vs. SG *op*-values for *Holz* and *Stuhl* are expected to be more similar to each other than in *Geld*, *Brille* and *Spiel*.

4.3 Results

4.3.1 Acoustic data

First, the results of the acoustic analyses will be presented. We begin with a comparative overview of the WCB vs. SG trajectories of the V+/l/ target words in relation to baseline /i/ (from *Wiese* /v**i**:sn/) and /l/ (from *Müll* /mʏ**l**/). We then assess whether WCB vocalized /l/ is being influenced by SG resulting in a shift of the children's vowels towards SG compared with those of adults in words that are acoustically similar in the two varieties. A further indicator for a change would be whether the adult-child differences are increasingly marked for children at later recording timepoints.

4.3.1.1 Overview

In a first step the aim was to acoustically justify the auditory division of the words of the V+/l/ group into similar (*Holz* and *Stuhl*) and divergent (*Geld*, *Spiel* and *Brille*) between WCB and SG. Figures 23-27 present aggregated F2 trajectories over (normalised) time of the V+/l/ target segment of the respective words. Within one word the trajectories are grouped by speaker group, i.e., adults, children from year 1, 2 and 3. In addition to the V+/l/ trajectories, aggregated trajectories of baseline /i/ and /l/ (from *Wiese* and *Müll*, respectively) are displayed as comparative anchor points. Whereas for the adults just one trajectory (per word) with WCB pronunciation (i.e., a diphthong) is given, for the children at all three timepoints V+/l/ trajectories with WCB as well as SG pronunciation each are presented. As described in Section 2.3.2, the reason for this is that the children are not yet fully aware of their two speech systems and switched rather unconsciously between the two varieties whereas the adults could consciously stick to the dialect when advised to.

Figures 23 and 24 show that the words of the similar group exhibit the same acoustical patterns between the two varieties by means of their F2 trajectories while at the same time WCB and SG productions are still clearly separable. The slopes behave similar in all age groups while the comparison to SG pronunciation was only possible within the recordings of the children since there were hardly any occurrences of code switching and therefore SG productions among the adult participants as they are able to employ either the one or the other variety consciously. For *Holz* (Fig. 23) the main distinction between the two varieties is in the second half of the trajectory, where in the dialect the lateral is vocalized while in SG it is not. The preceding vowel is produced quite similar. The comparison /i/ from *Wiese* and /l/ from *Müll* demonstrate that both productions lay in between these baselines in which the WCB production approximates /i/ while the SG production approximates /l/. Concerning *Stuhl* (Fig. 24) the F2 trajectories are again similar in shape and course between the two varieties but the WCB production is overall higher, in the first (the vowel) just as in the second part (the vocalized /l/) of the diphthong. Again, the vocalization in the WCB production approximates the baseline /i/ and even achieves it in the case of the adults while the child-SG production is approximately at the height of the baseline /l/ in all cases.

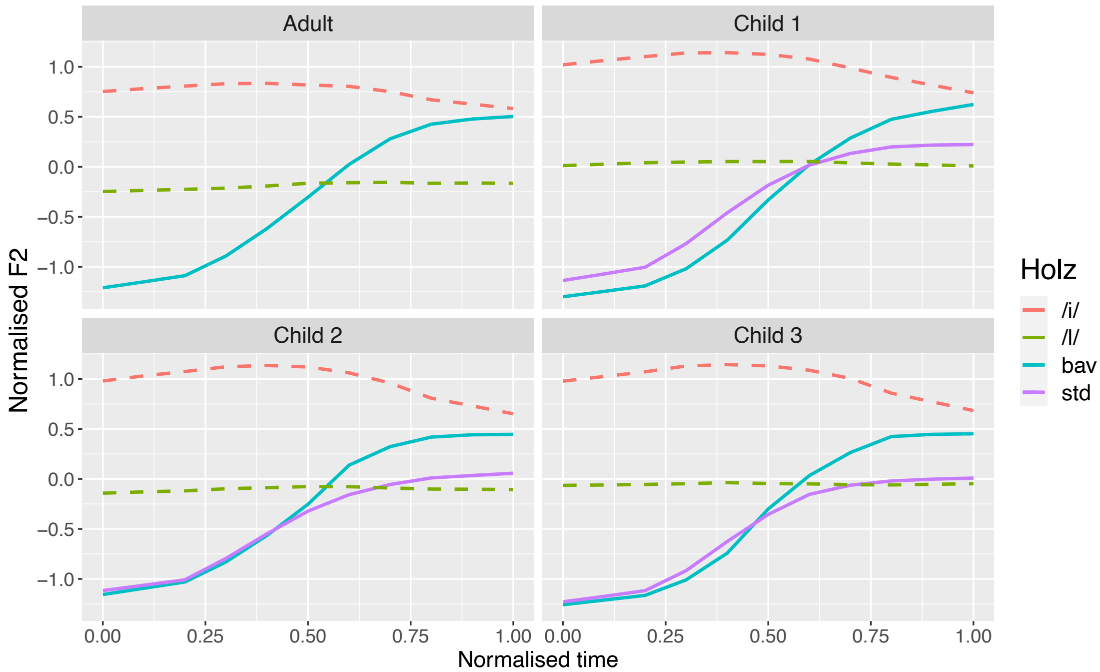


Fig. 23. F2 trajectories for /oi/ (blue; WCB pronunciation) and /ɔl/ (purple; SG pronunciation) within the word *Holz*, aggregated by word and speaker group (adults; year 1, year 2 and year 3 children). Dashed red/green correspond to the trajectories of baseline /i/ (from *Wiese*) and /l/ (from *Müll*) respectively.

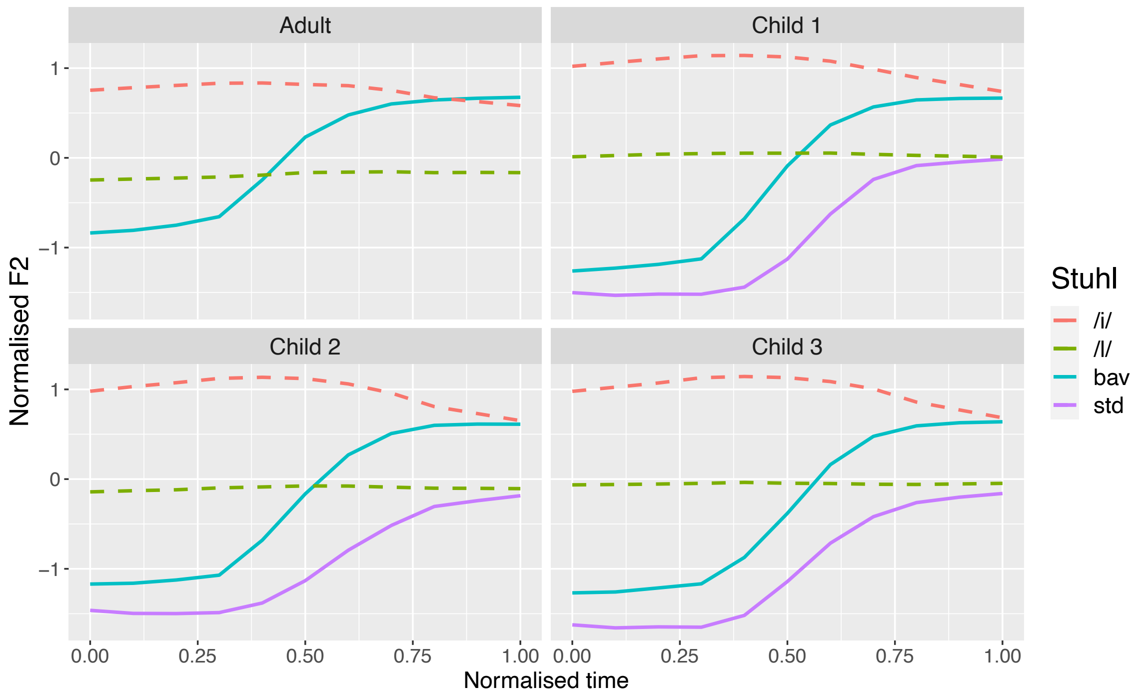


Fig. 24. F2 trajectories for /ui/ (blue; WCB pronunciation) and /uːl/ (purple; SG pronunciation) within the word *Stuhl*, aggregated by word and speaker group (adults; year 1, year 2 and year 3 children). Dashed red/green correspond to the trajectories of baseline /i/ (from *Wiese*) and /l/ (from *Müll*) respectively.

Figures 25, 26 and 27 exhibit that the trajectories of the WCB productions in the words assigned to the divergent group differ substantially from those of the SG pronunciations in all age groups. The differences in the preceding vowels between the two varieties cause the trajectories not just to differ towards the end but also in the first half, inducing highly differing courses of the second formant. While in *Spiel* (Fig. 25) the slopes of SG vs. WCB proceed in opposite directions the main difference in *Brille* (Fig. 26) and *Geld* (Fig. 27) is in the curvature, which is rather flat in the standard pronunciation. Again, the endpoints of the trajectories approximate the baseline /i/ in the WCB productions and the baseline /l/ in the SG productions, while /i/ is actually reached in the case of WCB *Spiel* (Fig. 25) and /l/ is actually reached in the case of SG *Brille* (Fig. 26). In *Geld* (Fig. 27) the endpoints of the WCB and SG trajectories are closest to each other compared to the other V+/l/ productions.

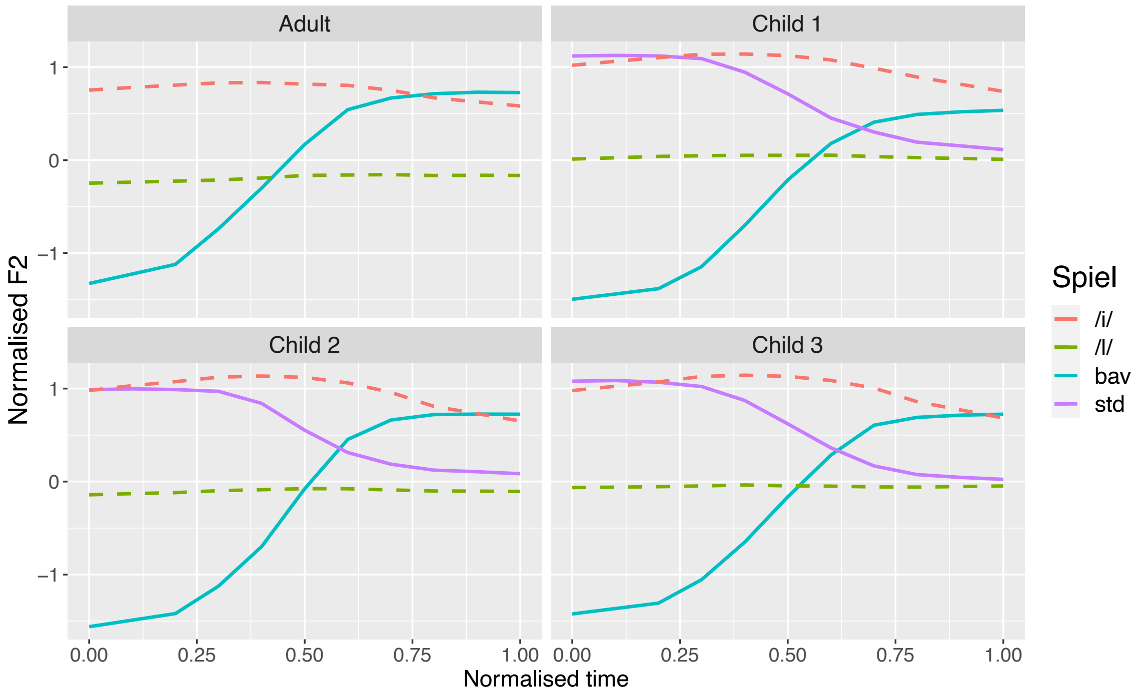


Fig. 25. F2 trajectories for /ui/ (blue; WCB pronunciation) and /iːl/ (purple; SG pronunciation) within the word *Spiel*, aggregated by word and speaker group (adults; year 1, year 2 and year 3 children). Dashed red/green correspond to the trajectories of baseline /i/ (from *Wiese*) and /l/ (from *Müll*) respectively.

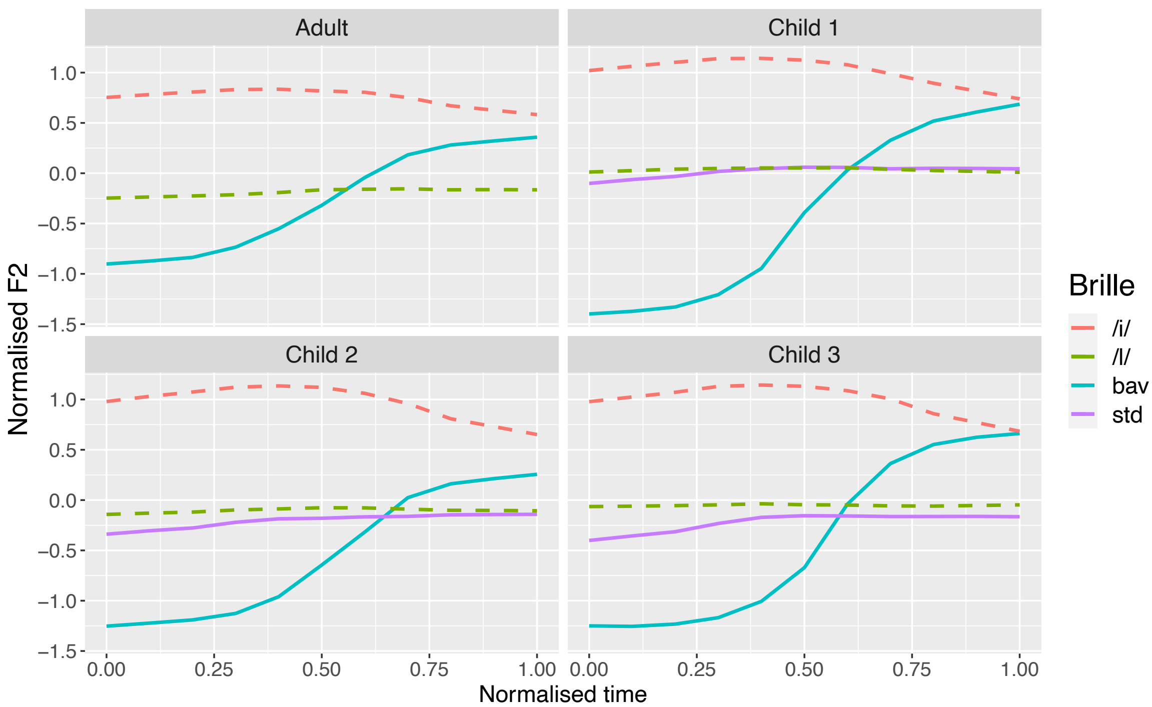


Fig. 26. F2 trajectories for /ui/ (blue; WCB pronunciation) and /il/ (purple; SG pronunciation) within the word *Brille*, aggregated by word and speaker group (adults; year 1, year 2 and year 3 children). Dashed red/green correspond to the trajectories of baseline /i/ (from *Wiese*) and /l/ (from *Müll*) respectively.

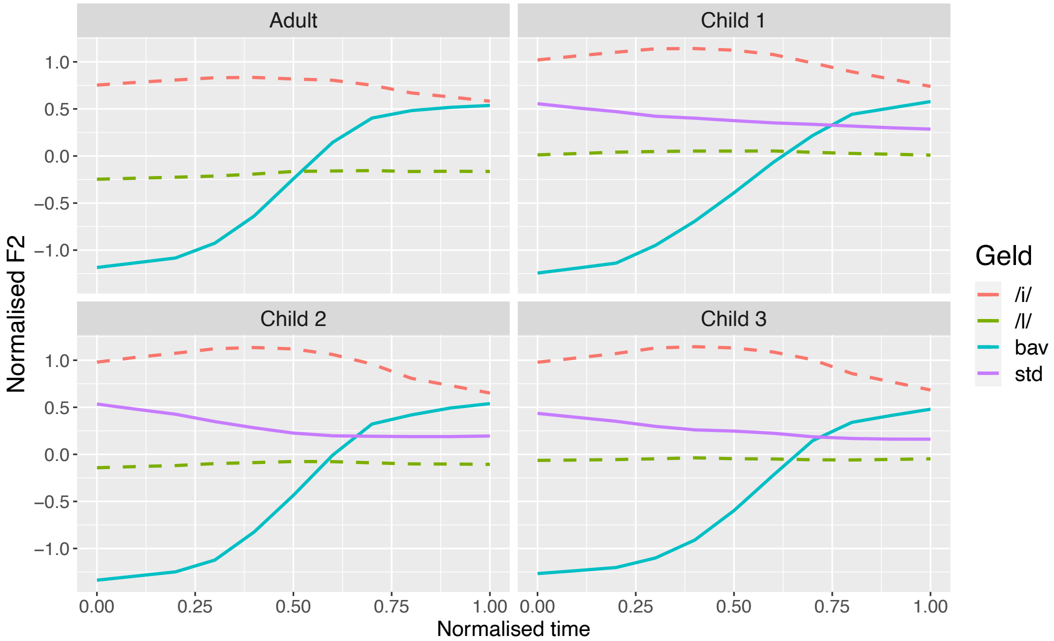


Fig. 27. F2 trajectories for /oi/ (blue; WCB pronunciation) and /ɛl/ (purple; SG pronunciation) within the word *Geld*, aggregated by word and speaker group (adults; year 1, year 2 and year 3 children). Dashed red/green correspond to the trajectories of baseline /i/ (from *Wiese*) and /l/ (from *Müll*) respectively.

This first overview of the acoustical properties of the V+/l/ words allowed us to reassure that, first, there are acoustically apparent differences between SG and WCB and, second, that the similar words are indeed acoustically similar and the divergent words are indeed acoustically divergent.

4.3.1.2 Distances to baseline /i/ and /l/

Since WCB vocalized /l/ and SG /l/ were observed to be acoustically separable we further assessed our hypotheses of (H1) whether there is a shift of WCB vocalized /l/ towards a more consonantal /l/ in words that are acoustically similar to SG as opposed to words that are acoustically divergent and (H2) whether such a shift is more pronounced in children compared to adults, and also increasingly so from year 1 to year 2 to year 3 within the child group.

For this purpose, we determined the relative distances from the end of the V+/l/ segments to baseline /i/ just as to baseline /l/. We were looking at the distances to both baselines because further away from /i/ does not necessarily imply closer to /l/ and the other way round. By taking both anchor points into account the results and direction of the distance calculations can be better decoded.

The difference between the second half of the trajectories of the diphthongs from the WCB utterances and /i/ as well as /l/ was assessed by calculating the inter-Euclidean distances in a three-dimensional F2-DCT space between all vocalized /i/-vowels to the combined centroid of baseline /i/ (or /l/) and *vice versa* separately by speaker and separately for each word following equation (2), Section 2.2.3 (see Section 4.2.3 for a more detailed description).
The Euclidean distances are larger the further the second half of the trajectory of the respective diphthong is apart from /i/ or /l/, respectively.

In the case of a shift, we would expect the distances of the children's vocalizations to be further apart from the baseline /i/ (since they are shifting towards /l/) as compared to adults, as well as a greater distance of /oi/, /ui/ in *Holz* and *Stuhl* (which are acoustically similar to SG and therefore more prone to change) to /i/ as compared to *Geld*, *Brille* and *Spiel*.
The expectations for the distances of the vocalizations to baseline /l/ are the other way around. That is, children's productions are expected to be closer to /l/ (hence smaller distances) as the adults' and the distances of *Holz* and *Stuhl* to /l/ should also be smaller as those of *Geld*, *Brille* and *Spiel*.

Concerning the distances from the second part of the trajectory of /oi, ui/ towards /i/ the results (Fig. 28) show greater inter-Euclidean distances for children at all three timepoints than for adults but no increasing distance from year 1 to year 2 to year 3. Further, none of the words of the acoustically similar group (*Holz*, *Stuhl*; framed in Fig. 28) manifests greater distances from /i/ than the words of the acoustically divergent group. The results of the mixed model as in formula (3) (Section 2.2.3) calculated separately per word showed significant differences between adults and children at all three timepoints for all words but no significant differences in the distances between neither of the child groups (see Table 2).

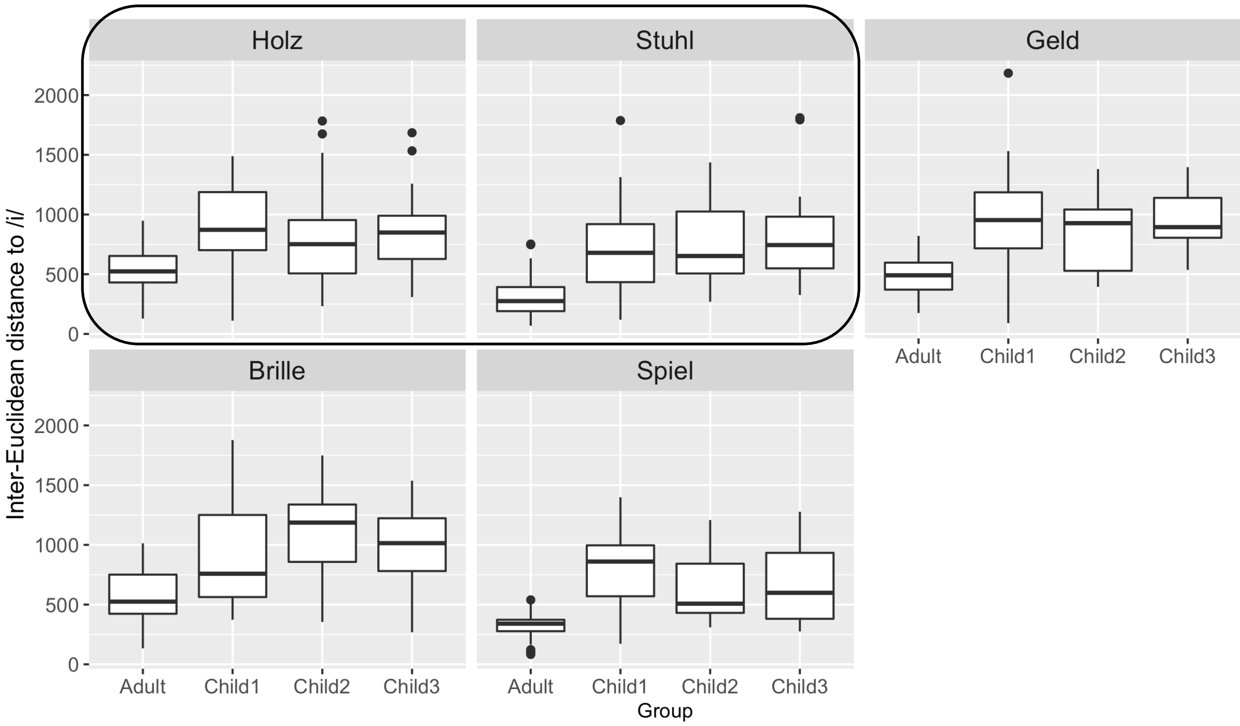


Fig. 28. Inter-Euclidean distance calculated in a 3-dimensional F2 DCT-space between the second half of /oi/ (in *Holz*, *Geld*) or /ui/ (in *Stuhl*, *Brille*, *Spiel*) and /i/ (in *Wiese*) for adults and three groups of children recorded in their first (Child 1), second (Child 2) and third (Child 3) year of school attendance. The words assigned to the group of acoustically similar words are framed.

Results for the inter-Euclidean distance calculations from the second part of the trajectory of /oi, ui/ to /l/ (Fig. 29) reveal distances of about the same height for all age groups. Again, the words of the acoustically similar group (*Holz*, *Stuhl*; framed in Fig. 29) show no apparently different behavior concerning the distance to the baseline vowel than the acoustically divergent words (*Geld*, *Brille*, *Spiel*).

The results of applying a mixed model as in equation (3) separately per word revealed no significant differences of the inter-Euclidean distances between the age groups except for *Brille*, where the adults' distance was significantly lower than the children's, and *Spiel*, where the children in year 2 and year 3 differed significantly from the children in year 1 (see Table 2).

Hence, there was no decrease of inter-Euclidean distances from the adults to the children and neither from the children from year 1 to year 2 to year 3.

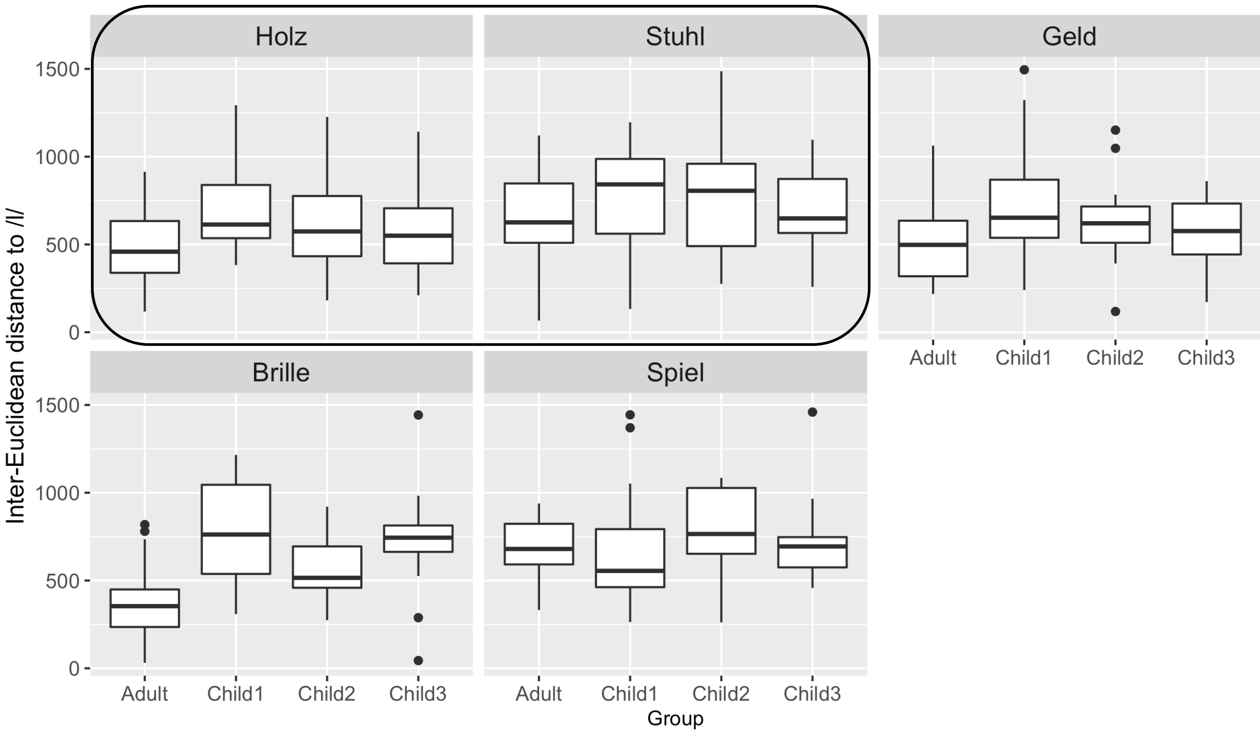


Fig. 29. Inter-Euclidean distance calculated in a 3-dimensional F2 DCT-space between the second half of /oi/ (in *Holz*, *Geld*) or /ui/ (in *Stuhl*, *Brille*, *Spiel*) and /l/ (in *Müll)* for adults and three groups of children recorded in their first (Child 1), second (Child 2) and third (Child 3) year of school attendance. The words assigned to the group of acoustically similar words are framed.

Table 2: Significant results from the linear mixed model with the Euclidean-distances from the second half of the diphthong /oi, ui/ to either /i/ or /l/ as the dependent variable, compared between the different age groups (adults, children from year 1, year 2 and year 3).

Baseline phoneme	Word	Compared groups	df	t	p
		Adult vs. Child 1	36.4	-5.8	< 0.0001
	Holz	Adult vs. Child 2	40.8	-5.3	< 0.0001
		Adult vs. Child 3	41.1	-5.5	< 0.0001
		Adult vs. Child 1	34.1	-6.0	< 0.0001
	Stuhl	Adult vs. Child 2	37.1	-6.1	< 0.0001
		Adult vs. Child 3	37.3	-6.9	< 0.0001
/i/		Adult vs. Child 1	20.9	-4.6	< 0.001
	Geld	Adult vs. Child 2	21.8	-4.2	< 0.01
		Adult vs. Child 3	21.4	-4.9	< 0.001
		Adult vs. Child 1	27.7	-4.3	< 0.001
	Brille	Adult vs. Child 2	28.5	-4.4	< 0.001
		Adult vs. Child 3	28.7	-4.3	< 0.01
		Adult vs. Child 1	16.6	-4.2	< 0.01
	Spiel	Adult vs. Child 2	18.6	-3.6	< 0.01
		Adult vs. Child 3	17.6	-4.2	< 0.01
		Adult vs. Child 1	13.2	-4.7	< 0.01
	Brille	Adult vs. Child 2	13.3	-4.5	< 0.01
/l/		Adult vs. Child 3	13.4	-4.3	< 0.01
		Child 1 vs. Child 2	181.9	-2.9	< 0.05
	Spiel	Child 1 vs. Child 3	182.0	-2.6	< 0.05

4.3.1.3 Differences between acoustically similar and divergent words

As mentioned earlier (Section 4.1.1), the vocalization of the post-vocalic lateral lead to two new diphthong phonemes in WCB, namely /oi/ and /ui/. However, the corresponding V+/l/ combinations in SG can be diverse (see Fig. 3, Section 1.4 for an association between SG vowels before /l/ and WCB diphthongs).

Since the hypothesis was that there is a shift of WCB vocalized /l/ towards a more consonantal /l/ in words that are acoustically similar to SG as opposed to words that are acoustically divergent, we were next directly comparing the WCB trajectories of one word being acoustically similar to SG with one word from the acoustically divergent group but both produced with the same diphthong in WCB. If children are being influenced by SG, they should show differences within the formant trajectories of the same WCB diphthongs depending on whether the corresponding SG pronunciation is similar or not. For WCB /oi/ the only words available for comparison were *Holz* and *Geld*. For WCB /ui/ *Spiel* and *Stuhl* were chosen for comparison since in both words the diphthong is in utterance final position (as opposed to *Brille* /bruin/), providing a better basis for contrasting them.

Figure 30 shows the F2 trajectories of WCB /oi/ from the words *Holz* (acoustically similar; WCB /h**oi**ts/) and *Geld* (acoustically divergent; WCB /g**oi**t/). In case of a shift of the WCB vocalized form towards a more consonantal pronunciation we would expect the F2 trajectory of /oi/ in *Holz* to be lower (and therefore in the direction of SG /l/) than that of /oi/ in *Geld*, especially towards the end of the segment and particularly for children. The trajectories (Fig. 30), aggregated over all speakers per age group, do not reveal any obvious shift. We therefore calculated the differences between the /oi/-trajectories of *Geld* and *Holz* by subtracting the mean F2 trajectory of *Holz* from the mean F2 trajectory of *Geld* separately for each speaker. The result of this subtraction is represented as trajectories over time in Figure 31.

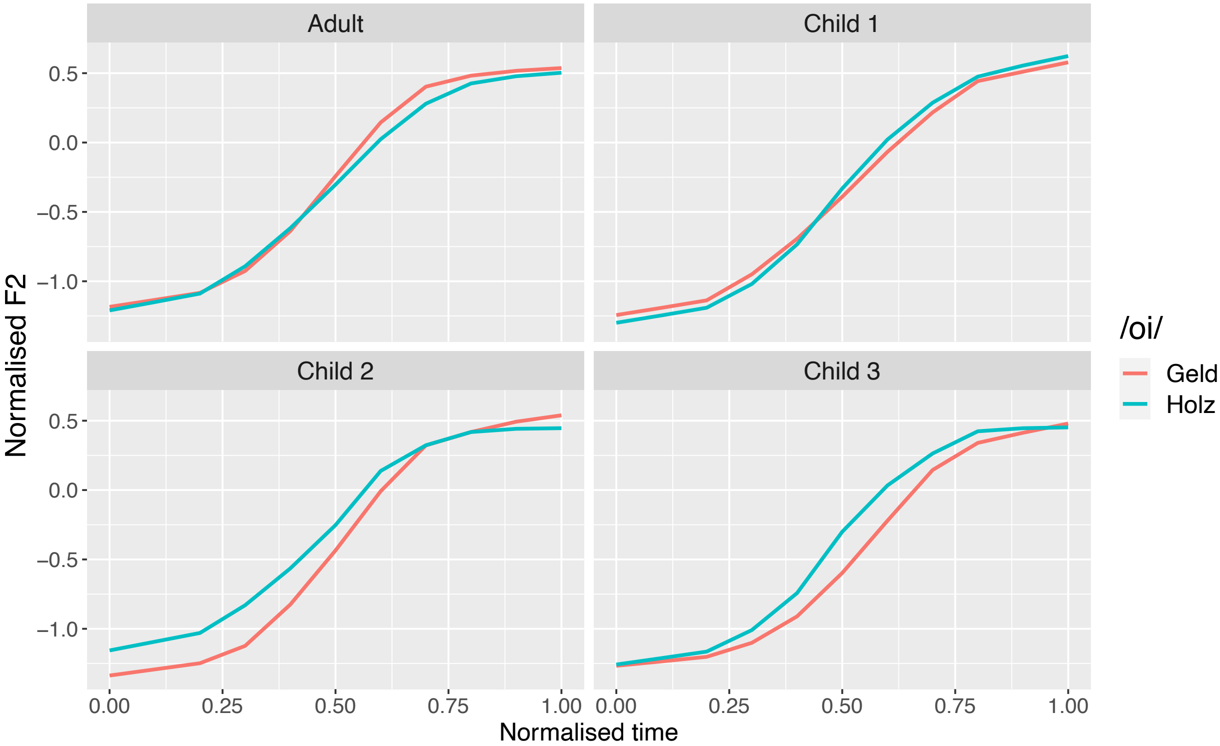


Fig. 30. F2 trajectories of /oi/ within the words *Holz* (blue) and *Geld* (red), aggregated by word and speaker group (adults; children in their 1st, 2nd and 3rd of school attendance).

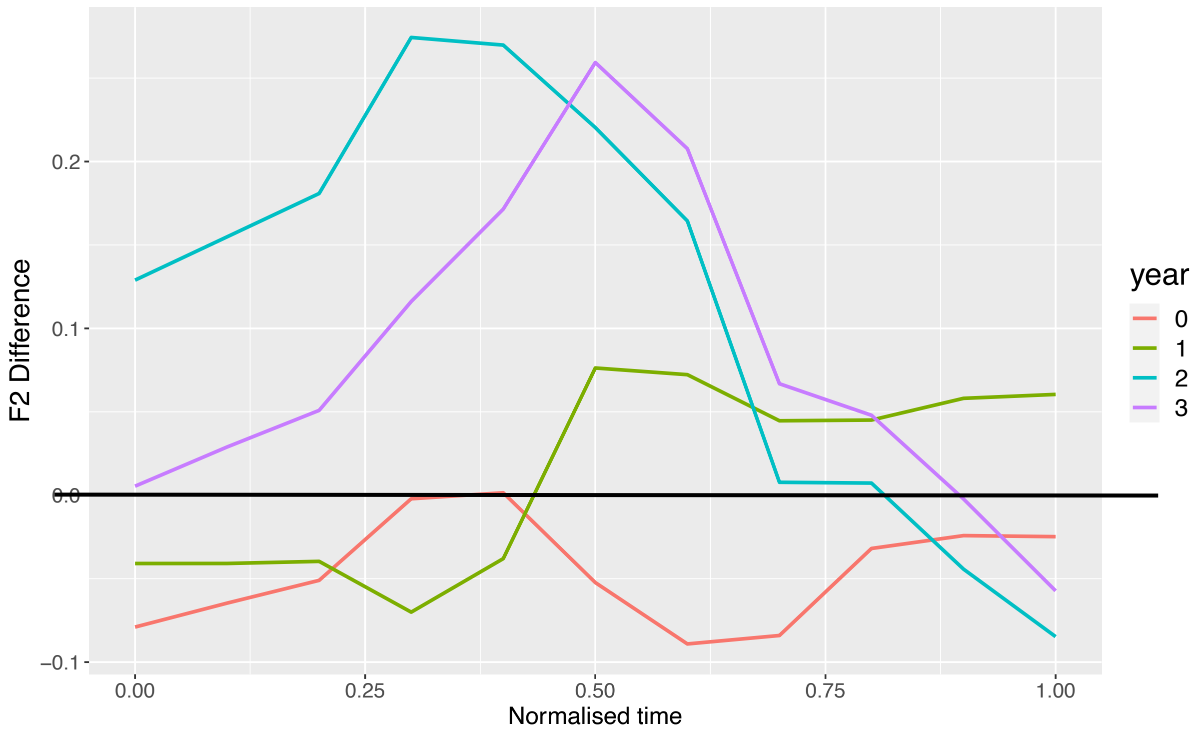


Fig. 31. F2 differences resulting from the subtraction of the mean F2 trajectory of /oi/ in *Holz* from the mean F2 trajectory of /oi/ in *Geld*, calculated separately per speaker. The values are represented as trajectories over time, aggregated by speaker group (0 = adults, 1 = year 1 children, 2 = year 2 children, 2 = year 3 children).

The calculation of the F2 differences exhibits a generally greater difference between the two /oi/ trajectories for children as compared to adults, especially for children in their 2nd and 3rd school year. However, these differences arise rather in the middle of the diphthong trajectories. Regarding the end of the trajectories, F2 of /h**oi**ts/ is lower than the F2 of /g**oi**t/ for adults, year 2 and year 3 children. For the children of year 1 the F2 of *Holz* becomes even higher compared to *Geld* in the second half of the /oi/ trajectory. Nevertheless, these differences between the two /oi/ trajectories as well as between the age groups are very small.

The same approach was applied to the diphthong /ui/. Here, the F2 trajectories from the words *Stuhl* (acoustically similar; WCB /ʃt**ui**/) and *Spiel* (acoustically divergent; WCB /ʃp**ui**/) were compared (Fig. 32). Again, the expectation in case of a shift from WCB vocalized /l/ towards SG /l/ would be a lower F2 trajectory of /ui/ in *Stuhl* than that of /ui/ in *Spiel*, especially towards the end of the diphthong and even more pronounced in children as compared to adults.

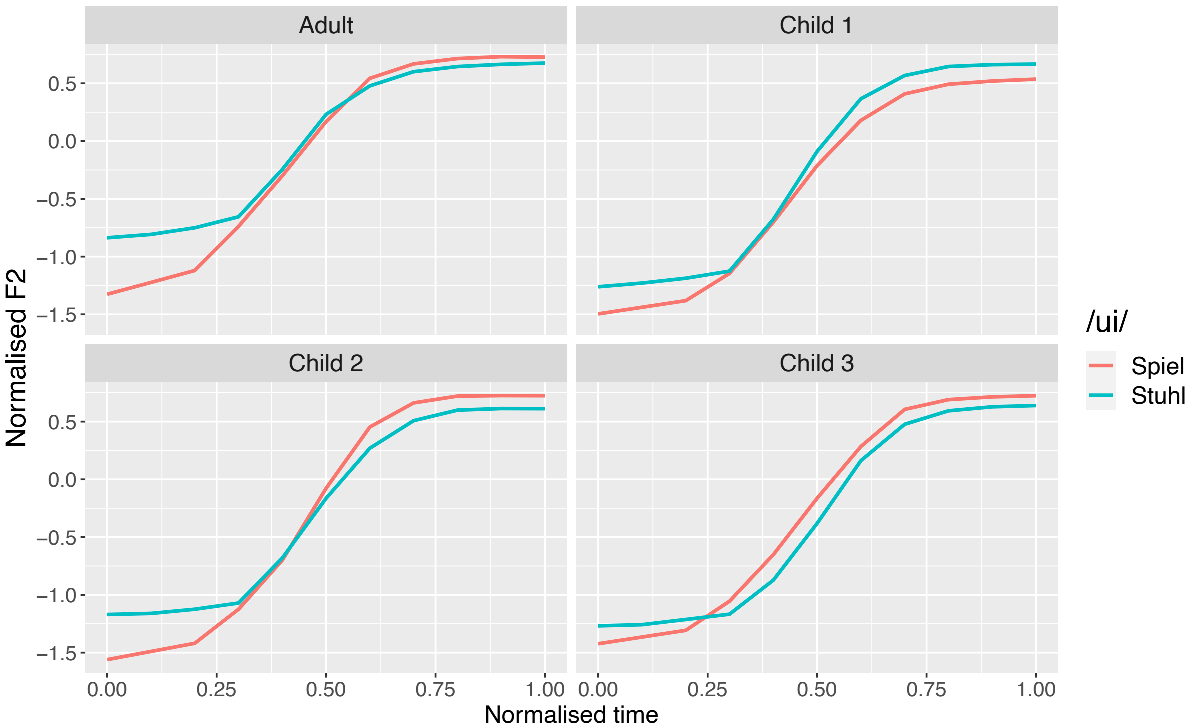


Fig. 32. F2 trajectories of /ui/ within the words *Stuhl* (blue) and *Spiel* (red), aggregated by word and speaker group (adults; children in their 1st, 2nd and 3rd of school attendance).

Again, the two trajectories appear to process similar for all speaker groups, at which especially the first part of the diphthong seems to differ insofar as the F2 of the /u/ in /ʃpui/ (*Spiel*) is lower than the /u/ in /ʃtui/ *(Stuhl)*.

This difference is also apparent in the F2 difference between the two /ui/-trajectories in Figure 33 calculated the same way as described earlier for /oi/. Alle age groups exhibit a difference in the first part of the trajectories whereas this difference is greatest for adults. Regarding the differences towards the end of the trajectories, F2 of /i/ in /ʃtui/ is lower for adults and children in the 2nd and 3rd school year. The F2 of the children in their 1st year is once again even higher than the F2 of /i/ in /ʃpui/. However, these differences range again on a very small scale, especially in the second half of the trajectory.

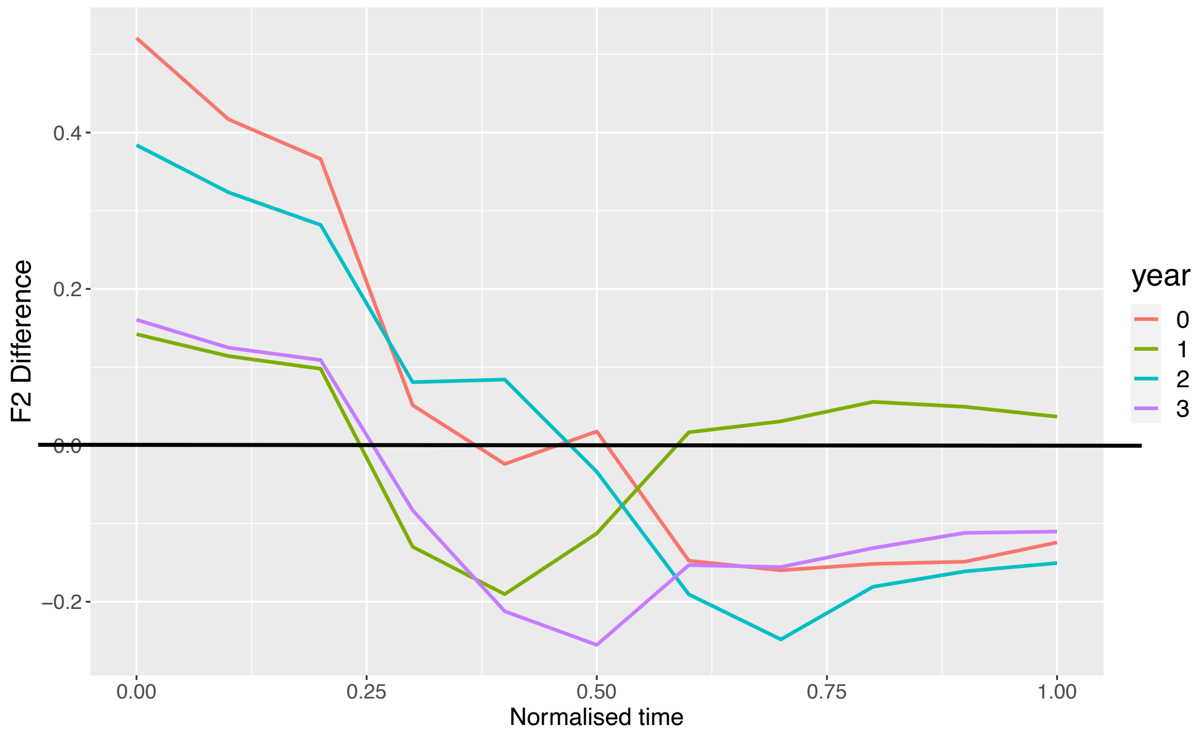


Fig. 33. F2 differences resulting from the subtraction of the mean F2 trajectory of /ui/ in *Stuhl* from the mean F2 trajectory of /ui/ in *Spiel*, calculated separately per speaker. The values are represented as trajectories over time, aggregated by speaker group (0 = adults, 1 = year 1 children, 2 = year 2 children, 2 = year 3 children).

4.3.2 Articulatory data

As the acoustic data indeed clearly discriminated WCB /oi/ and /ui/ from SG V+/l/ but did not exhibit explicit evidence for a greater shift of WCB vocalized /l/ towards consonantal /l/ in words that are acoustically similar to SG, neither for children nor for adults, we consulted the articulatory data in order to investigate whether articulation matches the acoustics or if we can observe any peculiarities within the gestures of the front vowel.

4.3.2.1 Overview

In a first step we were looking at the tongue shape in terms of values for tongue curvature and tongue curvature position as described in Section 2.3.3 using equations (5) and (6), respectively. If the produced phoneme is more /l/-like it is supposed to have a smaller curvature value and a greater position value. In the case of a more /i/-like pronunciation a greater curvature value and a smaller position value is expected. For the remainder, the data presented below is obtained from the children in their 2nd year of school attendance.

The plot of the calculated curvature and position values taken at the relative time point 0.8 (i.e., towards the end) of either the diphthong (in case of WCB pronunciation) or vowel-lateral segment (in case of SG pronunciation) of the five target words (*Holz, Stuhl, Spiel, Brille, Geld*) in Figure 34 shows that the two varieties are articulatory generally discriminable by means of the extracted measures of tongue curvature and position. Thereby the main difference between the SG lateral and the WCB vocalic production was found in the values of the curvature.

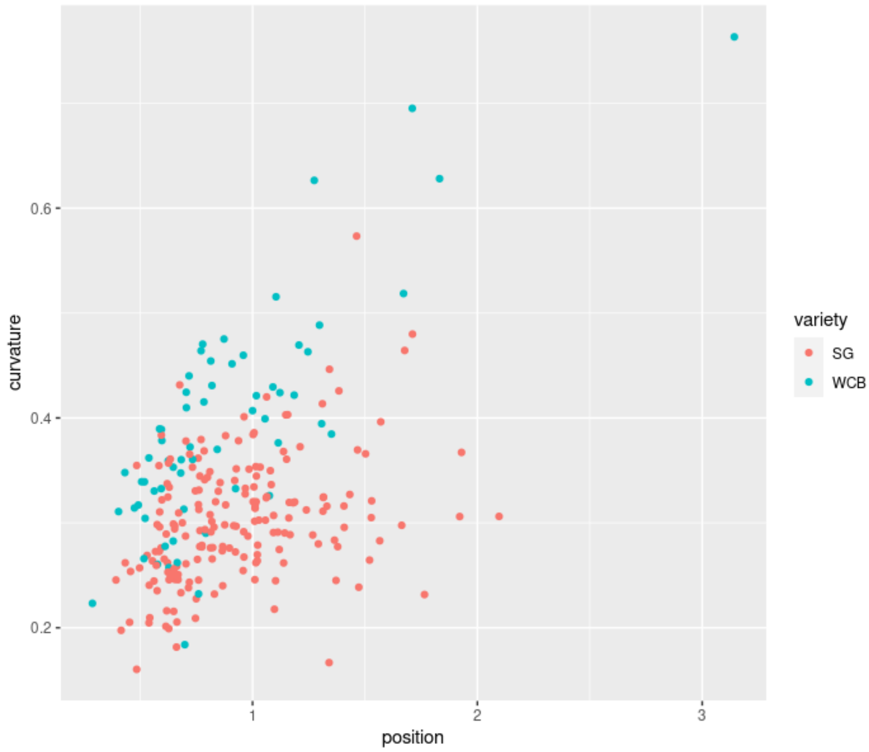


Fig. 34. Values of tongue curvature (y-axis) and position (x-axis) at time-point 0.8 of the diphthong or V+/l/ Segment for the children in their 2nd year of school attendance, separated by SG (red) and WCB (blue) pronunciation.

4.3.2.2 Distances to baseline /i/ and /l/

As the productions labelled as WCB or SG were shown to be not just acoustically but also articulatory separable we continued assessing from an articulatory point of view whether there is a (continuous) shift of WCB vocalized /l/ towards a more consonantal /l/ observable in words that are acoustically similar to SG as opposed to words that are acoustically divergent.

Analogical to the acoustic analyses we were looking at the differences of the words from the V+/l/ group to both the baseline /i/ extracted from *Wiese* and the baseline /l/ extracted from *Müll*. In the case of a sound change we would expect the articulatory patterns of the WCB vocalized /l/ to shift towards /l/ in the acoustically similar words (i.e, *Holz* and *Stuhl*), resulting in smaller curvature and higher position values in the similar words as compared to the un-similar. The position of either the diphthong (WCB pronunciation) or the vowel plus lateral segment (SG pronunciation) at time point 0.8 relative to /i, l/ was determined using the orthogonal projection following equation (8) (Section 4.2.3) from the combined curvature and position values of any V+/l/ segment to /i/ and /l/. Whether the values are in the direction of +1 or -1 indicates their relative proximity to /i/ or /l/, respectively. In the case of a shift, we would expect the values of the orthogonal projection to be closer to -1 within the words *Holz* and *Stuhl* as compared to *Geld*, *Brille* and *Spiel*. The results of the orthogonal projection calculated across all speakers in Figure 35 show that the segments produced in WCB on the right are consistently closer to the baseline /i/ than the segments with SG pronunciation on the left.

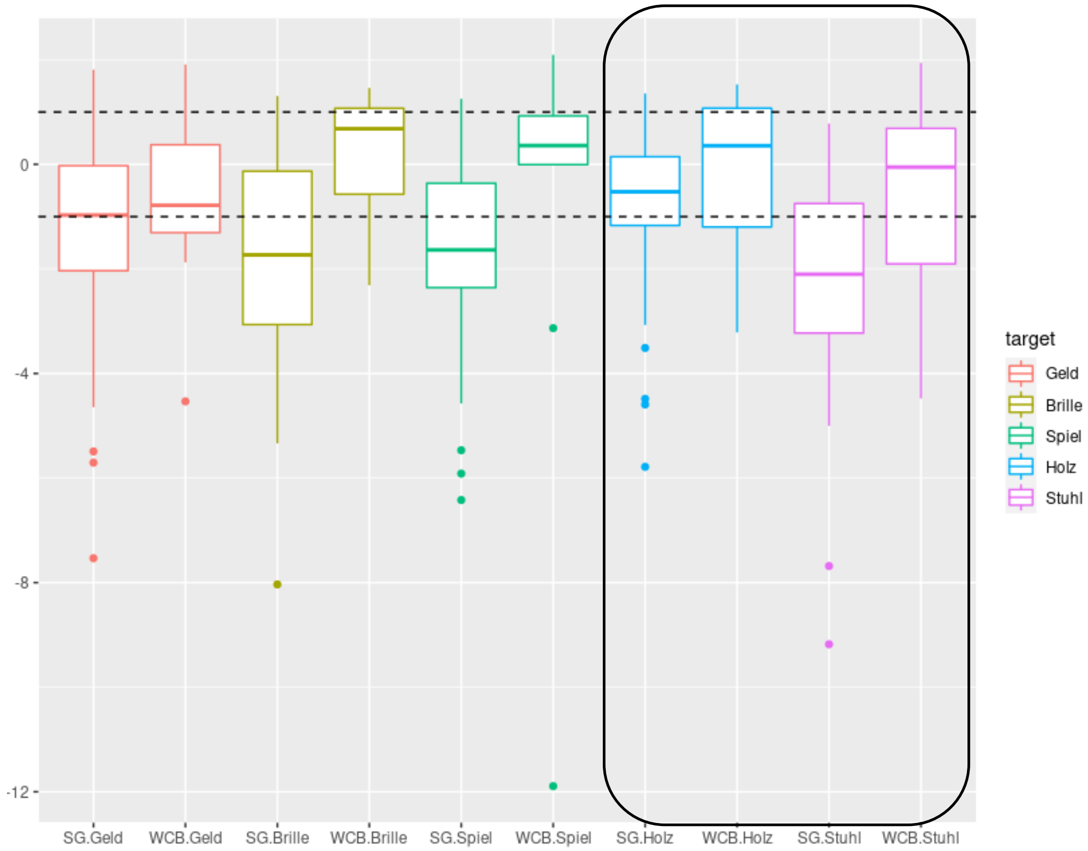


Fig. 35. Orthogonal projection values separately (color coded) for each target word for the SG V+/l/ segment (left, respectively) and the WCB diphthong (right, respectively) at timepoint 0.8. The dashed horizontal lines are at +1 and -1 and correspond to the aggregated orthogonal projection values of /i/ from *Wiese* and /l/ from *Müll* at timepoint 0.5, respectively. The words assigned to the group of acoustically similar words are framed.

The articulatory differences between the two varieties are greatest in *Brille*, *Spiel* and *Stuhl* while at the same time the articulatory patterns of the vocalized variant of the former two words are closest to baseline /i/. In *Geld* and *Holz* there is the least difference between WCB vocalized /l/ and SG /l/ at which in *Geld* the articulatory properties of the WCB pronunciation are closest to baseline /l/. Overall, there is no systematic difference between the words similar in SG and WCB (framed in Fig. 35) compared to the others. The articulatory patterns of the WCB production are closest to /i/ in *Brille* followed by *Spiel, Holz* and *Stuhl* and last *Geld*, which is even closer to baseline /l/ than to baseline /i/.

4.4 Discussion

The study has been concerned with the investigation of whether the post-vocalically vocalized lateral in West Central Bavarian becomes de-vocalized in certain words under the assumption that the WCB dialect is being influenced by Standard German. The question was addressed by documenting the differences between the fully vocalized lateral in WCB and its consonantal counterpart in SG both acoustically and articulatory. Based on the measurability of these differences we then predicted the circumstances and direction in which the WCB vowel might shift. As for the acoustic analyses WCB children were expected to diverge from WCB adults as they are assumed to be influenced to a greater extent by SG. The ultrasound data was used to zoom into the articulatory properties underlying the acoustic observations, for which reason the ultrasound recordings from children at one timepoint (in their second year of school attendance) were exemplarily regarded. We predicted the WCB front vowel that resulted from /l/-vocalization in post-vocalic position to shift towards a more consonantal pronunciation as present in the standard. This shift was expected for words that are acoustically similar between WCB and SG and especially for children.

The analysis of the children's speech showed that their dialectal productions exhibit undoubtedly WCB characteristics as they are in line with the adults' productions on the one hand and are clearly distinct to the sporadic standard productions of the same children on the other hand. However, none of our predictions could be verified. Looking at the acoustic data, there was no shift observable from WCB vocalized /l/ towards a more consonantal /l/ in words that are acoustically similar between WCB and SG, neither for adults nor for children at any of the three recording timepoints. While the calculations of inter-Euclidean distances could indeed show that the children's vocalized form was generally further apart from their baseline /i/ than it was the case for the adults (Fig. 28), the children were not closer to their baseline /l/ in comparison to the adults (Fig. 29). Further, the words assigned to the acoustically similar group did not reveal systematic differences in the realization of the vocalized lateral compared to the acoustically divergent words. The results of the subtraction of the F2-diphthong-trajectories of two words at a time that have the same diphthong in WCB (either /oi/ or /ui/) but differing V+/l/ segments in SG (i.e., one word from the acoustically similar group and one from the un-similar group) revealed similar trajectories, irrespective of the SG correlation (Figs. 30 and 32). Actually, the greatest differences between the WCB trajectories of acoustically similar and divergent words were neither for /oi/ nor for /ui/ in the second half of the trajectory (where a shift from /i/ towards /l/ and therefore a lower F2 in the acoustically similar words would have been expected) but rather earlier. Especially for /ui/ there was an obvious difference in the very beginning of the diphthong, i.e. between the realizations of the /u/ (Fig. 33). While one could argument that that the expected shift could possibly also start with an adaptation of the properties of the vowel preceding the vocalized /l/, we would again expect the acoustically similar word to have lower F2 values, signalizing a general acoustical drop of the second formant. Such a lowering effect on F2 in the case of a succeeding lateral becomes obvious in Fig. 24 where the F2 trajectories of the WCB and SG productions of *Stuhl* (/ʃt**ui**/ vs. /ʃt**u**ː**l**/, respectively) are displayed. While both trajectories exhibit a similar shape, the F2 of SG /uːl/ is consequently lower throughout the whole V+/l/ segment as compared to WCB /ui/. But since the values appear to be the other way round, i.e., the diphthong of the acoustically divergent word starts off with a lower F2, coarticulatory reasons seem to be more probable.

The articulatory data went hand in hand with the acoustic data. While the method chosen for the quantification of the tongue contour was capable of differentiating between /i/ and /l/ and could clearly distinguish the WCB vocalized variant from the corresponding SG lateral (Fig. 34), the distance calculations to either baseline /i/ or /l/ using orthogonal projection revealed no coherent trend dividing the articulatory properties of the vocalized /l/ in acoustically similar from those in the acoustically divergent words (Fig. 35). In the case of a shift, we would have expected the WCB productions of the acoustically similar words (*Holz, Stuhl*) to be closer to baseline /l/ as the un-similar productions (*Geld, Brille, Spiel*). However, the results showed that the vocalized /l/ in *Brille, Spiel* (un-similar) and *Holz* (similar) range about equally close to baseline /i/, while *Stuhl* (similar) is slightly lower (and slightly closer to baseline /l/ than to /i/) followed by *Geld* (un-similar) which is closest to baseline /l/.

Thus, we found neither acoustical nor articulatory proof for a sound change from the WCB post-vocalically vocalized lateral towards a standard-near consonantal pronunciation. Why isn't there any change within this category observable while the influence of the standard language on the dialect could be shown for many other vowel categories in Chapter III?

In general, in the history of examining sound change, many theories were proposed that may promote phonemes of a language to change. Our expectations were aligned to Ohala's approach (1993). In his theory he implies that sound change is led by misapprehensions as a result of ambiguities in how speech production is associated with the acoustic speech signal. He argues that small misapprehensions of pronunciation stay uncorrected on the listener's side, who then forms a new phonological norm that differs from that intended by the speaker. These altered pronunciations can then potentially be the beginning of a sound change. Our assumption therefore was that those WCB vocalized forms that are acoustically similar to SG have the potential to be perceptively confused by the children. Thus, the presumed trigger for de-vocalization is that (children) listeners parse the high vowel resulting from WCB lateral vocalization as coarticulatory undershoot of an actually intended lateral as it is produced in standard pronunciation. Additional to the general tendency of German dialects to shift towards the standard as described above (section 4.1) we expected the children to modify their WCB pronunciation norms in the direction of SG. However, not all perception errors lead to sound change. In fact, it is rather infrequent that such mis-perceptions of coarticulatory relationships occur in the first place and even more rare for them to spread throughout a community resulting in a sound change. Lindblom (1990) on the other hand claims that sound change arises from the interaction between minimizing the effort in speech production combined with the aim of the speaker to provide a speech signal that is perceptually sufficiently contrastive in order to be still properly understood. Following this approach sound change is speaker-driven and its origins lie in situational phonetic variation in the spectrum between hyper- and hypoarticulation and the undershoot resulting from the latter (Lindblom et al., 1995). Our predictions were furthermore based on previous studies showing that German varieties are being influenced by the standard (Scheuringer, 1990; Müller et al., 2011; Bukmaier et al., 2014; Kleber, 2017) as well as our own research (Chapter III) finding a shift in children's speech towards SG to be most likely when there is variation within the WCB sounds that encompasses those of SG phonetically. However, matching Lindblom et al.'s (1995) theory, this explanation applies to SG sound categories that result from hypoarticulation, i.e. undershoot and/or centralization, of WCB phonemes. Hence, while there is indeed an acoustic similarity between the WCB vocalization-diphthong and the SG vowel plus lateral segment in certain words, hypoarticulated variants of the WCB pronunciation would not lead to the SG form. Consequently, besides the acoustic similarity, an approximation from WCB vocalized /l/ towards a consonantal /l/ could be considered as unlikely from an articulatory point of view. Further, the outcome of this study is also in line with the findings in Chapter III where we could not observe any sound change of

WCB diphthongs towards SG categories, assuming the reason for this to be that diphthongs are such clear identifiers of WCB. A change within this category would be clearly categorical and intentional while the changes observed in section 3.3 were rather gradual and could take place on a subconscious level. The WCB /l/-vocalization on the contrary is, just as most of the WCB diphthong categories, a characteristic dialect marker. It is even referred to as one of the most salient features of the Bavarian dialect and is also considered as such by dialect speakers themselves (Rein, 1974)[20]. Previous work on dialect change has also found that a shift from a given dialect towards another is less likely when sounds are salient and established markers of a dialect (e.g., Sankoff, 2004; Nycz, 2013).

Also, regarding it from a more general point of view, while the vocalization of a lateral is quite common in the languages of the world, a change from the vocalized form (back) to the lateral is rather unusual. As Lindblom (1990) points out, individual languages tend to favor a small core of phonetic properties that occur consistently with minor variations in all systems. Such preferences also hold for sound change tendencies. There are some general sound change tendencies that have been found in many of the world's languages (see e.g. Harrington et al., 2019b for a more detailed list). What these changes have in common is an asymmetry in the direction of the shift. Applied to the present study this means that whereas there are several instances of a lateral becoming vocalized, this does not imply a shift in the other direction, i.e., from a vowel to a lateral, to be probable. This is also in line with Labov's idea (1994) of 'natural' factors which sound changes tend to follow. He postulated principles of chain shifting that comprise internal, structural motivations for vowel shifts that are important predictors for phonetic change (Torgensen & Kerswill, 2014). Again in terms of the present study, this would imply that the supposed sound change is highly unlikely for system-internal, phonetic reasons

[20] The saying „fui tsfui Gfui" (SG *viel zu viel Gefühl*) is a famous Bavarian shibboleth, meaning to demonstrate to strangers the special pronunciation of /il/, /yl/ as /ui/ (Rein, 1974).

since neutralizing sound changes (like the historic sound change of WCB post-vocalic /l/ towards /i/) tend not to be reversed.

Both Ohala's (1993) and Lindblom et al.'s (1995) models comprise the approach to explain sound change as emerging as a consequence of how speech production is perceptually processed (either by misapprehension on the listener's side or by variation due to adapting to the listener on the speaker's side, respectively). Following these theories, the beginning point of sound change lies in speech perception, meaning that perception leads production during a sound change in progress. There is also evidence for that in an apparent-time study of Kleber, Harrington, & Reubold (2012) investigating a sound change in progress concerning lax /ʊ/-fronting in Standard Southern British. In their study they compared younger and older speakers of this accent on the perception and production of coarticulation. Their results showed that, while the amount of coarticulation in /ʊ/ was about the same for both age groups in production, the degree to which listeners normalised for this coarticulatory effect was much less for younger than for older speakers. For this reason, a perception experiment accounting for the detection of a vocalized as well as a non-vocalized lateral of both younger and older dialect speakers could be useful to complete the examination of possible alterations within this sound category, since there is the possibility that in the very beginning of a sound change speech perception can be altered while no change to speech production has actually taken place yet.

Further, as mentioned in the introduction (section 4.1.3) laterals are highly prone to coarticulation. While our word list was built in order to capture as much WCB vowel categories as possible in diverse phonetic contexts, for the present study this selection caused a lot of variability making results harder to interpret and to subsume. Therefore, more words with WCB vocalized forms per SG vowel context would be advantageous to seek for more stable effects.

In summary, the main driving force for a sound change of the kind investigated in the present study would have been the influence of the standard language which has shown to be superimposed on German varieties. The lack of evidence for a shift leads to the conclusion that a mere social motivation is not sufficient to provoke the dialectal sound categories to change, at least for the investigated WCB dialect. This is in line with Lindblom et al.'s (1995) and Ohala's (1993) models that both consider phonetic-intrinsic characteristics to be the fuel for sound change as well as with Labov (2001) and Trudgill (2008) who have argued that sound change at least in its earliest stages may be non-social. Thus, while we believe that dialect contact does play an important role in dialect change as it serves as trendsetting attractor once a phoneme began to shift and largely predicts its direction, internal motivated factors (i.e., system-driven and motivated by general principles of vowel change) may play a more decisive role in inducing a shift.

However, we are aware that due to the limited scale of the study based on only 5 tokens, these conclusions have to be handled with care. Hence, the possibility must also be considered that the WCB diphthongs resulting from vocalization could be less stable when examined in a larger scope. But despite the restricted sample size and the absence of an indication to a sound change in progress in the category of WCB post-vocalically vocalized laterals in the present study, it provides a useful methodological contribution to reliably measuring and describing the properties of a syllable-final post-vocalic lateral compared to its vocalized counterpart, both acoustically and articulatory.

Summary and Conclusion

Chapter V

5.1 Summary

West Central Bavarian (WCB) is a German basic dialect that differs substantially from the standard language. These differences extend to all kinds of linguistic levels: Bavarian manifests differences in grammar, lexical forms, syllable structure, timing patterns, as well as phoneme inventories (Bannert, 1973; Zehetner, 1989). On the phonemic level, the differences are not only restricted to distinctions of the phonetic realization but are mostly also of systemic nature. That is, Standard German (SG) phonemes do not equal to one WCB phoneme with a different phonetic value but the associations are much more complex (cf. Fig. 3, section 1.4). While there are numerous linguistic studies concerned with the attempt to describe the WCB dialect, these are almost entirely based on individual auditory impressions (e.g., Zehetner, 1985; Merkle, 1976; Capell, 1979; Mansell, 1973a; Keller, 1961). However, even if the Bavarian dialect represents an autonomous system that is independent from SG, the dialect and the standard are in strong interaction (due to media, television, school-language, books, etc.).

The overall goal of this thesis was to provide a phonetically based investigation of the West Central Bavarian dialect and simultaneously investigate sound change in the shape of a shift of certain dialectal features in the direction of the standard variety. Sound changes of this kind have been reported for dialects in general (Nylvek, 1992; Boberg, 2004), German dialects more specifically (Müller et al., 2011; Harrington et al., 2012; Bukmaier et al., 2014) and in particular also the WCB dialect (Kleber, 2017). A further aim here was to determine the social and phonological properties that might affect the initiation, progress and direction of change in the speech sounds that were investigated. Therefore, we performed several analyses of various WCB vocalic features, differing in whether the investigated shift towards SG would take place on an unconscious level within a phonological category, whether a shift would be more salient affecting overt markers of WCB and whether or not a shift would be along a trajectory of phonological reorganization. The WCB vowels under investigation were chosen on the basis of descriptions of previous (impressionist) linguistic work on characteristic WCB features. A survey of those was compiled in Chapter I. The main commonality of the described and investigated attributes was that they were all distinct in relation to the corresponding standard pronunciation. Even though our database did not allow to account for all of the peculiarities outlined in Chapter I, nevertheless a diversified phonetic analysis of some of the defining vocalic features of WCB could be provided.

5.1.1 Chapter II: Method

In Chapter II, the methodological approaches and the corpus used in this thesis to address our aims were described. As one goal was to contribute to a phonetically based description of the characteristics of West Central Bavarian vowels, acoustic recordings of single words produced by WCB speaking adults and primary school children were conducted via a picture naming task. The stressed target vowels of the words were designed in order to provide a preferably large-scale acoustical representation of the WCB monophthong and diphthong spaces as well as for analysing various possible occurrences of sound change where WCB may shift towards SG as addressed in Chapters III and IV.

The speech of 21 adults and 20 children was compared in an apparent-time analysis, which has been shown to be a valid method for detecting dialect change (e.g., Bailey et al., 1991; Weinreich et al., 1968). Furthermore, the primary school children were repeatedly recorded at three consecutive timepoints in annual intervals. That is, starting off at the beginning of the children's first year in primary school, the same words of the same children were recorded again at the beginning of their second and third school year. This allowed us to complement the apparent-time comparison with longitudinal data from the same WCB speaking children to gain a more extensive view of whether WCB features are being transmitted to the younger generations on the one hand and the progress of potential vocalic shifts on the other hand. Additionally, the acoustic data was supplemented by articulatory data gained from ultrasound recordings of a subset (N=17) of the same WCB speaking children at two timepoints with a one year interval (i.e., during the children's 1st and 2nd year in primary school).

5.1.2 Chapter III: The influence of SG on the vowels and diphthongs of WCB

In Chapter III diversified acoustic analyses of phonemic changes in WCB were carried out, resorting to the longitudinal acoustic recordings of WCB speaking primary school children in comparison with the adult data.

The investigated features were chosen based on the compilation of WCB characteristics and their relationship to SG in Chapter I (section 1.4), and examined with regard to the assumption that WCB is being increasingly influenced by the standard. The focus was on six different analyses investigating predicted shifts from WCB towards SG. In all cases the analysis was of whether children diverged from adults and increasingly so in their second and third years.

First, open vowels were regarded, as WCB has an opposition of (at least) two open vowel qualities where the standard has just one. While SG /a/ is retracted and raised to /ɒ/ in WCB in native German and old loan words (Scheuringer, 2004; Stör, 1999a), the dialect reintroduced open, front /a/ in loanwords that were borrowed after the 16th century (Kleber, 2011; Kufner 1957; Scheuringer, 1990) (e.g., *Kabel* /k**a**:be/ vs. *Gabel* /g**ɒ**:be/ in WCB). These two open vowel phonemes in WCB were expected to merge and hence to be closer together for young than for old. Results showed that the F1xF2 distances between the two vowel categories were indeed smaller for children than for adults. Within the children even a longitudinal trend was observable; that is, the distance between /a/ and /ɒ/ decreased from year 1 to year 2 to year 3.

A similar result could be found for the shortening of the post-vocalic long consonant. There is an inverse quantity relationship between a vowel and the following consonant in WCB. That is, long vowels are predictably followed by short consonants (Vː C) and short vowels by long consonants (VCː) (Bannert, 1976). While in SG durational differences in vowels are always accompanied by distinctions in quality (long vowels are tense and short vowels are lax; Jessen, 1993), the complementary distribution of vowel length in WCB is merely durational and less qualitative (Capell, 1979). We determined whether we could find any evidence for such a long vs. short vowel distinction that is phonetically conditioned by a following short vs. long consonant, hypothesizing that the WCB contrast between VːC and VCː might collapse given that there is no such contrast in SG. We found that whereas the vowel quantity distinctions were maintained in all age groups, the quantity distinctions in consonants merged for children. Since the children's consonants seemed to level off at the length of the adult's short consonants, the greatest adult-child differences were expected in the duration of consonants after short vowels (which should be long following the VCː pattern). As indicated above, we found a decreasing trend in the duration of post-vocalic consonants after short vowels at least from adults to year 1 and year 2 children, while year 3 children ranged at a similar level as for year 2. This is in line with the findings of Kleber (2017) that younger WCB speakers started to produce differences in vowel length independently of the following consonant length.

As these WCB quantity correlations were supposed and shown to collapse, a further analysis was of whether this might give rise to the emergence of quality distinctions as present in the standard. For this purpose, we compared words that have the same quality in WCB but which are tense and lax in SG. This was done for words that have /i/ vs. /ɪ/, /e/ vs. /ɛ/ and /o/ vs. /ɔ/ in SG but /i/, /e/ and /o/ in WCB, respectively. We found that children started to produce quality distinctions for WCB /i/ and /e/ whereas the adults did not, but no group differences for /o/. Hence, we observed a shift (at least in /i/ and /e/) that pointed to the development of an SG-like quality contrast but no longitudinal trend within the children.

Traditionally, /i/ is described to be more centralized in the dialect as compared to the Standard close vowel. This conditions /e/ to be more peripheral than /i/ in the WCB vowel system (Schikowski, 2009). If the dialect is giving way to the influence of Standard German, then WCB /i/ should front (and/or raise) relative to WCB /e/, given that in SG /i/ is typically fronted and raised relative to SG /e/. Therefore, we tested whether /e/ is fronted relative to /i/ in adults and whether this relationship is being reversed in children. Our results showed that the F2 of /e/ was higher than the F2 of /i/ for adults but the other way around for children. Hence, there was an indication that the fronting relationship in /i, e/ had changed between adults and children.

A further difference in vowel quality between SG and WCB comes about as a process of derounding in WCB. Whereas there is a rounding opposition in the front vowel set in the Standard, front rounded /y, ʏ, ø, œ/ were derounded and coalesced with unrounded front vowels of the same height (Kufner, 1957) in WCB (i.e., e.g., /ø/ became /e/ and /y/ became /i/). The hypothesis here was that WCB should begin to show evidence of the development of such a rounding contrast in front vowels as present in SG. This was tested by means of words that are unrounded /e, ɛ/ in WCB but map to either /e/ or rounded /œ, ø/ in SG. We found evidence for the development of a rounding contrast in children as compared to adults but again no longitudinal differences within the children from one year to another. This was tested by means of words that are unrounded /e, ɛ/ in WCB but map to either /e/ or rounded /œ, ø/ in SG.

Another salient distinction between the dialect and the Standard is in the domain of diphthongs. While there are various differences in the mapping between the two varieties in this area, three kinds of mismatches were examined in Chapter III. First, we looked at instances where there is a monophthong in SG but a diphthong in WCB (SG tense /iː, yː, uː/ are realized as diphthongs in the dialect (Wiesinger, 1990; Kufner, 1957), e.g., SG *Fliege* /fliːgə/ 'fly', *Füsse* /fyːsə/ 'feet' and *Schuh* /ʃuː/ 'shoe' are /flɪaŋ/, /fɪas/ and /ʃʊa/ in WCB). Second, we investigated occurrences where one diphthong in SG maps to two different diphthongs in WCB (SG /aɪ/ that maps to either /ai/ or /oa/ in WCB, e.g., SG *Stein* /ʃtaɪn/ 'stone' is /ʃtoa/ in WCB whereas *drei* /draɪ/ 'three' is equal in both varieties (Scheuringer, 1990; Zehetner, 1989)). Third, we looked at SG /ɔʏ/, which maps with regularity to WCB /ai/ (e.g., *Feuer* 'fire' is /ɔʏ/ in SG and /ai/ in WCB). Therefore, we analyzed the WCB opening diphthongs /ia, ua/, exemplified by FLIEGE, FÜSSE in Fig. 3 (Chapter I), which were expected to shift in the direction of the corresponding SG monophthongs. In addition, we investigated whether WCB /oa, ai/ exemplified by STEIN, DREI show evidence of a merger, given that they both map to SG /aɪ/. Last, we examined a possible split of WCB DREI, FEUER given that these are both /ai/ in WCB but /aɪ, ɔʏ/ in SG. However, there was no evidence that the children had shifted towards SG in any of the diphthongs.

The overall conclusion was that sound change in WCB is most likely to happen if it applies to SG characteristics that already exist in the dialect, i.e. when there is variation in WCB sounds (e.g. due to hypoarticulation) that is phonetically directed towards those of SG.

5.1.3 Chapter IV: The realization of vocalized laterals in West Central Bavarian

The analysis in Chapter IV was on a further component in the domain of WCB diphthongs, namely /oi/ and /ui/ that resulted historically from /l/-vocalization. A salient feature of the WCB dialect is that the lateral /l/ is vocalized in syllable-final, post-vocalic position, resulting in the production of diphthongs where there is V+/l/ in SG (Kufner, 1957). In accordance with the assumptions in Chapter III we supposed a shift of young WCB speakers from vocalized /l/ towards a lateral as it is produced in the standard.

The possible sound change examined in this chapter is typologically rare for two reasons. First, it goes in the opposite direction as the more often described /l/-vocalization since we expect a vowel moving towards a lateral. Generally, /l/-vocalization is a common sound change tendency reported for many languages of the world (Recasens, 1996; Müller, 2011; Jongkind & van Reenen, 2007; Leemann et al., 2014; Nagórko, 1996) whereas the development from a vowel that resulted from former vocalization back to a lateral is hardly reported. Second, the investigated lateral-vowel continuum is between a clear /l/ and a front vowel whereas most studies concerning /l/-vocalization imply velarization of a dark /l/ (Hall-Lew & Fix, 2012).

The general aim of the study was to seek for a continuous change from a front vowel to a clear lateral acoustically as well as articulatorily and to relate acoustic and articulatory patterns to the initiation of sound change. The investigations in Chapter III have suggested that a sound change was most likely for WCB sounds that encompass those of SG and are thus similar enough to permit a gradual change. Following these findings, we assumed a sound change in progress in which the production of the WCB vocalized lateral shifts towards an actual consonantal lateral (as in SG) in words where the two varieties are acoustically similar. Again, such a shift was supposed to become evident in the productions of children as compared to adults and even more so in their second and third year of recordings.

According to the analyses in Chapter III, Chapter IV examined the acoustical properties of the post-vocalically vocalized lateral in the WCB dialect by means of a combined longitudinal and apparent-time acoustic analysis of dialect speaking adults and children at three different timepoints, resorting to the same corpus as in Chapter III and as described in Chapter II. However, since a lateral is a complex segment prone to coarticulation and acoustically elusive (Recasens & Espinosa, 2005; Hall-Lew & Fix, 2012), the acoustic patterns were additionally set into relation to articulatory data gained from ultrasound recordings of the children during their 2nd year in primary school.

To test our assumptions, V+/l/ words that are acoustically similar between the two varieties (i.e., *Holz* and *Stuhl*: WCB /h**oi**ts/ vs. SG /h**ɔl**ts/ and WCB /ʃt**ui**/ vs. SG /ʃt**u**ːl/) were compared to acoustically more divergent productions (i.e., *Geld, Spiel* and *Brille*: WCB /g**oi**d/ vs. SG /g**ɛl**t/, WCB /ʃp**ui**/ vs. SG /ʃp**i**ːl/ and WCB /br**ui**n/ vs. SG /b**ʁɪl**ə/). We expected to find acoustically as well as articulatorily a greater variability within the WCB production of the vocalized /l/, pointing in the direction of a shift towards an SG-like lateral. For the acoustic recordings these differences were again expected to be more pronounced for children as compared to adults and increasingly so for children in their third vs. their second vs. their first year in school.

The analyses of the acoustic data revealed no observable shift from WCB vocalized /l/ towards a more consonantal /l/ in words that are acoustically similar between WCB and SG, neither for adults nor for children at any of the three recording timepoints. The comparative look at the articulatory data of the children at one timepoint (2nd year of recordings/in primary school) displayed matching results. That is, there was no coherent trend observable dividing the articulatory properties of the vocalized /l/ in acoustically similar from those in the acoustically divergent words. Therefore, neither acoustical nor articulatory proof for a sound change from a WCB post-vocalically vocalized lateral towards a standard-near consonantal pronunciation could be found.

The general conclusion was that WCB /l/-vocalization might be – just as the diphthongs analyzed in Chapter III – a too salient and established marker of the dialect, making a gradual shift unlikely. Further, the expected shift goes in the opposite direction of a common sound change tendency and would have also quite unlikely been a result of variations in production due to e.g., hypoarticulation (cf. Lindblom et al., 1995), which has been argued to be the main mechanism underlying the sound changes found in Chapter III.

5.2 Conclusions, implications and future directions

The main conclusion that can be drawn from the findings in this thesis is that while dialect contact may play an important role in dialect change as a trendsetting attractor once a phoneme has begun to shift, internally motivated factors seemed to play a more decisive role in inducing a change. While the influence of the standard on the dialect is not deniable and a reliable predictor for the direction of change, the actual catalyst promoting a certain speech sound to change was found to follow general (non-social) principles of vowel change. That is, we could only find shifts in WCB sounds that were considered to be in the scope of hypoarticulation already directed towards those of SG. This is in line with findings of Harrington et al. (2015) who investigated the mechanisms by which coarticulatory variation can give rise to sound change. In their study they tested how prosodic weakening affects shortening in polysyllabic words by comparing German minimal pairs differing in vowel tensity in both monosyllabic and disyllabic words, produced in accented and deaccented contexts. The main finding of their study was that in hypoarticulated speech the information for separating coarticulation from categorisation is weakened, which in turn creates a certain ambiguity that can provide the conditions for sound change.

Another crucial point in the studies of this thesis was that all of the observed shifts were gradual and could take place below a speakers' conscious awareness (Labov, 1994). As Garret and Johnson (2013) argued, slight phonetic differences in production that are not consciously perceived by listeners may be more likely to be included amongst stored exemplars and therefore to lead to sound change. Stevens and Harrington (2014) also subsumed from evidence from imitation literature that phonetically similar variants would be more likely to undergo sound change. The findings in this thesis seem to support this claim. As soon as a change would imply a categorical change of a salient WCB feature (i.e., all of the analyzed WCB diphthong categories), no adult-child differences and therefore no indication for a sound change in progress could be observed. This leads to the conclusion that in the investigated variety the impact of dialect contact on sound change may be of a non-social kind and rather due to contact-based interaction and imitation in terms of assimilation.

However, the present thesis mainly focuses on phonetic analyses of West Central Bavarian vowels. While vowels are typically seen as carriers of sociolinguistic variation (Pinget, 2015), consonants are often neglected. Moreover, when taken into account, consonantal variables have generally often been analyzed auditorily rather than acoustically (Foulkes, Scobbie, & Watt, 2010) and particularly so for WCB (Schikowski, 2009; Kufner, 1960). A similar conducted study investigating the peculiarities of the WCB consonant inventory would be an enriching extension of the present attempt of an acoustically based description of the WCB dialect.

A further variable relevant for gaining knowledge especially in the investigation of sound change that was not considered in the present investigations is the role of perception. Perception is crucial to several models of sound change. For instance, both Ohala (1993) and Lindblom et al. (1995) explain the emergence of sound change as a consequence of how speech production is perceptually processed. Whereas in Lindblom et al.'s model the speaker plays an active part by varying his productions in order to adapt to the listener's needs, Ohala's model incorporates the idea that sound change may have a perceptual origin without even involving a change to speech production in the first place. Browman and Goldstein (1991) suggested that it is the interaction between perception and production in an individual's speech that causes a speech sound to move in a particular direction. Lin, Beddor and Coetzee (2014) found in their physiological study on /l/-vocalization in American English that small articulatory shifts in tongue aperture could cause a major difference in perception, supporting the idea that some changes may be slight on the part of the speaker but yet enough for a reinterpretation of a sound category on the part of the listener (Stevens & Harrington, 2014). A perception experiment concerning the categories in which we found evidence for sound change but just as well as for those in which we found no such evidence would be a meaningful complement for the interpretation of the origins and the progress of sound change.

One main aim of this thesis was to contribute to an acoustically based description of the WCB vowel system. Such an attempt requires a solid amount of speech data from dialect speakers, preferably of different age groups, producing a variety of WCB sounds in diverse phonetic contexts. Although the design of the presented studies tried to account for these requirements with a diversified wordlist and older and younger participants, with the younger ones recorded repeatedly as they grew older, there are some limitations to the conclusions that can be drawn from the study.

First, it always poses a challenge to gain dialect data in an experimental setting. Experimental situations may feel formal and unnatural to the participants, which in turn increases the probability to switch to the standard variety. We aimed to account for this difficulty with several measures. On the one hand, we conducted the recordings in the field and not in our laboratories, so that the participants could perform the task in familiar surroundings. Further, the task itself (i.e. picture-naming) was chosen in order to gain semi-spontaneous, dialectal data without orthographic influence while simultaneously controlling for the intended target sounds. For the children, the pictures representing the target words were additionally embedded in a gaming environment (as described in Chapter II) in order to create a more playful and less formal situation. However, we could not prevent particularly the child participants from sometimes producing the standard instead of WCB. Furthermore, the experimental setting may still be too artificial and unnatural behaviours or experimental artifacts cannot fully be excluded. For a study where the investigated phenomenon is interactional in its nature, the task would definitely be improved if it could be run in a more real-life situation, including more spontaneous interaction among the participants, even if that tremendously complicates the post-processing as well as the control for certain features of interest.

Second, our studies were based on a very small number of tokens per participant and hypothesis. This was conditioned by our attempt to create a word list that includes as much dialectal features as possible in diverse phonetic contexts. This goal was limited by the amount of recording time that could be accomplished for children as well as the available words as they had to be highly frequent and likely to be known to children as well as easy to visualize at the same time. In other words, the word list had to be kept short with many constraints concerning the pictures/words that could be presented. Therefore, each of the performed analyses would considerably profit and the results could be strengthened if based on more items.

Third, the acoustic analyses of this thesis were restricted to two age groups speaking one regional variety. It would be useful to record Standard German speakers with the same materials in order to further evaluate and more precisely interpret the amount of dialect levelling. This would also be relevant for verifying that there are no age dependent-differences between Standard speakers and therefore further exclude influences of age-grading. Additionally, acoustic recordings of intermediate age groups would be beneficial in order to determine potential intermediate stages of sound change in progress.

To conclude, the present thesis contributed to a diversified phonetically based description of some defining features of the West Central Bavarian vowel system. One of the main findings was that the speech of adults showed many of the defining characteristics of WCB that make it distinct and different from SG and that these are being transmitted to the younger generations. However, we found indications for a sound change in progress in many aspects of the children’s speech data. Therefore, this thesis further contributed to a better understanding of the underlying mechanisms of sound change by finding that the influence of SG and therefore dialect contact largely predicted the direction of a shift, but only when phonetically motivated conditions that favour sound change were met. That is, shifts were only observable in categories when potential variations of WCB sounds were phonetically already directed towards SG. In the present analyses, the influence of dialect contact on language change appears to be merely contact-based and as a result of a non-socially motivated accommodation process.

Zusammenfassung

Westmittelbairisch (WMB) ist ein Basisdialekt des Deutschen, der sich wesentlich von der Standardsprache unterscheidet. Diese Unterschiede erstrecken sich auf diverse linguistische Ebenen. So ist das Bairische durch Unterschiede in Grammatik, lexikalischen Formen, Silbenstruktur, Zeitstruktur sowie im Phoneminventar (Bannert, 1973; Zehetner, 1989) gekennzeichnet. Auf phonemischer Ebene beschränken sich die Unterschiede nicht nur auf Unterschiede in der phonetischen Realisierung, sondern sind meist auch systemischer Natur. Das bedeutet, dass standarddeutsche (SD) Phoneme nicht einfach einem bestimmten (unterschiedlichen) WMB Phonem zuzuordnen sind, sondern dass sich die Assoziationen weitaus komplexer (vgl. Abb. 3, Abschnitt 1.4) gestalten. Zwar gibt es zahlreiche linguistische Studien, die sich mit einer Beschreibung des WMB Dialekts befassen, diese jedoch fast ausschließlich auf individuellen Höreindrücken basieren (z. B. Zehetner, 1985; Merkle, 1976; Capell, 1979; Mansell, 1973a; Keller, 1961). Doch auch wenn der bairische Dialekt ein vom SD unabhängiges, autonomes System darstellt, stehen Dialekt und Standard in ständigem Austausch (durch Medien, Fernsehen, Schulsprache, Bücher etc.).

Das übergeordnete Ziel dieser Arbeit war eine Darstellung des westmittelbairischen Dialekts auf phonetischer Basis, kombiniert mit der Untersuchung eines möglichen Lautwandels in Form einer Verschiebung bestimmter Dialektmerkmale in Richtung der Standardvarietät. Solche Lautveränderungen wurden für Dialekte im Allgemeinen (Nylvek, 1992; Boberg, 2004), für deutsche Dialekte im Besonderen (Müller et al., 2011; Harrington et al., 2012; Bukmaier et al., 2014) und für den WMB-Dialekt im Speziellen berichtet (Kleber, 2017). Ein weiteres Ziel war es, die sozialen und phonologischen Eigenschaften zu bestimmen, die eine Auswirkung auf die Initiation, den Verlauf und die Richtung der Veränderung der untersuchten Sprachlaute haben können. Dazu wurden mehrere Analysen verschiedener

vokalischer Merkmale des WMB durchgeführt, die sich in der Frage unterschieden, ob der untersuchte Wandel in Richtung SG auf einer unbewussten Ebene innerhalb einer phonologischen Kategorie stattfindet, ob es sich um einen salienteren Wandel handelt, der allgemein bekannte Marker des Bairischen betrifft oder ob der Wandel entlang einer Linie der phonologischen Reorganisation verläuft. Die untersuchten WMB Vokale wurden auf der Grundlage von Beschreibungen früherer (impressionistischer) linguistischer Arbeiten zu charakteristischen Merkmalen des WMB ausgewählt. Eine Übersicht über diese wurde in Kapitel I zusammengestellt. Die wichtigste Gemeinsamkeit der beschriebenen und untersuchten Dialekteigenschaften bestand darin, dass sie sich alle von der entsprechenden Standardaussprache unterscheiden. Auch wenn unsere Datenbank es nicht ermöglichte, alle in Kapitel I beschriebenen dialektalen Besonderheiten zu berücksichtigen, konnte dennoch eine breit gefächerte phonetische Analyse einiger der definierenden vokalischen Merkmale des WMB präsentiert werden.

Methode

In Kapitel II wurden die methodischen Ansätze sowie der Korpus beschrieben, auf denen die Analysen in dieser Arbeit basieren. Um zu einer phonetisch basierten Beschreibung westmittelbairischer Vokale beizutragen, wurden akustische Aufnahmen von Einzelwörtern WMB sprechender Erwachsener und Grundschulkinder mithilfe einer Bildbenennungsaufgabe erhoben. Die betonten Zielvokale der Wörter wurden so gewählt, dass eine möglichst breit gefächerte akustische Darstellung des WMB Monophthong- und Diphthonginventars gewährleistet werden konnte, sowie verschiedene mögliche Formen von Lautwandel untersucht werden konnten, bei denen sich WMB Laute in Richtung SD verschieben, wie in Kapitel III und IV genauer behandelt.

Die Sprachdaten von 21 Erwachsenen und 20 Kindern wurden in einer *apparent-time* Analyse miteinander verglichen. Darüber hinaus wurden die Grundschulkinder zu drei aufeinanderfolgenden Zeitpunkten mit jährlichem Abstand wiederholt aufgenommen.
Dadurch konnte der *apparent-time* Vergleich mit longitudinalen Daten der immer gleichen WMB sprechenden Kinder ergänzt werden, was uns wiederum ermöglichte einen umfassenderen Überblick darüber zu erhalten, ob einerseits WMB Dialekteigenschaften an die jüngeren Generationen weitergegeben werden und wie andererseits potentielle vokalische Verschiebungen verlaufen.

Zusätzlich wurden die akustischen Daten durch artikulatorische Daten ergänzt, die aus Ultraschallaufnahmen einer Teilmenge (n=17) derselben WMB sprechenden Kinder zu zwei Zeitpunkten im Abstand von einem Jahr (d. h. während des 1. und 2. Grundschuljahres der Kinder) gewonnen wurden.

Der Einfluss von SD auf WMB Vokale und Diphthonge

In Kapitel III wurden breit angelegte akustische Analysen der phonemischen Veränderungen innerhalb des WMB durchgeführt, wobei auf die longitudinalen Aufnahmen von WMB sprechenden Grundschulkindern sowie auf die Erwachsenendaten als Vergleich zurückgegriffen wurde.

Die untersuchten Merkmale wurden auf Grundlage der Zusammenfassung einiger WMB Merkmale und deren Beziehung zu SD in Kapitel I (Abschnitt 1.4) ausgewählt und im Hinblick auf einen möglichen, wachsenden Einfluss vom Standard auf den Dialekt untersucht. Der Fokus lag auf sechs verschiedenen Analysen, die auf prognostizierten Verschiebungen von WMB in Richtung SD basierten. In allen Fällen wurde analysiert, ob Kinder sich von Erwachsenen unterscheiden, und das zunehmend im zweiten und dritten Aufnahme-/ Schuljahr.

Zuerst wurden offene Vokale betrachtet, da WMB eine Opposition von (mindestens) zwei offenen Vokalqualitäten hat, während im Standard hingegen nur eine existiert (z.B. KABEL /k**a**:be/ vs. GABEL /g**ɒ**:be/ in WMB). Hier wurde erwartet, dass sich die beiden offenen Vokalphoneme des WMB annähern und daher für die Kinder näher beieinander liegen als für die Erwachsenen. Die Ergebnisse zeigten, dass die F1xF2-Abstände zwischen den beiden Vokalkategorien bei Kindern in der Tat kleiner waren als bei Erwachsenen. Bei den Kindern war zusätzlich ein longitudinaler Trend zu beobachten, d. h. der Abstand zwischen /a/ und /ɒ/ nahm von Jahr 1 über Jahr 2 über Jahr 3 kontinuierlich ab.

Ein ähnliches Ergebnis wurde für die Kürzung des postvokalischen langen Konsonanten gefunden werden. Im WMB gibt es eine inverse Dauerbeziehung zwischen einem Vokal und dem darauffolgenden Konsonanten. Das hat zur Folge, dass auf einen langen Vokal vorhersagbar ein kurzer Konsonant folgt (Vː C) und auf einen kurzen Vokal ein langer Konsonant (VCː) (Bannert, 1976). Während im Standard Dauerunterschiede bei Vokalen stets von Qualitätsunterschieden begleitet werden (lange Vokale sind gespannt und kurze Vokale sind ungespannt; Jessen, 1993), ist die komplementäre Verteilung der Vokallänge in WMB lediglich durch einen Unterschied in der Dauer gekennzeichnet und weniger durch eine qualitative Unterscheidung (Capell, 1979). Die Untersuchung bestand darin, einen Nachweis für solch eine allophonische Unterscheidung zwischen langen und kurzen Vokalen zu finden, die phonetisch durch einen darauffolgenden kurzen vs. langen Konsonanten bedingt ist. Die Annahme hierbei war, dass sich die typisch WMB Korrelation zwischen VːC und VCː auflösen könnte, da ein solcher Kontrast im Standard nicht existiert. Die Ergebnisse zeigten, dass die Dauerunterschiede bei Vokalen in allen Altersgruppen beibehalten wurden, die konsonantischen Dauerunterschiede bei den Kindern allerdings zusammenfielen. Nach kurzen Vokalen (denen traditionell ein langer Konsonant folgt) fanden wir einen abnehmenden Trend in der Konsonantendauer von Kindern der 1. und 2. Klasse im Vergleich zu Erwachsenen, während die Kinder im 3. Jahr auf einem ähnlichen (niedrigen) Niveau wie im 2. Jahr rangierten.

Da vermutet und auch gezeigt wurde, dass sich die WMB Quantitätskorrelation auflöst, wurde in einem nächsten Schritt untersucht, ob das wiederum die Entstehung von Qualitätsunterschieden wie sie auch im Standard vorzufinden sind begünstigen könnte. Dazu haben wir Wörter verglichen, die in WMB die gleiche Qualität aufweisen, im Standard aber mit einem Qualitätsunterschied produziert werden. Für die Analyse wurden Wörter gewählt, deren Zielvokale in SD /i/ vs. /ɪ/, /e/ vs. /ɛ/ und /o/ vs. /ɔ/ wären, aber in WMB jeweils mit /i/, /e/ und /o/ produziert werden. Die Ergebnisse wiesen darauf hin, dass Kinder im Gegensatz zu den Erwachsenen in der Tat begonnen haben Qualitätsunterschiede für WMB /i/ und /e/ zu produzieren, während für /o/ keine Gruppenunterschiede nachweisbar waren. Das bedeutet, dass wir (zumindest für /i/ und /e/) eine Entwicklung beobachten konnten, die auf die Bildung eines standardähnlichen Qualitätskontrastes hindeutet, aber ohne einen Hinweis auf einen longitudinalen Trend innerhalb der Kinder.

Darüber hinaus wird im Dialekt laut Beschreibungen der hohe Vorderzungenvokal /i/ im Vergleich zum Standardvokal traditionell eher zentralisierter gebildet. Das hat zur Folge, dass /e/ im WMB Vokalsystem peripherer positioniert ist als /i/ (Schikowski, 2009). Wenn der Dialekt in dieser Kategorie vom Standarddeutschen beeinflusst wird, dann sollte WMB /i/ im Verhältnis zu WMB /e/ weiter vorne (und/oder angehoben) produziert werden, so wie es auch im SD der Fall ist. Daher wurde getestet, ob /e/ bei Erwachsenen frontierter produziert wird als /i/ und ob sich diese Beziehung bei Kindern umkehrt. Unsere Ergebnisse zeigten, dass bei den Erwachsenen der F2 von /e/ höher war als der F2 von /i/, während es bei den Kindern umgekehrt war. Das wiederum bedeutet einen Hinweis darauf, dass sich die relative Beziehung von /i, e/ als peripherster hoher Vokal im Vokalsystem zwischen Erwachsenen und Kindern geändert hat.

Ein weiterer Unterschied in der Vokalqualität zwischen SD und WMB ergibt sich durch einen Entrundungsprozess im WMB. Während im Standard der Bereich der Vorderzungenvokale eine Rundungsopposition aufweist, kam es im Dialekt zu einer Entrundung von /y, ʏ, ø, œ/ infolge derer diese gerundeten, vorderen Phoneme mit vorderen Vokalen gleicher Höhe zusammenfielen (Kufner, 1957) (d.h., z.B. /ø/ wurde zu /e/ und /y/ wurde zu /i/). Hier war die Annahme, dass sich im WMB Tendenzen, die auf die Entwicklung eines solchen Rundungskontrasts bei vorderen Vokalen wie er auch im Standard vorzufinden ist hindeuten, erkennen lassen sollten. Um dies zu testen wurde Wörter ausgewählt, deren Zielphoneme im Dialekt durchweg ungerundet sind (/e, ɛ/), aber im Standard entweder zu /e/ oder aber gerundetem /œ, ø/ zuzuordnen sind. Die Ergebnisse lieferten Hinweise auf die Entwicklung eines solchen Rundungskontrastes bei WMB Kindern im Vergleich zu Erwachsenen, wobei auch hier kein longitudinaler Trend innerhalb der Kinder von einem Jahr zum nächsten zu erkennen war.

Einer der deutlichsten Unterschiede zwischen Dialekt und Standard ist dem Bereich der Diphthonge zuzuschreiben. Während hier diverse Unterschiede in der Zuordnung zwischen den beiden Varietäten vorzufinden sind, wurden in Kapitel III drei Formen solcher Inkongruenzen untersucht. Zum einen wurden diejenigen Vorfälle genauer betrachtet, bei denen ein WMB Diphthong auf einen Monophthong in SD fällt (SD /iː, yː, uː/ werden im Dialekt als Diphthonge realisiert (Wiesinger, 1990; Kufner, 1957), z.B. SD FLIEGE /fliːgə/, FÜSSE /fyːsə/ und SCHUH /ʃuː/ sind /flɪaŋ/, /fɪas/ und /ʃʊa/ im WMB). Des Weiteren wurden Fälle untersucht, in denen der gleiche SD Diphthong zwei verschiedenen WMB Diphthongen zuzuordnen ist. Dies ist beispielsweise bei SD /aɪ/ der Fall, das im Dialekt entweder zu /ai/ oder aber zu /oa/ werden kann (z. B. SD STEIN /ʃtaɪn/ ist /ʃtoa / in WMB, während DREI /draɪ/ in beiden Varietäten gleich ist (Scheuringer, 1990; Zehetner, 1989)). Als drittes wurde SD /ɔʏ/ betrachtet, das im Dialekt in der Regel zu /ai/ wird (z. B. wird FEUER im SD mit /ɔʏ/ und im WMB mit /ai/ gebildet).

Die Analysen beinhalteten daher die WMB öffnenden Diphthonge /ia, ua/, bei denen erwartet wurde, dass sie sich in Richtung der entsprechenden SD Monophthonge verschieben. Darüber hinaus wurde untersucht, ob sich bei WMB /oa, ai/ Hinweise auf einen Zusammenfall finden lassen, da beide SD /aɪ/ entsprechen. Zuletzt wurde eine mögliche Spaltung im WMB Diphthong in Wörtern wie DREI, FEUER untersucht, die im Dialekt beide mit /ai/, im Standard aber mit /aɪ/ und /ɔʏ/ produziert werden. Im Allgemeinen konnten aber keinerlei Hinweise darauf gefunden werden, dass es bei den Kindern im Bereich der Diphthonge eine Verschiebung in Richtung des Standards gab.

Die allgemeine Schlussfolgerung war, dass ein Lautwandel im WMB dann am wahrscheinlichsten ist, wenn SD Merkmale betroffen sind, die in einer gewissen Form im Dialekt bereits existieren. Das bedeutet, es konnten nur dann Hinweise auf einen Lautwandel gefunden werden, wenn Varianten der intendierten WMB Phoneme (z.B. bedingt durch Hypoartikulation) phonetisch bereits in Richtung der Standardphoneme ausgerichtet waren.

Die Realisierung vokalisierter Laterale im Westmittelbairischen

Die Analyse in Kapitel IV behandelte eine weitere Komponente im Bereich der WMB Diphthonge, nämlich /oi/ und /ui/, die historisch betrachtet aus einer /l/-Vokalisierung hervorgingen. Ein hervorstechendes Merkmal des WMB Dialekts ist nämlich, dass der Lateral /l/ in silbenfinaler, postvokalischer Position vokalisiert wird. Dadurch entstanden Diphthonge in Segmenten, in denen im Standard nach wie vor V+/l/ produziert wird (Kufner, 1957). Angelehnt an die Annahmen in Kapitel III wurde eine Verschiebung von einem vokalisierten /l/ hin zu einem Lateral (wie er auch im Standard produziert wird) innerhalb junger WMB Sprecher vermutet.

Der Lautwandel, der in diesem Kapitel untersucht wurde ist aus zweierlei Gründen als selten zu betrachten. Zum einen verläuft er in die entgegengesetzte Richtung der häufig beschriebenen Lautwandeltendenz einer /l/-Vokalisierung, die für viele Sprachen der Welt berichtet wurde (Recasens, 1996; Müller, 2011; Jongkind & van Reenen, 2007; Leemann et al., 2014; Nagórko, 1996), da wir erwarteten, dass sich ein Vokal in Richtung eines konsonantischen Laterals bewegt.

Zum anderen liegt das untersuchte Lateral-Vokal-Kontinuum zwischen einem klaren /l/ und einem vorderen Vokal, während in den meisten Studien zur /l/-Vokalisierung ein dunkles /l/ Gegenstand der Forschung ist (Hall-Lew & Fix, 2012).

Die Untersuchungen in Kapitel III haben gezeigt, dass ein Lautwandel für diejenigen WMB Laute am wahrscheinlichsten war, die SD Lauten ähnlich genug waren, um eine graduelle Änderung zu ermöglichen. An diese Resultate angelehnt, wurde einen Lautwandel von einem im WMB vokalisierten Lateral in Richtung eines tatsächlich konsonantischen Laterals (wie im SD) bei solchen Wörtern und Segmenten vermutet, bei denen sich die beiden Varietäten akustisch ähneln. Solch eine Verschiebung sollte sich abermals in der Produktion von Kindern im Vergleich mit Erwachsenen zeigen, und dabei ggf. zunehmend im zweiten und dritten Jahr der Aufnahmen zutage treten.

Ähnlich zu den Analysen in Kapitel III, wurden in Kapitel IV die akustischen Eigenschaften eines vokalisierten Laterals im WMB Dialekt mithilfe einer Kombination aus longitudinaler und *apparent-time* Analyse untersucht. Das bedeutet, dass abermals dialektsprechende Erwachsene mit Kindern verglichen wurden, die wiederum zu drei aufeinanderfolgenden Zeitpunkten aufgenommen wurden. Hierfür wurde der gleiche Sprachkorpus wie in Kapitel III und wie in Kapitel II beschrieben verwendet.

Da es sich bei einem Lateral jedoch um einen komplexen Laut handelt, der anfällig für Koartikulation und daher akustisch schwer fassbar ist (Recasens & Espinosa, 2005; Hall-Lew & Fix, 2012), wurden die akustischen Merkmale zusätzlich in Relation zu artikulatorischen

Daten betrachtet, die durch Ultraschallaufnahmen der Kinder im zweiten Schuljahr gewonnen wurden.

Um unsere Annahmen zu testen, wurden V+/l/ Wörter, die sich in beiden Varietäten akustisch ähneln (d.h. *Holz* und *Stuhl*: WCB /hoits/ vs. SG /hɔlts/ und WCB /ʃtui/ vs. SG /ʃtuːl/) mit solchen verglichen, die akustisch mehr voneinander abweichen (d.h., *Geld*, *Spiel* und *Brille*: WCB /goid/ vs. SG /gɛlt/, WCB /ʃpui/ vs. SG /ʃpiːl/ und WCB /bruin/ vs. SG /bʁɪlə/). Die Erwartung war, dass die akustisch ähnlichen Wörter sowohl akustisch als auch artikulatorisch eine größere Variabilität innerhalb des WMB produzierten vokalisierten /l/s aufweisen, was wiederum als Hinweis auf eine Verschiebung hin zu einem standardähnlichen Lateral zu betrachten wäre. Bei den akustischen Analysen wurden wieder stärker ausgeprägte Unterschiede bei Kindern im Vergleich zu Erwachsenen erwartet, die sich wiederum weiter im zweiten und dritten Schuljahr ausprägen sollten.

Die Analysen der akustischen Daten ergaben allerdings weder für Erwachsene noch für Kinder zu einem der drei Aufnahmezeitpunkte eine beobachtbare Verschiebung von einem WMB vokalisierten /l/ zu einem eher konsonantischen /l/ in Wörtern, die sich im SD und im WMB akustisch ähneln. Der vergleichende Blick auf die artikulatorischen Daten der Kinder zu einem Zeitpunkt (2. Aufnahmejahr/ Schuljahr) zeigte übereinstimmende Ergebnisse. Auch hier war kein kohärenter Trend zu beobachten, der die artikulatorischen Eigenschaften des vokalisierten /l/ in akustisch ähnlichen von denen in akustisch abweichenden Wörtern unterscheiden würde. Somit konnte weder akustisch noch artikulatorisch ein Hinweis auf einen Lautwandel von einem WMB postvokalisch vokalisierten Lateral zu einer standardnahen konsonantischen Aussprache gefunden werden.

Die allgemeine Schlussfolgerung war, dass die WMB /l/-Vokalisierung – ähnlich wie die in Kapitel III analysierten Diphthonge – ein zu markantes und etabliertes Kennzeichen des WMB Dialekts darstellen, was eine graduelle Verschiebung unwahrscheinlicher macht.

Darüber hinaus ginge die erwartete Verschiebung wie bereits erwähnt in die entgegengesetzte Richtung einer weit verbreiteten Lautwandeltendenz und wäre zudem kein typisches Resultat von Produktionsschwankungen aufgrund von beispielsweise Hypoartikulation (vgl. Lindblom et al., 1995), was aber als einer der Hauptmechanismen angesehen wurde, denen die Lautwandel in Kapitel III zugrunde liegen.

Appendix A: Lexical Sets

Table A1. Words exemplifying the LEXICAL SETS for the SG-WCB correspondences shown in Fig. 3.

y	ia	FÜSSE, Gemüse, Kühe, müde, süß
i	ia	FLIEGE, Brief, lieb, Lied, schießen
i	ea	IHM, ihnen, Riemen, verdienen, Wien
i	i	WIESE, Dieb, Kies, Vieh, Zwiebel
ɪ	i	SPINNE, Liste, sitzen, Tisch, Winter
ʏ	i	SCHLÜSSEL, gesünder, Hütte, München, Stückchen
ʏ	u	DRÜCKEN, Brücke, hüpfen, nützen, zurück
ʊ	u	HUND, Butter, lustig, Rutsche, Suppe
u	u	ZUG, Bluse, Hupe, Nudel, super
u	ua	SCHUH, Bruder, Fuß, Kuchen, Kuh
ɔ	u	TROCKEN, Sommer, Sonne, Sonntag, umsonst
ɔ	o	ROCK, Frosch, Loch, Post, Stock
o	o	HOSE, groß, Ofen, Rose, tot
ɛ	ɛ	SCHNECKE, Fett, schwächer, Stecken, wetten
ɛ	e	BETT, Hände, länger, Messer, Wetter
ɛ	a	MÄNNER, Ente, kämmen Lämmchen, Rettich
e	ɛ	BESEN, beten, Reh, Schnee, weh
e	e	LESEN, Kleber, Regen, Steg, Weg
ø	ɛ	BÖSE, blöd, Größe, Höhe, stößen
ø	e	VÖGEL, Möbel, mögen, möglich, schön
œ	e	LÖFFEL, Frösche, Köche, können, Röcke
ɛː	ɛ	TÄTER, Bräter, Fräse, gelähmt, später
ɛː	a	KÄSE, Gläser, mähen, schämen, zäh
a	a	KABEL, Examen, Gas, Rahm, Spaß
a	ɒ	GABEL, Glas, Hase, Laden, Nadel
ɐ	a	SACK, Gasse, lassen, Platz, Spatz
ɐ	ɒ	PFANNE, Kamm, Klasse, Tasse, Katze
aʊ	au	HAUS, Kraut, Laus, laut, Maus
aʊ	a	BAUM, Daumen, glauben, kaufen, laufen
ɔʏ	a	BÄUME, räumen, streuen, träumen, versäumen
ɔʏ	ai	FEUER, Freude, Heu, Häuser, Teufel
aɪ	ai	DREI, Leim, weiß (the colour), Wein, Zeit
aɪ	oa	STEIN, Ei, klein, Leiter, zwei
aɪ	ea	STEINE, Breite, breiter, heißer, kleiner
al	oi	WALD, alt, halt, kalt, Salz
ɔl	oi	HOLZ, soll, Stolz, voll, Wolke
ɛl	oi	GELD, helfen, schnell, Welt, Zelt
ul/ʊl	ui	STUHL, Dult, Pulver, Schuld, Schule
ɪl	ui	BRILLE, Bild, gilt, Milch, will
il	ui	SPIEL, Petersilie, Stiel, viel, Ziel
yl	ui	GEFÜHL, Kanüle, Mühle, spülen, Stühle

Appendix B: Speech materials

Table B1. Recorded words, their target vowels, and the total number of repetitions correctly produced by adults and by children in years 1, 2 and 3. Recorded words that formed no part of the analysis in the study in Chapter III are marked in grey.

Target vowel	Word	English translation	Adults	Children year 1	Children year 2	Children year 3
/a/	KLASSE	class	77	50	56	53
	KÄSE	cheese	77	37	22	18
	KABEL	wire	83	68	65	61
	SÄGE	saw	17	11	1	4
/ɒ/	GLAS	glass	78	21	18	20
	SACK	sack	68	29	22	14
	HASE	rabbit	71	31	22	16
	GABEL	fork	73	27	24	24
/i/	TISCH	table	79	29	12	20
	DIEB	thief	21	55	54	37
	WIESE	lawn	79	68	52	57
	SPINNE	spider	84	74	70	61
	SCHLÜSSEL	key	25	3	4	2
	HÜTTE	cabin	53	4	5	2
	SCHÜLER	pupil	30	34	29	27
	MÜLL	waste	72	74	68	63
/u/	SUPPE	soup	82	72	70	64
	HUND	dog	76	75	69	61
	BUTTER	butter	82	72	71	62
	RUTSCHE	slide	81	76	71	63
/o/	HOSE	trousers	83	73	68	62
	ROSE	rose	84	77	69	62
	ROCK	skirt	80	22	11	18
	STOCK	stick	9	21	13	14
/ɛ/	SCHNECKE	snail	84	73	71	58
	BETEN	to pray	61	12	5	5
	SCHNEE	snow	43	7	10	3
	BESEN	broom	70	10	9	7
	REH	deer	65	3	7	12
/e/	LÖFFEL	spoon	83	22	14	15
	VÖGEL	birds	80	24	12	17
	LESEN	to read	66	64	59	50
	BETT	bed	81	38	25	20
	MESSER	knife	79	31	24	23
	WEISS	white	37	38	41	43

/ai/	DREI	three	84	72	67	61
	WEIN	wine	82	62	58	59
	FEUER	fire	84	19	14	16
	HÄUSER	houses	83	14	14	15
	HEU	hay	11	17	14	15
	EI	egg	71	14	8	9
/oa/	ZWEI	two	82	35	22	23
	STEIN	stone	84	38	26	18
	LEITER	ladder	83	13	17	17
	EINS	one	84	41	21	23
/ia/	FLIEGE	fly	79	26	19	20
	FÜSSE	feet	80	26	17	12
	KIRCHE	church	84	73	56	40
	LICHT	light	11	5	1	4
/ua/	SCHUH	shoe	82	41	28	15
	FUTTER	fodder	74	5	8	11
	SCHNUR	string	30	48	41	31
	UHR	clock	84	80	67	21
/oi/	GELD	money	43	26	15	20
	HOLZ	wood	71	34	25	12
/ui/	STUHL	chair	84	35	25	3
	BRILLE	glasses	81	13	14	8
	SPIEL	game	25	23	10	6

Appendix C: Vocalization of laterals

List and number of items used for the analysis in Chapter IV, with the proportional amount of WCB and SG productions included, divided by recording situation: Table C1 displays the tokens obtained from the ultrasound recordings and table C2 the tokens from the acoustic experiment. *Wiese* and *Müll* are not split into WCB and SG productions since the target vowel is the same for both varieties.

Table C1. Words used for the analysis recorded with ultrasound, their WCB target sounds, the total number of repetitions correctly produced by children in the 2nd year of primary school, as well as the proportion of WCB and SG productions.

Target vowel	Word	English translation	WCB productions	SG productions	Total productions
/oi/	Geld	money	11	41	52
	Holz	wood	16	39	55
/ui/	Stuhl	chair	18	37	55
	Brille	glasses	8	49	57
	Spiel	game	9	24	33
/i/	Wiese	lawn			41
/l/	Müll	waste			41

Table C2. Words used for the analysis from the acoustic recordings, their WCB target sounds, the total number of repetitions correctly produced by adults and by children in years 1, 2 and 3, as well as the proportion of WCB and SG productions.

	Target vowel	Word	English translation	WCB productions	SG productions	Total productions
Adults	**/oi/**	Geld	money	43		43
		Holz	wood	71		71
	/ui/	Stuhl	chair	84		84
		Brille	glasses	81		81
		Spiel	game	25		25
	/i/	Wiese	lawn			79
	/l/	Müll	waste			72
Children Year 1	**/oi/**	Geld	money	26	61	87
		Holz	wood	36	55	91
	/ui/	Stuhl	chair	37	58	95
		Brille	glasses	14	79	93
		Spiel	game	23	38	61
	/i/	Wiese	lawn			83
	/l/	Müll	waste			95
Children Year 2	**/oi/**	Geld	money	15	63	78
		Holz	wood	28	59	87
	/ui/	Stuhl	chair	25	63	88
		Brille	glasses	14	73	87
		Spiel	game	10	35	45
	/i/	Wiese	lawn			62
	/l/	Müll	waste			83
Children Year 3	**/oi/**	Geld	money	22	38	60
		Holz	wood	25	37	62
	/ui/	Stuhl	chair	29	33	62
		Brille	glasses	19	44	63
		Spiel	game	19	30	49
	/i/	Wiese	lawn			57
	/l/	Müll	waste			64

Appendix D: Parental letter

Liebe Eltern,

Wer den Elternabend am 21.9. besucht hat kennt mich bereits: Mein Name ist **Katrin Wolfswinkler** und ich bin Promotionsstudentin am Institut für Phonetik und Sprachverarbeitung der LMU München.
In unserem aktuellen Projekt zu *„Menschliche Interaktion und die Entwicklung von Akzent in der gesprochenen Sprache“* interessieren wir uns für den **boarischen Dialekt** und suchen deshalb Schulkinder der 1. und 4. Klasse, die im Elternhaus bairisch sprechen.
Meine Kontaktdaten für Fragen und genauere Informationen finden Sie auf der rechten Seite und zusätzliche Infos auf unserer Webseite http://www.phonetik.uni-muenchen.de/kids.

Für unser Projekt konnten wir die Unterstützung der Schulleitung und des Lehrerkollegiums der Nikodem-Caro-Grundschule Hart/Wald gewinnen.
Die Studie wird im Rahmen einer Unterrichtsstunde stattfinden, wobei die Lehrer garantieren, dass die teilnehmenden Kinder keinen Lehrstoff verpassen.

Was machen wir?

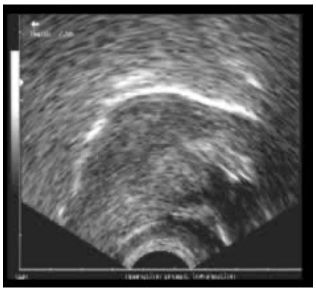
1. Sprachaufnahmen
   Den Kindern werden in spielerischer Form alltägliche Bilder gezeigt, die sie benennen sollen.
   Insgesamt dauert das Experiment (inkl. Vorbereitungszeit) ca. 30 Minuten und findet in den Räumlichkeiten des Schulhauses Wald statt.
   Die gesprochenen Wörter werden dabei mittels Headset-Mikrofon (ein sehr leichtes und an die Kopfgröße Ihres Kindes anpassbares Mikrofon) auf einem Computer aufgenommen.
   Die Kinder bekommen dafür ein Spielzeug Ihrer Wahl und einen Gutschein im Wert von 10€

   Da es unser Ziel ist, die **Entwicklung des Dialektes im Verlauf der Zeit** zu untersuchen, soll das Experiment (nur bei den Schülern der 1. Klasse) im Abstand von ca. 9 Monaten wiederholt werden, im besten Fall bis zum Ende der Grundschulzeit.

2. Ultraschallaufnahmen
   Ca. 6-8 Wochen nach den ersten Sprachaufnahmen wollen wir ein ähnliches Spiel mit den Kindern durchführen aber diesmal bekommen die Kinder die Sonde eines mobilen Ultraschallgeräts an ihren Kiefer.
   Das ermöglicht uns, die Bewegungen der Zunge zu verfolgen.

   Ultraschallaufnahmen sind Ihnen wahrscheinlich bisher hauptsächlich im Rahmen einer Schwangerschaft bekannt, was auch zeigt, dass dies eine vollkommen unbedenkliche Untersuchungsmethode ist.

   Die Ultraschallaufnahmen sorgen bei Kindern erfahrungsgemäß für eine Menge Spaß, da sie die Bewegung ihrer Zunge selbst live mitverfolgen können. Die Zungenkonturen sehen ähnlich aus, wie auf dem unteren Bild rechts. Die Aufnahme dauert mit Vorbereitungszeit ca. 45 min und Sie und Ihr Kind bekommen dafür einen Gutschein im Wert von 20€.



Hinweis: Die Sprachaufnahmen und die Ultraschallaufnahmen werden unabhängig voneinander durchgeführt (d.h. es wäre auch möglich, nur bei den Sprachaufnahmen teilzunehmen). Die Kinder haben die Möglichkeit, sich im Anschluss an das erste Sprachexperiment selbst an dem Ultraschallgerät zu versuchen und damit zu experimentieren, ohne dass Aufnahmen gemacht werden.

Datenschutz:
Alle personenbezogenen Daten – Ihre und die Ihres Kindes – werden streng vertraulich und anonymisiert behandelt. Außerdem wurde die Studie über die Ethikkommission der LMU München auf ethische Unbedenklichkeit geprüft und bewilligt.

Wenn Sie die Studie unterstützen möchten und Ihr Kind noch nicht angemeldet haben, dann melden Sie es gerne über unser Kontaktformular an:
http://www.phonetik.uni-muenchen.de/kids/kontakt.html
oder geben sie Ihrem Kind einfach den beigefügten Abschnitt bis zum **25.10.2017** mit.

Sobald wir eine Rückmeldung von Ihnen erhalten haben, bekommen sie nochmal ein detailliertes Informationsblatt zum genauen Ablauf der Experimente und den Datenschutzbestimmungen.

Wir freuen uns über jede/n Teilnehmer/in!

Mit herzlichen Grüßen,

Katrin Wolfswinkler

....

Ich, ____ willige hiermit ein, dass mein Kind

________________________________ an der Forschungsstudie zum Bairischen teilnimmt.

Er/Sie besucht die _____ Klasse.

E-Mail: ____

Tel./Handy: ____

………………………………..   ………………………………………..

Ort, Datum   Unterschrift

References

Adams, D. (2012). *The Hitchhiker's Guide to the Galaxy: The Complete Trilogy of Five*. Pan Macmillan: UK.

Articulate Instruments Ltd. (2017). *Articulate Assistant Advanced ultrasound module user manual, revision 2.16.* Articulate Instruments Ltd.: Edinburgh, UK.

Auer, P., Barden, B., & Grosskopf, B. (1998). Subjective and objective parameters determining "salience" in long-term dialect accommodation. *Journal of Sociolinguistics*, 2, 163–87.

Bailey, G., (2002). Real and apparent time. In: J.K. Chambers, P. Trudgill and N. Schilling-Estes (eds.), *The Handbook of Language Variation and Change*. Blackwell: Oxford, UK. (p. 312-332)

Bailey, G., Wikle, T., Tillery, J., & Sand, L. (1991). The apparent time construct. *Language variation and change*, 3(3), 241-264.

Bannert, R. (1973). Zur Stimmhaftigkeit und Quantität in einem bairischen Dialekt. *Working papers*, Vol 6., Lund University, Department of Linguistics and Phonetics.

Bannert, R. (1976). Mittelbairische Phonologie auf akustischer und perzeptorischer Grundlage. Ph.D. dissertation, Lund University.

Batliner, A. (1979). Die psychische Realität kovariiender Systeme: experimentelle Untersuchungen zur l-Vokalisierung im Bairischen. Ph.D dissertation, Ludwig-Maximilians-University, Munich.

Beddor, P. (1982). Phonological and phonetic effects of nasalization on vowel height (Unpublished Ph.D. dissertation). University of Minnesota. Bloomington, In: Indiana University Linguistics Club.

Besch, W. (1983). Entstehung und Ausprägung der binnensprachlichen Diglossie im Deutschen. In: W. Besch, U. Knoop, W. Putschke, and H. Wiegand (eds.), *Dialektologie: ein Handbuch zur deutschen und allgemeinen Dialektforschung*, Vol. 2., de Gruyter: Berlin. (p. 1399 – 1411).

Bigham, D. (2010). Mechanisms of accommodation among emerging adults in a university setting. *Journal of English Linguistics*, 38, 193–210.

Blackwood Ximenes, A., Shaw, J. A., & Carignan, C. (2017). A comparison of acoustic and articulatory methods for analyzing vowel differences across dialects: Data from American and Australian English. *The Journal of the Acoustical Society of America*, *142*(1), 363-377.

Boberg, C. (2004). Real and apparent time in language change: Late adoption of changes in Montreal English. *American speech*, *79*(3), 250-269.

Boersma, P. & Weenink, D. (1992-2016). Praat: doing phonetics by computer (Version 6.0.23) [Computer program]: http://www.praat.org/

Bose, I., Hirschfeld, U., Neuber, B., & Stock, E. (2016). *Einführung in die Sprechwissenschaft.* Narr: Tübingen.

Bowie, D. (2005). Language change over the lifespan: A test of the apparent time construct. *University of Pennsylvania Working Papers in Linguistics*, *11*(2), 3.

Bukmaier, V., Harrington, J., & Kleber, F. (2014). An analysis of post-vocalic/s-ʃ/ neutralization in Augsburg German: evidence for a gradient sound change. *Frontiers in Psychology*, 5, 828.

Britain, D. (2010). Supralocal Regional Dialect Levelling. In: C. Llamas & D.Watt (eds.), *Language and Identities*. Edinburgh University Press: Edinburgh. (p. 193-204).

Browman, C., & Goldstein, L. (1991). Gestural structures: Distinctiveness, phonological processes, and historical change. In: I. G. Mattingly & M. Studdert-Kennedy (eds.), *Modularity and the motor theory of speech perception: Proceedings of a conference to honor Alvin M. Liberman*. New Jersey: Erlbaum: New Jersey. (p. 313-338).

Bybee, J. (2002). Word frequency and context of use in the lexical diffusion of phonetically conditioned sound change. *Language Variation and Change*, 14, 261–290.

Capell, C. E. (1979). Transcription, vowel and consonant systems of Upper Bavarian dialect. *Journal of the International Phonetic Association*, *9*(1), 7-14.

Carignan, C. (2018). Using naïve listener imitations of native speaker productions to investigate mechanisms of listener-based sound change. Laboratory Phonology: *Journal of the Association for Laboratory Phonology,* 9(1), 18.

Carter, P. (1999). Abstractness in phonology and extrinsic phonetic interpretation: The case of liquids in English. In: J.J. Ohala, Y. Hasegawa, M. Ohala, D. Granville, A.C. Bailey (eds.), *Proceedings of the 14 International Congress of Phonetic Sciences.* University of California: Berkeley. (p. 105-108).

Carter, P. (2007). Phonetic variation and speaker agency: Mexicana identity in a North Carolina middle school. *University of Pennsylvania Working Papers in Linguistics*, 13(2), 1-14.

Chambers, J. (1992). Dialect acquisition. *Language,* 68, 673–705.

Chambers, J. K. & Trudgill, P. (1998). *Dialectology.* Cambridge University Press: Cambridge.

Chermak, G. D. & Schneiderman, C. R. (1986). Speech timing variability of children and adults. *J. Phon*, 13, 477–480.

Clopper, C. & Pisoni, D. (2006). Effects of region of origin and geographic mobility on perceptual dialect categorization. *Language Variation and Change*, 18, 193 – 221.

Croft, W. (2000). *Explaining Language Change. An Evolutionary Approach*. Longman: London.

Dawson, K. M., Tiede, M. K., & Whalen, D. H. (2016). Methods for quantifying tongue shape and complexity using ultrasound imaging. *Clinical linguistics & phonetics*, *30*(3-5), 328-344.

Delvaux, V. & Soquet, A. (2007). The influence of ambient speech on adult speech productions through unintentional imitation. *Phonetica*, 64, 145–73.

Derrick, D., Carignan, C., Chen, W.-R., Shujau, M., & Best, C. (2018). Three-dimensional printable ultrasound transducer stabilization system. *Journal of the Acoustical Society of America,* 144(5), EL 392-398.

Dodsworth, R., Plichta, B., & Durian, D. (2006). An acoustic study Columbus /l/-vocalization. *Paper presented at NWAV 35, Columbus, OH*.

Draxler, C., & Jänsch, K. (2004). SpeechRecorder—A universal platform independent multichannel audio recording software, *Proceedings of the Fourth International Conference on Language Resources and Evaluation*, Lisbon, Portugal, 559–562.

Eckert, P. (2012). Three waves of variation study: The emergence of meaning in the study of sociolinguistic variation. *Annual Review of Anthropology*, 41, 87-100.

Edwards, J. & Beckman, M. (2008). Some cross-linguistic evidence for modulation of implicational universals by language-specific frequency effects in phonological development. *Language Learning and Development*, 42, 122-156.

Evans, B., & Iverson, P. (2007). Plasticity in vowel perception and production: A study of accent change in young adults. *Journal of the Acoustical Society of America*, 121, 3814–3826.

Fant G. (1970). *Acoustic Theory of Speech Production*. Mouton: The Hague.

Farrar, K., & Jones, M. C. (2002). Introduction. In: K. Farrar, M. C. Jones (eds.), *Language Change: The Interplay of Internal, External and Extra-Linguistic Factors*. Mouton de Gruyter: New York. (p. 1-16).

Flipsen Jr. P., Lee, S. (2012). Research note: Reference data for the American English acoustic vowel space. *Clinical Linguistics and Phonetics, 26* (11–12), 926-933.

Foulkes, P., & Docherty, G. (2006). The social life of phonetics and phonology. *Journal of Phonetics*, 34 (4), 409–438.

Foulkes, P., Scobbie, J., & Watt, D. (2010). Sociophonetics. In: W. J. Hardcastle, J. Laver, F. E. Gibbon (eds.), *The Handbook of Phonetic Sciences*. Blackwell: Oxford. (p.703–754).

Foulkes, P., & Vihman, M. (2015). Language acquisition and phonological change. In: P. Honeybone & J. C. Salmons (eds.), *The Oxford handbook of historical Phonology,* 289-312. Oxford University Press: Oxford.

Fowler, C. A. (2005). Parsing coarticulated speech in perception: Effects of coarticulation resistance. *Journal of Phonetics*, 33, 199–213.

Fowler, C., Richardson, M., Marsh, K., & Shockley, K. (2008). Language use, coordination, and the emergence of cooperative action. In A. Fuchs & V. Jirsa (Eds). *Understanding Complex System*s. Springer: Berlin. (p. 261-279).

Garrett, A. & Johnson, K. (2013). Phonetic bias in sound change. In: A. Yu (Ed.), *Origins of Sound Change*. Oxford University Press: Oxford. (p. 51–97).

Gick, B.,Campbell, F., Oh, S., & Tamburri-Watt, L. (2006). Towards universals in the gestural organization of syllables: A cross-linguistic study of liquids. *Journal of Phonetics*, 34, 49–72.

Giese, W. (2021). Gerhard Rohlfs–Romanische Sprachgeographie. Geschichte und Grundlagen, Aspekte und Probleme. In: P. Werle, Y. Stork, O. Deutschmann, R. Grossmann, H. Petriconi, H. Tiemann, D. Jacob, A. Kablitz, B. König, M. Kruse, J. Küpper, C. Schmitt & W. Stempel (eds.), *Band 22 1971*. De Gruyter: Berlin, Boston. (p. 208-211).

Hajek, J. (1997). *Universals of Sound Change in Nasalization.* Blackwell: Oxford.

Hall-Lew, L., & Fix, S. (2012). Perceptual coding reliability of (L)-vocalization in casual speech data. *Lingua*, 122(7), 794-809.

Harrington, J. (2006). An acoustic analysis of 'happy-tensing' in the Queen's Christmas broadcasts. *Journal of Phonetics*, 34(4), 439-457.

Harrington, J., Gubian, M., Stevens, M., and Schiel, F. (2019a). Phonetic change in an Antarctic winter. *Journal of the Acoustical Society of America,* 146, 3327-3332.

Harrington, J., Hoole, P., Kleber, F., & Reubold, U. (2011). The physiological, acoustic, and perceptual basis of high back vowel fronting: Evidence from German tense and lax vowels. *Journal of Phonetics*, 39, 121-131.

Harrington, J., Kleber, F., & Reubold, U. (2012). The production and perception of coarticulation in two types of sound changes in progress. In: S. Fuchs, M. Weirich, D. Pape, & P. Perrier (eds.), *Speech Planning and Dynamics*. Peter Lang: Bern. (p. 39-62).

Harrington, J., Kleber, F., Reubold, U., Schiel, F., & Stevens, M. (2018) Linking cognitive and social aspects of sound change using agent-based modeling. *Topics in Cognitive Science*, 1-21.

Harrington, J., Kleber, F., Reubold, U., Schiel, F., & Stevens, M. (2019b). The phonetic basis of the origin and spread of sound change. In: Katz, W., & Assmann, P. (eds.), *The Routledge Handbook of Phonetics*. Routledge: London. (p. 401-426)

Harrington, J., Kleber, F., Reubold, U., & Siddins, J. (2015). The relationship between prosodic weakening and sound change: Evidence from the German tense/lax vowel contrast. *Laboratory Phonology*, *6*(1), 87-117.

Harrington, J., & Schiel, F. (2017). /u/-fronting and agent-based modeling: The relationship between the origin and spread of sound change. *Language,* 93(2), 414–445.

Hay, J. & Drager, K. (2010). Stuffed toys and speech perception. *Linguistics,* 48, 865–892.

Hazen, K. (2001). An introductory investigation into bidialectalism. *University of Pennsylvaia Working Papers in Linguistics,* 7, 85-99.

Hinskens, F. (1998). Dialect Levelling: A Two-dimensional Process. *Folia Linguistica*, 32, 35–52.

Hoole, P. (1987). Bite-block speech in the absence of oral sensibility. In *Proceedings of the XIIIth International Conference of Phonetic Sciences*, 4, 16-19.

Hoole, P. (1999). On the lingual organization of the German vowel system. *Journal of the Acoustical Society of America*, 106, 1020–1032.

Hoole, P. & Pouplier, M. (2017). Öhman returns: New horizons in the collection and analysis of imaging data in speech production research. *Computer Speech and Language*, 45, 253-277.

Institut für Demoskopie Allensbach (ed.) (1998). *Allensbacher Berichte. Bayerisch hören viele gern* (22). Institut für Demoskopie: Allensbach.

Institut für Demoskopie Allensbach (ed.) (2008). *Allensbacher Berichte. Auch außerhalb von Bayern wird Bayerisch gern gehört* (4). Institut für Demoskopie: Allensbach.

Jannedy, S. & Weirich, M. (2014). Sound change in an urban setting: category instability of the palatal fricative in Berlin. *Laboratory Phonology: Journal of the Association for Laboratory Phonology*, 5, 91-122.

Jessen, M. (1993). Stress conditions on vowel quality and quantity in German. *Working Papers of the Cornell Phonetics Laboratory*, 8, 1–27.

Johnson, K. (1997). Speech perception without speaker normalization: An exemplar model. In K. Johnson & J. Mullennix (Eds.), *Talker Variability in Speech Processing.* Academic Press: San Diego. (p. 145-165).

Johnson, W., Britain, D. (2007). L-vocalisation a natural phenomenon: explorations in sociophonology. *Language Sciences*, 29, 294–315.

Johnstone, T. M. (1975). The Modern Southern Arabian Languages. *Afroasiatic Linguistics,* 1, 1-29.

Jones, M. C., & Esch, E. (2002). *Language change. The interplay of internal, external and extra-linguistic factors.* Mouton de Gruyter: Berlin.

Kerswill, P. (1996). Children, adolescents, and language change. *Language Variation and Change*, 8, 177-202.

Jongkind, A.P., & van Reenen, P. (2007). The vocalization of /l/ in standard Dutch. In: A. Timuska (ed.), *Proceedings of the IVth international conference of dialectologists and geolinguists.* Latvian Language Institute: Riga. (p. 1-6).

Kerswill, P. (1996). Children, adolescents, and language change. *Language variation and change*, *8*(2), 177-202.

Kerswill, P. (2002). Models of linguistic change and diffusion: New evidence from dialect levelling in British English. *Reading Working Papers in Linguistics*, 6, 187–216.

Kerswill, P. (2003). Dialect levelling and geographical diffusion in British English. In: D. Britain, J. Cheshire (eds.), *Social dialectology. In honour of Peter Trudgill,* Benjamins: Amsterdam. (p. 223-243).

Kerswill, P., Williams, A. (2000). Creating a New Town koine: Children and language change in Milton Keynes. *Language in Society,* 29, 65-115.

Kerswill, P., & Williams, A. (2002). 'Salience' as an explanatory factor in language change: evidence from dialect levelling in urban England. In: M.C. Jones, E. Esch (eds.), *Language Change. The Interplay of Internal, External and Extra-linguistic Factors*. De Gruyter: Berlin. (p. 81-110).

Kerswill, P., Cheshire, J., Fox, S., & Torgersen, E. (2013). English as a contact language: the role of children and adolescents. In: M. Hundt, D. Schreier (eds.), *English as a contact language.* Cambridge University Press: Cambridge. (p. 258-282).

Kisler, T., Reichel, U., & Schiel, F. (2017). Multilingual processing of speech via web services. *Computer Speech & Language*, 45, 326-347.

Kleber, F. (2011). Incomplete neutralization and maintenance of phonological contrasts in varieties of Standard German. Ph.D. dissertation, Ludwig-Maximilians-University, Munich.

Kleber, F. (2017). Complementary length in vowel–consonant sequences: Acoustic and perceptual evidence for a sound change in progress in Bavarian German. *Journal of the International Phonetic Association*, 50, 1-22.

Kleber, F., Harrington, J., & Reubold, U. (2012) The relationship between the perception and production of coarticulation during a sound change in progress. *Language & Speech*, 55, 383–405.

König, W. (1994). *Dtv-Atlas Deutsche Sprache.* Deutscher Taschenbuch Verlag: München.

Kohler, K. (1977). The production of plosives. *Arbeitsberichte des Instituts für Phonetik der Universität Kiel*, 8, 30–110.

Kohler, K. (1995). *Einführung in die Phonetik des Deutschen*. 2nd Edition. Schmidt: Berlin.

Kohn, M. & Farrington, C. (2012). Speaker normalization: Evidence from longitudinal child data. *Journal of the Acoustical Society of America,* 131(3), 2237-2248.

Kohn, M., & Farrington, C. (2017). Longitudinal Sociophonetic Analysis: What to expect when working with child and adolescent data. In: S. E. Wagner, I. Buchstaller (eds.), *Panel studies of variation and change*. Routledge: New York. (p. 101-128).

Kufner, H. L. (1957). History of the Middle Bavarian vocalism. *Language*, 33(4), 519-529.

Kufner, H. L. (1960). History of the Central Bavarian obstruents. *Word*, 16(1), 11-27.

Kuznetsova, A., Brockhoff, P. & Christensen, R. (2017). lmerTest Package: Tests in Linear Mixed Effects Models. *Journal of Statistical Software,* 82(13), 1-26.

Labov, W. (1966). *The social stratification of English in New York City*. Center for Applied Linguistics: Washington.

Labov, W. (1994) *Principles of Linguistic Change*. *Volume 1: Internal Factors.* Blackwell: Oxford.

Labov, W. (2001). *Principles of Linguistic Change*. *Volume 2: Social factors*. Blackwell: Oxford.

Labov, W. (2007) Transmission and diffusion. *Language*, 83, 344–387.

Labov, W., Yaeger, M., & Steiner, R. (1972). *A Quantitative Study of Sound Change in Progress*. U. S. Regional Survey: Philadelphia.

Ladefoged, P. & Maddieson, I. (1996). *The sounds of the world´s languages.* Blackwell: Oxford.

Lawson, E., Stuart-Smith, J., Scobbie, J.M., Yaeger-Dror, M., Maclagan, M. (2011). Liquids. In: M. Di Paolo, M. Yaeger-Dror (eds.), *Sociophonetics: A Student's Guide*. Routledge: New York. (p. 72–86).

Lee, S., Potamianos, A., Narayanan, S. (1999). Acoustics of children's speech: Developmental changes of temporal and spectral parameters. *Journal of the Acoustical Society of America*, *105* (3), 1455-1468.

Leemann, A., Kolly, M.-J., Werlen, I., Britain, D., & Studer-Joho, D. (2014). The diffusion of /l/-vocalization in Swiss German. *Language Variation and Change*, 26, 191– 218.

Lenth, R., (2019). Emmeans: Estimated marginal means, aka least-squares means. R package version 1.3.4. https://CRAN.R-project.org/package=emmeans

Leopold, W. F. (1959). The decline of German dialects. *Word*, 15(1), 130-153.

Lin, S., Beddor, P. S., & Coetzee, A. W. (2014). Gestural reduction, lexical frequency, and sound change: A study of post-vocalic/l. *Laboratory Phonology*, *5*(1), 9-36.

Lindblom, B. (1990). Explaining phonetic variation: a sketch of the H&H theory. In W. Hardcastle & A. Marchal (eds.), *Speech Production and Speech Modelling*. Dordrecht: Kluwer. (p. 403-439).

Lindblom, B., Guion, S., Hura, S., Moon, S-J., & Willerman, R. (1995). Is sound change adaptive? *Rivista di Linguistica*, 7, 5–36.

Lindblom & Sundberg, (1971). Acoustical consequences of lip, tongue, jaw, and larynx movement. *Journal of the Acoustical Society of America*, 50, 1166-1179.

Lindsey, G. (2019). *English After RP: Standard British Pronunciation Today*. Palgrave MacMillan: London.

Lisker, L. (1989). On the interpretation of vowel “quality”: The dimension of rounding. *Journal of the International Phonetic Association*, *19*(1), 24-30.

Lobanov, B. M. (1971). Classification of Russian vowels spoken by different speakers. *The Journal of the Acoustical Society of America*, *49*(2B), 606-608.

Machelett, K. (1996). *Das Lesen von Sonagrammen* [lecture notes]. Institute of phonetics and speech processing, LMU, Munich. *http://www.phonetik.unimuenchen.de/studium/skripten/SGL/SGLHome.html.*

Mansell, P. (1973). A sketch of Bavarian vowel phonology. *Forschungsberichte des Instituts für Phonetik und sprachliche Kommunikation der Universität München*, 1, 187-208.

McMahon, A. (1994). *Understanding Language Change*. Cambridge University Press: Cambridge.

Ménard, L., Aubin, J., Thibeault, M., & Richard, G. (2012). Measuring tongue shapes and positions with ultrasound imaging: A validation experiment using an articulatory model. *Folia Phoniatrica et Logopaedica*, 64(2), 64-72.

Merkle, L. (1976). *Bairische Grammatik*. Dtv: München.

Milroy, J. (1992). Social network and prestige arguments in sociolinguistics. In: K. Bolton, H. Kwok (eds.), *Sociolinguistics Today: International Perspectives*. Routledge: London. (p. 146-162).

Milroy, L. (2002). Introduction: Mobility, contact and language change - Working with contemporary speech communities. *Journal of Sociolinguistics*, 6, 3–15.

Mooney, S. (2020). Child Acquisition of Sociolinguistic Variation. Ph. D. dissertation, Georgetown University.

Moosmüller, S. (2007). On some timing aspects of the Viennese dialect. *The Phonetician*, *95*, 19-27.

Moosmüller, S. (2010). Die vorderen Vokale des Wiener Dialekts. *Fokus Dialekt. Analysieren Dokumentieren–Kommunizieren. Festschrift für Ingeborg Geyer zum 60.*, 279-288.

Moosmüller, S., & Scheutz, H. (2013). Chain shifts revisited: The case of Monophthongisation and E-confusion in the city dialects of Salzburg and Vienna. In: P. Auer, J. C. Reina, G. Kaufmann (eds.), *Language Variation–European Perspectives IV.* Benjamins: Amsterdam. (p. 173-186).

Müller, D. (2011). Developments of the lateral in Occitan dialects and their Romance and cross-linguistic context. Ph.D. dissertation. Université Toulouse, Toulouse.

Müller, V., Harrington, J., Kleber, F., & Reubold, U. (2011). Age-dependent differences in neutralization of the intervocalic voicing contrast: Evidence from an apparent-time study on East Franconian. In *Twelfth Annual Conference of the International Speech Communication Association.*

Nagórko, A. (1996). *Zarys gramatyki polskiej [An outline of Polish grammar]*. Wydawnictwo Naukowe PWN: Warszawa.

Nardy, A., Chevrot, J.-P., & Barbu, S. (2014). Sociolinguistic convergence and social interactions within a group of pre-schoolers: A longitudinal study. *Language Variation and Change*, 26, 273– 301.

Nettle, D. (1999). Using social impact theory to simulate language change. *Lingua*, 108 (2), 95–117.

Niedzielski, Nancy. (1999). The effect of social information on the perception of sociolinguistic variables. *Journal of Language and Social Psychology,* 18, 1–18.

Nielsen, K. (2011). Specificity and abstractness of VOT imitation. *Journal of Phonetics*, 39, 132-142.

Nielsen, K. (2014). Phonetic imitation by young children and its developmental changes. *Journal of Speech Language and Hearing Research*, 57, 2065–2075.

Noelliste, E. (2017). The Phonology of Sonorants in Bavarian German. Ph.D. dissertation, Indiana University, Indiana.

Noiray, A., Ries, J., & Tiede, M. (2015). Sonographic & Optical Linguo-Labial Articulation Recording system (SOLLAR). *Ultrafest VII, Hong Kong.*

Nycz, J. (2013a). Changing words or changing rules? Second dialect acquisition and phonological representation. *Journal of Pragmatics*, 52, 49–62.

Nycz, J. (2013b). New contrast acquisition: methodological issues and theoretical implications. *English Language and Linguistics*, 17, 325–357.

Nycz, J. (2015). Second dialect acquisition: A sociophonetic perspective. *Language and Linguistics Compass*, 9, 469–482.

Nycz, J. (2016). Awareness and Acquisition of new dialect features. In A. Babel (Ed.), *Awareness and Control in Sociolinguistic Research*. Cambridge University Press: Cambridge. (p. 62-79).

Nycz, J. (2019). Linguistic and social factors favoring acquisition of contrast in a new dialect. *Proceedings of the 19th International Congress of Phonetic Sciences*, Melbourne.

Nylvek, J. A. (1992). Is Canadian English in Saskatchewan Becoming More American?, *American Speech*, 67, 268–78.

Ohala, J. J. (1981). The listener as a source of sound change. In: C. S. Masek, R. A. Hendrick, M. F. Miller (eds.), *Papers from the Parasession on Language and Behavior*. Chicago Linguistic Society: Chicago. (p. 178–203).

Ohala, J. (1993). The phonetics of sound change. In: C. Jones (ed.), *Historical Linguistics: Problems and Perspectives*. Longman: London. (p. 237 – 278).

Oschwald, J., Schättin, A., von Bastian, C., & Souza, A. (2018). Bidialectalism and bilingualism: exploring the role of language similarity as a link between linguistic ability and executive control. *Frontiers in Psychology*, 9, 1997.

Pardo, J., Gibbons, R., Suppes, A., & Krauss, R. (2012). Phonetic convergence in college roommates. *Journal of Phonetics*, 40, 190-197.

Pascoe, R. G. (1981). The phonology of Upper Bavarian—some observations. *Journal of the International Phonetic Association*, 11(2), 75-77.

Pätzold, M., & Simpson, A. P. (1997). Acoustic analysis of German vowels in the Kiel Corpus of Read Speech. *Arbeitsberichte des Instituts für Phonetik und Digit. Sprachverarbeitung Univ. Kiel*, 32, 215-247.

Payne, A. (1976). The Acquisition of the Phonological System of a Second Dialect. Ph.D. dissertation, University of Pennsylvania.

Payne, A. (1980). Factors controlling the acquisition of the Philadelphia dialect by out-of-state children. In: W. Labov (ed.), *Locating Language in Time and Space*. Academic Press: New York. (p. 143-178).

Pettinato, M., Tuomainen, O., Granlund, S. & Hazan, V. (2016). Vowel space area in later childhood and adolescence: Effects of age, sex and ease of communication. *Journal of Phonetics, 54*, 1-14.

Phillips, B. (1984). Word frequency and the actuation of sound change. *Language*, 60, 320–342.

Pierrehumbert, J. B. (2003). Phonetic Diversity, Statistical Learning, and Acquisition of Phonology. *Language and Speech*, 46(2-3), 115–154.

Pinget, A. C. H. (2015). The actuation of sound change. Ph.D. dissertation, Utrecht University, Utrecht.

Pols, L. C., Tromp, H. R., & Plomp, R. (1973). Frequency analysis of Dutch vowels from 50 male speakers. *The journal of the Acoustical Society of America*, *53*(4), 1093-1101.

Proctor, M. (2009). Gestural characterization of a phonological class: the liquids. Ph.D. dissertation, Yale University, New Haven.

Proctor, M. (2011). Towards a gestural characterization of liquids: Evidence from Spanish and Russian. *Laboratory Phonology*, 2(2), 451-485.

Raphael, L. J., Bell-Berti, F., Collier, R., & Baer, T. (1979). Tongue position in rounded and unrounded front vowel pairs. *Language and Speech*, 22(1), 37-48.

Recasens, D. (1996). An articulatory-perceptual account of vocalization and elision of dark /l/ in the Romance languages. *Language and speech*, 39, 63–89.

Recasens, D., & Espinosa, A. (2005). Articulatory, positional and coarticulatory characteristics for clear /l/ and dark /l/: evidence from two Catalan dialects. *Journal of the International Phonetic Association*, 35(1), 1-25.

Recasens, D., & Farnetani, E. (1990). Articulatory and acoustic properties of different allophones of /l/ in American English, Catalan and Italian. *Proceedings of the International Conference on Spoken Language Processing*, Acoustical Society of Japan, 90(2), 961-964

Recasens, D., Fontdevila, J., & Pallarès, M. D. (1995). Velarization degree and coarticulatory resistance for/I/in Catalan and German. *Journal of Phonetics*, 23(1-2), 37-52.

Redford, M. A. & Oh, G. E. (2017). The representation and execution of articulatory timing in first and second language acquisition. *Journal of Phonetics*, 63, 127-138.

Reiffenstein, I. (1976). *Primäre und sekundäre Unterschiede zwischen Hochsprache und Mundart: Überlegungen zum Mundartenabbau.* Heyn: Klagenfurt.

Rein, K. (1974). Die mittelbairische Liquiden-Vokalisierung. *Zeitschrift für Dialektologie und Linguistik.* 41(1), 21-37.

Reubold, U., & Harrington, J. (2015). Disassociating the effects of age from phonetic change. In: A. Gerstenberg, A. Voeste (eds.), *Language Development: The life span perspective*. Benjamin: Amsterdam (p. 9-37).

Rickford, J. R. & Price, M. (2013). Girlz II women: Age-grading, language change, and stylistic variation. *Journal of Sociolinguistics,* 17(2): 143-179.

Rowley, A. R. (2011). Bavarian: Successful dialect or failed language? In Joshua A. Fishman & Ofelia García (eds.), *Handbook of Language and Ethnic Identity, The Success-Failure Continuum in Language and Ethnic Identity Efforts*, Vol. 2. Oxford University Press: New York. (p. 299-309).

Rues, B., Redecker, B., Koch, E., Wallraff, U., & Simpson, A. P. (2007). *Phonetische Transkription des Deutschen.* Ein Arbeitsbuch mit CD. Narr: Tübingen. (p. 288-293).
Sampson, R. (1999). Nasal Vowel Evolution in Romance. Oxford University Press: Oxford.

Sankoff, G. (2004). Adolescents, young adults, and the critical period: Two case studies from "Seven Up". In C. Fought (ed.), *Sociolinguistic Variation: Critical Reflections*. Oxford University Press: Oxford. (p. 121–39).

Sankoff, G., & Blondeau, H. (2007). Language change across the lifespan: /r/ in Montreal French. *Language*, 83, 560-588.

Scheuringer, H. (1990). *Sprachentwicklung in Bayern und Österreich: eine Analyse des Substandardverhaltens der Städte Braunau am Inn (Österreich) und Simbach am Inn (Bayern) und ihres Umlandes.* Buske: Hamburg.

Schikowski, R. (2009). Die Phonologie des Westmittelbairischen. Master's thesis, Ludwig-Maximilians-University, Munich: https://doi.org/10.5282/ubm/epub.10991.

Schmidt, W. (2000). *Geschichte der deutschen Sprache*. 8th edition. S. Hirzel: Stuttgart.

Scobbie, J. M., Lawson, E., and Stuart-Smith, J. (2012). Back to front: A socially-stratified ultrasound tongue imaging study of Scottish English /u/. *Rivista di Linguistica, Special Issue: Articulatory Techniques for Sociophonetic Research*. 24(1), 103–148.

Sebanz, N., Bekkering, H., & Knoblich, G. (2006). Joint action: bodies and minds moving together. *Trends in Cognitive Sciences*, 10, 70-76.

Seiler, G. (2009). Sound change or analogy? Monosyllabic lengthening in German and some of its consequences. *The Journal of Comparative Germanic Linguistics*, 12(3), 229-272.

Siegel, J. (2010). *Second Dialect Acquisition*. Cambridge University Press: Cambridge.

Smith, A. & Zelaznik, H. N. (2004). Development of functional synergies of speech motor coordination in childhood and adolescence. *Developmental Psychobiology*, 45, 22-33.

Smith, B. L. (1994). Effects of experimental manipulations and intrinsic contrasts on relationships between duration and temporal variability in children's and adults' speech. *J. Phon*, 22, 155–175.

Smith, B. L., Kenney, M. K. & Hussain, S. (1996). A longitudinal investigation of duration and temporal variability in children's speech production. *Journal of the Acoustical Society of America*, 99, 2344-2349.

Sproat, R. & Fujimura, O. (1993). Allophonic variation in English /l/ and its implications for phonetic implementation. *Journal of Phonetics*, 21, 291–311.

Stevens, M., & Harrington, J. (2014). The individual and the actuation of sound change. *Loquens*, 1(1).

Stevens, M., Harrington, J., & Schiel, F. (2019). Associating the origin and spread of sound change using agent-based modeling applied to /s/- retraction in English. *Glossa: a journal of general linguistics 4(1),* 8.

Stör, B. (1999). *Die mundartlichen Verhältnisse in der Region München*. Band 1. Lang: Frankfurt.

Strycharczuk, P., Derrick, D., & Shaw, J. (2020). Locating de-lateralization in the pathway of sound changes affecting coda /l/. *Laboratory Phonology: Journal of the Association for Laboratory Phonology*, 11(1), 21.

Tiede, M. (2020). GetContours: tongue contour fitting software; v2.4. [Computer program]. https://github.com/mktiede/GetContours.

Todd, S., Pierrehumbert, J. & Hay, J. (2019). Word frequency effects in sound change as a consequence of perceptual asymmetries: An exemplar-based model. *Cognition*, 185, 1-20.

Torgersen, E., & Kerswill, P. (2004). Internal and external motivation in phonetic change: Dialect levelling outcomes for an English vowel shift. *Journal of sociolinguistics*, 8(1), 23-53.

Trudgill, P. (1986). *Dialects in Contact*. Blackwell: Oxford.

Trudgill, P. (2008). Colonial dialect contact in the history of European languages: On the irrelevance of identity to new-dialect formation. *Language in Society*, 241-254.

Vaissière, J., (2009). Articulatory modeling and the definition of acoustic-perceptual targets for reference vowels. *The Chinese Phonetics Journal*, 2, 22-33. Also available at: https://halshs.archives-ouvertes.fr/halshs-00676256/document

van Bergem, D. (1993). Acoustic vowel reduction as a function of sentence accent, word stress, and word class. *Speech Communication*, 12, 1-23.

van Son, R., Bolotova, O., Lennes, M., and Pols, L. (1994). Frequency effects on vowel reduction in three typologically different languages (Dutch, Finnish, Russian). *Proceedings of the 8th International Conference on Spoken Language Processing*. Grenoble: ISCA. (p. 1277-1280).

van Son, R. & Pols, L. (1999). An acoustic description of consonant reduction. *Speech Communication*, 28, 125-140.

Veith, W. (2005). *Soziolinguistik: Ein Arbeitsbuch*. 2nd edition. Narr: Tübingen.

Vollmann, R., Seifter, T., Hobel, B., & Pokorny, F. (2015). /l/-Vokalisierung in der Steiermark. *JournaLIPP*, (4), 13-25.

Vorperian, H. K., Kent, R. D. (2007). Vowel acoustic space development in children: A synthesis of acoustic and anatomic data. *Journal of Speech, Language, and Hearing Research, 50* (6), 1510-1545.

Walker, A. (2014). Crossing oceans with voices and ears: Second dialect acquisition and topic-based shifting in production and perception. Ph.D. dissertation, Ohio State University.

Wardhaugh, R. & Fuller, J. (2015). *An Introduction to Sociolinguistics.* 7th edition. Wiley Blackwell: Chichester.

Wedel, A. (2006). Exemplar models, evolution and language change. *The Linguistic Review*, 23, 247-274.

Weinreich, U., Labov, W., & Herzog, M. (1968). Empirical foundations for a theory of language change. In W. Lehmann and Y. Malkiel (Ed.) *Directions for Historical Linguistics*, U. of Texas Press: Austin. (p. 95-195).

Wells, J. (1982). *Accents of English, vol. 1: An introduction.* Cambridge University Press: Cambridge.

Wickham, H. (2016). *ggplot2: Elegant Graphics for Data Analysis*. Springer Verlag: New York. https://ggplot2.tidyverse.org.

Wiese, R. (1996). *The Phonology of German.* Oxford University Press: Oxford.

Wiesinger, P. (1990). The Central and Southern Bavarian Dialects in Bavaria and Austria. In: C. Russ (ed.), *The dialects of Modern German*. Routledge: London. (p. 438–519).

Winkelmann, R., Harrington, J., & Jänsch, K. (2017). EMU-SDMS: Advanced speech database management and analysis in R. *Computer Speech & Language,* 45, 392-410.

Wolfswinkler, K., & Harrington, J. (2021). The influence of Standard German on the vowels and diphthongs of West Central Bavarian. *Journal of the International Phonetic Association*, 1-33.

Wrench, A.A., & Scobbie, J.M. (2003). Categorising vocalisation of English /l/ using EPG, EMA and ultrasound. In: S. Palethorpe & M. Tabain (eds.), *Proceedings of the Sixth International Seminar on Speech Production.* (Sydney, Australia. (p. 314-319)

Zehetner, L. (1978). *Kontrastive Morphologie: Bairisch/Einheitssprache. Grundlagen einer dialektorientierten Sprachdidaktik*. Beltz: Basel.

Zehetner, L. (1985). *Das bairische Dialektbuch.* C.H. Beck: München.

Zehetner, L. (1989). *Die bairische Mundart in Bayern*. C.H. Beck: München.

Zhang, Z., & Espy-Wilson, C. Y. (2004). A vocal-tract model of American English/l. *The Journal of the Acoustical Society of America*, 115(3), 1274-1280.