Vertical vs. horizontal change in the traditional dialects of southwest Germany: a quantitative approach[1]

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Abstract

Typically, modern dialects show contact-induced rather than endogenous phonological change, i.e. a given dialect absorbs features of other varieties of the same language with which it is in contact, often replacing the dialect's own sounds. In most cases, this process is lexicalised, i.e. it proceeds word by word, although the entire sound structure of the variety may be affected in the end. One of the unresolved questions of research on phonological dialect change is the nature of the spread of these changes. In principle, they can be due to horizontal (neighbouring dialects) or vertical contact (the standard variety or other forms with a wider range influence the dialects in the area "below" it). This paper discusses some quantitative measures used to estimate the magnitude of the two alternative forms of the propagation of a change, and reports some findings for the traditional dialects of southwest Germany in the last century. On the basis of a large corpus of spontaneous speech, we present an aggregated analysis using statistical correlations and a mixed logistic regression model.

1. Introduction

One of the unsettled issues which has been discussed in (social) dialectology from its very beginnings as a scientific discipline in the late nineteenth century is the question of how dialects change. In the early debate surrounding this issue, the discussion focused on the spread of an endogenous innovation within a dialect area to its boundaries or beyond into the neighbouring dialects. The Neogrammarian position postulated a regular change in all relevant phonological environments and a wave-like spread, which is "nichts anderes als ein Naturereignis der deutschen Sprache, welches unbekümmert um äußere Forderungen oder Hemmnisse anfängt, fortschreitet und endet" ['nothing but a natural event in the German language which proceeds and ends irrespective of external demands or hindrances'], as Braune (1874: 37) put it with respect to the Early New High German (NHG) diphtongisation, a change discussed be-

1 Many thanks Uli Held for technical support.

low. The ensuing debate whether diffusion affects all words equally or rather proceeds at a different pace in different lexical environments, and about the nature of the "hindrances" that can stop such a wave-like expansion (natural, political, and ideological borders) need not concern us here (cf. Auer 2005). What Braune meant by "natural event" is of course not really a natural event, but one which follows law-like regularities determining the quality and speed of the spread; in early dialectology, there was wide consensus that *Verkehr* (Saussure's "intercourse") was the responsible factor which allowed dialectologists to predict both the quality and speed of language change. Speakers accommodate their interactants' speech and thereby change their language as a function (linear or not) of the amount of exposure to the target form through interaction with the innovators, i.e. in modern terms, sound change is a function of the density of the speakers' network contacts. This mechanistic view of the nature of diffusion had a renaissance in late twentieth-century social dialectology (e.g. in Trudgill 1986), echoing similar trends in human geography at that time. It is most certainly too simplistic, if not wrong (cf. Auer & Hinskens 2004). The counter-position can also be traced back to traditional dialectology where it was claimed – contra the Neogrammarians – that the spread of innovations has a "social- psychological" basis and is dependent on attitudinal factors (cf. Bach 1950: 65-79 for a summary). But whatever position one may favour in the debates about regular vs. lexical or mechanistic vs. social-psychological diffusion, the most important feature of the wave model is that it postulates a horizontal spread which is intimately linked to geography: The innovation starts from a centre and it is propagated from there by various mechanisms of contact from one location to the next. The most relevant form of contact is therefore that between two neighbouring locations.

The obvious counter-argument against this form of diffusion is that it reduces a language to a flat geographical space, i.e. it maps linguistic forms on locations and only looks at the interaction between these locations. A traditional dialect map is one such flat geographical space, and it comes as no surprise that as soon as dialectology became equated with dialect geography, its focus narrowed almost exclusively to this form of horizontal language contact. In its most trivialised form, atlas-based dialectology was reduced to the interpretation of the location of isoglosses in geographical space as traces of historical changes. However, since the late nineteenth century, the linguistic reality of speakers in all parts of Germany – as well as in many other parts of Europe – has changed: Speakers have been in contact not only with the neighbouring dialects, but also with the standard language, first as a written variety (*Schriftsprache*), and later as a spoken variety. In many parts of Europe, including the area we are concerned with here, there have been additional contact varieties in play which are located somewhere between the spoken standard and the traditional dialects, and for which terms such as regiolects/regional dialects and regional standards have come to be used.[2] Regional dialects are often urban lects, i.e. spoken varieties that were originally developed by the urban middle classes as an approximation of the (mostly written) standard varieties in the eighteenth and nineteenth centuries (Schmidt 2009). As soon as this vertical structure of the language is taken into account, a new model is necessary which distinguishes between two forms of contact: horizontal contact between the dialect of one location and its surrounding areas, and vertical contact between the dialect and the overarching regional or national forms of speaking (see Auer 2003 for details). It is clear that the vertical influence of the regional dialect and the standard on the traditional dialects cannot be explained mechanistically by the amount of exposure to this contact variety alone; attitudinal factors also play a role. The prestige of the standard and the regional (urban) dialects is the foundation of their influence on the dialects, not mere exposure to it. However, geographical distance is not irrelevant: in particular, for a long time, the urban middle classes – as the speakers of the regional dialect – were (and partly still are) the primary object of accommodation because of their prestige (and that of their language). The national standard variety was less prestigious in comparison. The urban middle classes were accessible as model speakers, while the national standard was hardly ever heard by most of the rural population before the beginnings of mass media consumption, even after it had been codified as a *Bühnensprache* (stage language).

From a map-based dialectological point of view, this vertical dimension of contact-induced variability and change is a challenge, since vertical change is not directly visible on a map. One way of dealing with this challenge was to investigate the geo-linguistic formations around urban conglomerates which were eo ipso taken to represent a more standardised way of speaking (cf. the summarising discussion in Britain 2004: 622-627). There is, however, another indirect method of identifying vertical influence in dialect geography. If there is variation between the near-standard and traditional dialectal forms across an area, there is a good chance that the variation is a result of the influence of the standard language (compare the model representations in Fig. 1 and 2). However, in most cases the situation is more difficult to judge since the dialect feature of one area (a) is similar or identical to the standard (Fig. 3). In this case, the occurrence of this feature in the neighbouring area (b) can be due either to standard-dialect or to dialect-dialect convergence – or, of course, a combination of both. This is the case we will be dealing with in this paper.

2 The term "regional dialect" is used here to refer to the product of a tension between a standard variety and traditional dialects, i.e. forms of speaking which are on the whole closer to the standard than the traditional dialects. There are forms of inter-dialect levelling which do not show this convergence to the standard which might better be called dialect koinai.

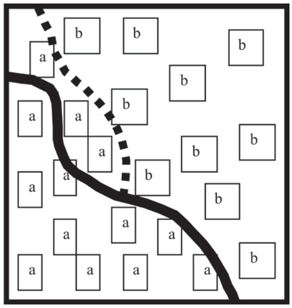


Fig. 1: Horizontal change: dialect feature a replaces dialect feature b (solid line = old isogloss, dotted line = new isogloss). Dialect change appears as the displacement of isoglosses.

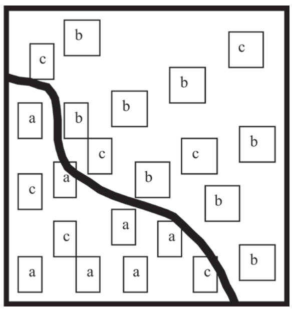


Fig. 2: Vertical change (change from above): standard feature c replaces both dialect features a and b. In the end, the isogloss will become irrelevant and c is used everywhere.

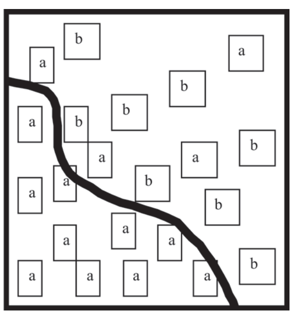


Fig. 3: Feature a is both a standard feature and the dialect feature used in the southwest area. Is the occurrence of a in the northeast b-area horizontally or vertically determined?

2. Data and methods

Since most dialect atlases are based on elicited data from questionnaire studies, they are strongly biased against the vertical dimension of standard influence; the interviewers usually insist on reporting the most dialectal form, even though the informants may not use it any longer in spontaneous speech. Most of our dialect maps therefore overrepresent horizontal and underrepresent vertical dialect change; for this reason, they are of limited use for our research question. In the southwest of Germany, the data for the regional dialect atlas (*Südwestdeutscher Sprachatlas*, SSA) were collected according to this principle (recovering the most traditional features using the direct method, even if only remembered forms – *Erinnerungsformen*). As in other similar projects, the informants were older, immobile speakers who lived in the countryside (i.e. larger towns and cities were not systematically investigated). As a consequence, the atlas is of restricted value for the present investigation. When compared to the relevant parts of the *Sprachatlas des Deutschen Reichs* compiled by Georg Wenker one hundred years earlier (cf. http://www.3.diwa.info/titel.aspx), the SSA indeed suggests a very conservative dialect area with few changes and very little standard influence. Fortunately, however, we also have audio recordings of spontaneous speech from about 370 locations (out of the 579 in which the questionnaire study was conducted), which were made for control purposes with most of the same speakers. The number of informants per location varies between one and six. It is therefore possible to compare the dialect knowledge of NORMs and NORFs in the 1970s with their spontaneous language production. In the following section, we analyse these data against the background of the knowledge-based map representations of the SSA as well as those of Wenker (who collected his data in 1887-88; see Schwarz & Streck 2010 for further details on this method). The dialect features investigated in spontaneous speech are a subset of those for which the SSA provides elicited (questionnaire) data.[3]

The data were coded for the factors shown in Fig. (4), but only some of them will be discussed in this paper in detail (see below, Fig. 30). Coding included linguistic parameters (such as the morphological complexity of the word in which the phonological feature occurs, its frequency as measured in various corpora and its clustering – "burstiness" – within a line or turn) and control factors referring to data elicitation (explorer effects, number of participants in the interview) along with non-linguistic (e.g. geographical) factors. The dependent variables had to be binary-coded for processing in a mixed logistic regression model. Since dialect features such as the ones represented in dialect atlases often show different developments in the various lexical items

3 Our approach differs from most large scale corpus investigations (such as Hinskens & van Oostendorp 2010) who work with elicited data.

affected, we coded word tokens for several moderately or highly frequent lexical contexts in which the phonological variable occurs.

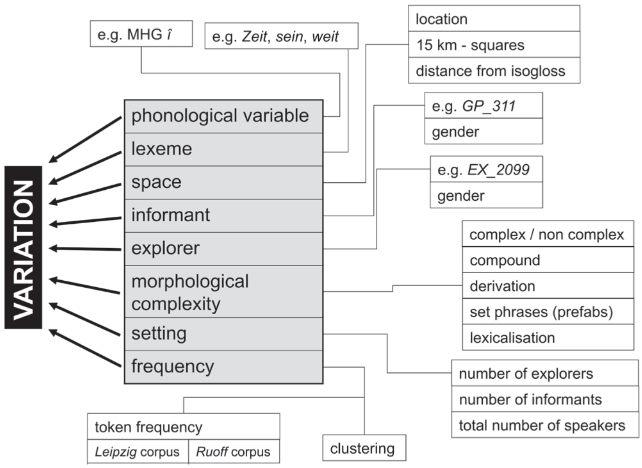


Figure 4: Factors incorporated into the statistical analysis of phonological variation within the spontaneous speech corpus.

For instance, the realization of the variable Middle High German (MHG) *î* was coded separately for the lemmata *bleib(en)* ‘stay’, *Eis* ‘ice’, *Eisen* ‘iron’, *eisern* ‘made of iron’, *gleich* ‘immediately’, *sein* ‘to be’, *seit* ‘since’, *Seite* ‘page’, *Weib* ‘woman (arch.)’, *Wein* ‘wine’, *weiß* ‘white’, *weit* ‘wide’ and *Zeit* ‘time’, all of which derive from MHG words containing a long high vowel instead of the diphthong of present-day German. Of course, for almost every phonological variable, we find more than just two realizations. These had to be reduced to two sets. For example, MHG *î* is realized as /i:/, /i/, /ei/, /ai/ and /oi/ in the area in question. The sound change we are interested in is diphthongization. The variable was therefore defined as {/i:/, /i/} vs. {/ei/, /ai/, /oi/}. Since it is useful to have a general term to refer to the two (sets of) realizations of any dichotomic variable, we speak of “receding forms” (first set) vs. “innovative forms” (second set). In many cases, and in all the cases discussed in the following sections, the receding forms are those that would be expected according to the traditional dialect atlases in a given area, and the innovations are the more standard-like realizations. In addition, we only chose variables which conform to the pattern shown in Fig. (3), i.e. the innovative form is both closer or identical to the standard and is also found in another adjoining dialect area; this selection is due to the fact that these features are most relevant for evaluating the relative weight of horizontal and vertical contact. There are also some cases in which the geographical distribution shows a different pattern. For instance, it may be the case that both the receding and innovative forms are dialectal (equally distant from the standard), or both forms are possible in the standard variety, one representing an "old" (hyperarticulated) and the other a "new" standard.[4]

In a geographical distribution such as shown in Fig. (3), variation between the receding and innovative form is restricted to one area (the one which traditionally diverges from the standard, here the *b*-area to the northeast of the isogloss), while the other area (the traditional *a*-area in which the feature is realized as in the standard or a standard-nearer variety) is stable and does not show variation. Since the isoglosses for most variables divide up the dialect space differently, the area showing variation also differs in size. Quantitative comparison between the variables would therefore be difficult if realizations across the total area were included in the analysis. (For instance, a small area in which the receding feature occurs variably would only contribute a very small fraction of the receding forms to all realizations found in the territory under investigation, while a large area would still contribute a substantial percentage of receding forms.) Therefore, we only included tokens from the *b*-area (in which both the receding and innovative forms occur variably) in our statistics.

The most important independent variable for the subsequent discussion is *space*. The factor is inherent in "location", i.e. the simple difference between the approximately 370 villages from which we obtained the data.[5] Regarding horizontal vs. vertical change, we postulate the following:

1 The geographical distribution of an innovative feature approximates the prototypical case of a horizontal change in an area to the degree that its frequency increases as a function of a location's distance from the isogloss which separates this area from the one in which the feature is traditionally used.
2 The geographical distribution of an innovative feature approximates the prototypical case of a vertical change in an area to the degree that the frequency of the receding and the innovative form is the same in all locations.

The two postulates are formulated in a non-categorical way, with 'pure' vertical and horizontal change as the extremes. Only under the idealization that the

4 An example is the deletion of final /d/ in the word *(sie) sind* ('they are'); the form without final /d/ is the modern standard form, while the form with /d/ is the traditional one supported by writing. The variable $d \sim ø$ also defines a traditional isogloss running through southwest Germany.
5 The number obviously varies from one variable to the next since we did not get tokens of some words for all locations.

language space separated by the isogloss shows no internal structure whatsoever are these extremes the polar ends of one single continuum though, i.e. only then would any divergence from the horizontal change pole imply an approximation of the vertical change pole and vice versa. Under the more realistic assumption that these language spaces are internally complex, divergence from the prototype of horizontal change may not imply a more vertical change. In particular, the even distribution of the innovative form in the traditional *b*-area is often disturbed when major or minor urban settlements enhance or hinder the innovation from spreading. The first case is the more general one, i.e. towns and cities propagate the spread of a change 'from above' (i.e. from the standard or a variety closer to it), while their rural surroundings 'lack behind'. But the opposite case is also observed (cf. Taeldeman 2005, Vandekerckhove 2010): a city may preserve a non-standard feature which, for lack of prestige, is given up in the surrounding area due to pressure from the standard. In both cases, more complex distributional patterns emerge than the ones covered by the two postulates. They should therefore be seen as heuristics to discover exactly those distributions.

The amount of variation in the data for which the factor *location* is responsible is high, but it is hard to interpret. In order to reduce the differences between the locations to meaningful spatial constellations, two different methods were used.

Quadrants: The first method was to define a grid of 15 km^2 quadrants over the investigated area. For each of the quadrants in the *b*-area, variation was calculated. If the percentage of the receding vs. innovative realisations is the same over the total *b*-area, Postulate 2 suggests vertical contact-induced change (influence of the standard or near-standard forms). If there are significant differences between the quadrants, interpretation is more difficult. It then must be decided whether the innovative quadrants form a cluster and whether they are closer to the *a*-area than the receding quadrants. Since this cannot be done automatically, we used a second method.

Distance: The factor *distance* refers to the closest direct (Euclidean) distance between a token in the *b*-area from the isogloss separating *a* from *b* (cf. Figure 5). Horizontal influence is defined as the metric value *distance* (measured in kilometres). For regression analysis, distances were measured on a logarithmic scale (cf. below). According to Postulate 1, horizontal influence will manifest itself in a linear or exponential correlation between the percentage of tokens with receding realizations and distance from the isogloss.

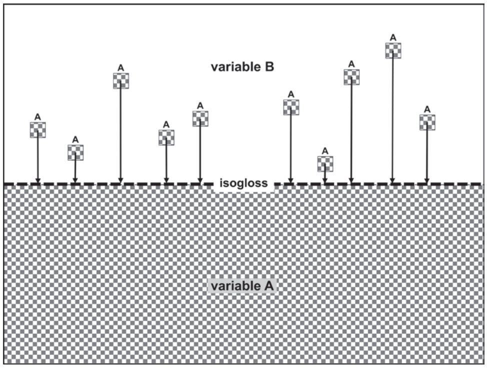


Figure 5: Horizontal influence measured according to distance from the isogloss.

This method has some methodological shortcomings as well, however. For instance, the innovative realisations may cluster in a subarea within the *b*-area, for instance around a town or city from which the standard forms spread into the neighbouring villages. While the quadrants method would make it possible to identify this area, the distance method does not.

3. The variables from a descriptive point of view

In this paper we will discuss seven variables (about a third of those covered in toto, but not reported here). We will present our data qualitatively first, as they appear on a map. In some cases, horizontal change is easy to detect on this level already, while other cases are more ambiguous. In the next section, we will present some simple statistical analyses using the two methods of operationalising space outlined above. In a third step we will present a mixed logistic regression model in section 5 which allows us to estimate the amount of variation explained by the horizontal component (as a fixed factor), especially in comparison with the random factor *location*. The variables are named *î, û, iu, ü, uo, ou* and *ô* according to their historical predecessors. The traditional distribution of these variables was taken from *Wenker's Sprachatlas des Deutschen Reichs* or the *Südwestdeutsche Sprachatlas* (Linguistic Atlas of Southwest Germany) whose isoglosses also served as a point of reference for the measurements. If isoglosses were available from both atlases, the area of reference consists of the largest area for which the traditional occurrence of a certain variable is attested.

The first three variables refer to the Early NHG diphthongisation of the MHG long high vowels *î, û* and *iu* (/i:, u:, y:/), a sound change that started in the twelfth century and spread out over most of the High German area (i.e. to the exclusion of Low German). It stopped in the far southwest of Germany and represents the major isogloss that separates the Swabian area from the rest of the Alemannic dialects. According to traditional dialect cartography based on elicited data, the diphthongal variants have proceeded slowly only over the last 100 years. Since the Swabian diphthongs resemble the standard forms (although they are not identical to them, cf. Swabian /ei/ vs. Standard German (std. G.) /ai/, etc.), the *b*-area in this case is the non-Swabian West and South, where we observe variation between the diphthongal and monophthongal forms in spontaneous speech. (The spatial pattern is roughly the same for the three variables; for reasons of space, we therefore only discuss maps for *î* in this section but will present statistics for *û* and *iu* as well in the following sections.)

Fig. 6 shows the traditional isogloss based on the elicitation data of the *Sprachatlas des Deutschen Reichs* and the *SSA* (full and dotted lines, respectively). Since the SSA data were collected roughly 100 years after Wenker's study, real-time changes can be expected, even though the archaizing data collection methods of the SSA reduce this effect.

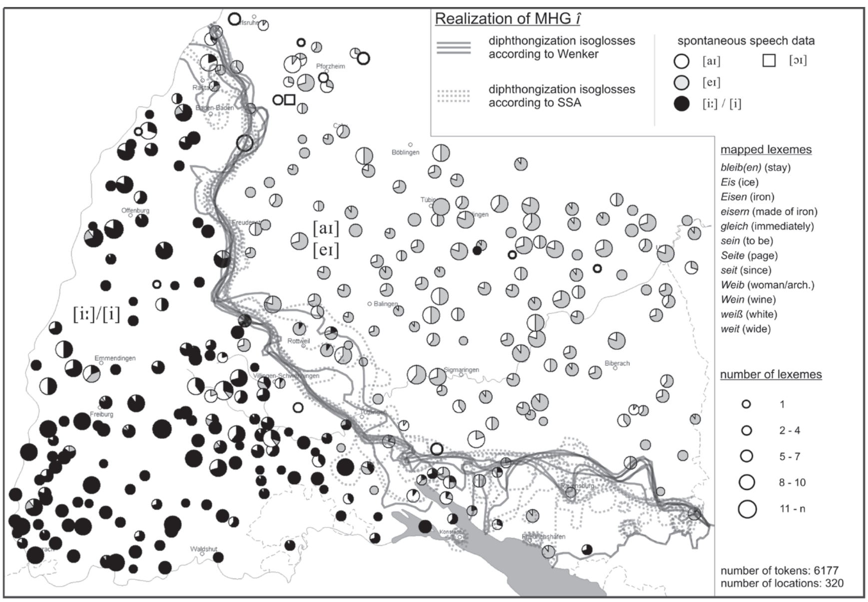


Figure 6: MHG î – isogloss between the monophthongal and diphthongal realizations according to elicited data for the words bleib(en) 'stay', Eis 'ice', Eisen 'iron', gleich 'immediately', sein 'to be', Weib 'woman (arch.)', Wein 'wine', weiß 'white', weit 'wide', Zeit 'time' according to Wenker (continuous lines) and SSA (dotted lines), and spontaneous realizations.

In addition, the map shows the distribution of the spontaneous speech data for the lemmata *bleib(en)* 'stay', *Eis* 'ice', *Eisen* 'iron', *eisern* 'made of iron', *gleich* 'immediately', *sein* 'to be', *seit* 'since', *Seite* 'page', *Weib* 'woman (arch.)', *Wein* 'wine', *weiß* 'white', *weit* 'wide' and *Zeit* 'time' (circles). Since spontaneous language is usually more advanced with respect to language change than questionnaire-type investigations of dialect knowledge suggest, we expect the innovative feature (i.e. the diphthongs) to be more frequent in spontaneous speech than in the questionnaire data. A comparison both on the level of real time and apparent time (questionnaire data vs. spontaneous speech data) indicates a unidirectional change towards the diphthongal form. Wenker's isoglosses for the words *bleib(en)* 'stay', *Eis* 'ice', *gleich* 'immediately', *Wein* 'wine', *weiß* 'white' and *Zeit* 'time' (continuous lines) are almost identical, i.e. they bundle within a very small space, suggesting a regular sound change. In contrast, the SSA isoglosses (dotted lines) for the words *bleib(en)* 'stay', *Eis* 'ice', *Eisen* 'iron', *gleich* 'immediately', *sein* 'to be', *Weib* 'woman (arch.)', *Wein* 'wine', *weiß* 'white', *weit* 'wide' and *Zeit* 'time' vary to a much higher extent, especially in the far southeast (north of Lake Constance) and northern regions, suggesting a word-by-word recession of the monophthongal forms in these areas. There is not much evidence of vertical change in the questionnaire data; rather, it is the neighbouring Swabian forms which are expanding towards the south (and less prominently to the west), not the standard diphthongs or those of a regional dialect that are valid for the area as a whole. The spontaneous speech data present a more mixed picture. The diphthongal forms are scattered all over the western, traditionally monophthongal area; according to Postulate 1, this indicates vertical change. On the other hand, the most dramatic changes are observed in the spontaneous speech of speakers living south of the traditional (Wenker) isogloss, north of Lake Constance. According to Postulate 2, this is evidence for horizontal, contact-induced dialect change. Further support for this interpretation comes from the fact that the diphthongs replacing the old monophthongs in this area are the Swabian forms rather than Standard German ones. In the western part of the area (i.e. west of the old isogloss), the occurrence of the standard diphthongs is much higher by contrast. In sum, a first, map-based interpretation of the diphthongisation of old /iː, uː, yː/ suggests a horizontal change particularly in the south, but also a vertical change over the entire area.

Our fourth variable is the unrounding of MHG *ü* (/y/); map (7) only gives the spatial distribution for the lexeme *über* ('over') because of its high occurrence (but we also included the words *Hütte* 'hut', *Schlüssel* 'key', *Stückchen* 'piece' and *Tür* 'door' in the statistical analysis).[6] In earlier times, the older rounded form disappeared in almost all parts of the Upper German dialect area and was replaced by an unrounded version /i/, again with the excep-

6 Unrounding also occurs in MHG /iuː/ and its diphthongal reflexes, as well as in MHG /œ/; the results are not shown here due to their low rate of occurrence.

tion of the far southwest. However, in this case, the standard language has the rounded vowel, which corresponds to the traditional form in the southwestern dialect area. The *b*-area is therefore the northern subarea in which standard/southern dialectal rounding competes with northern unrounding.

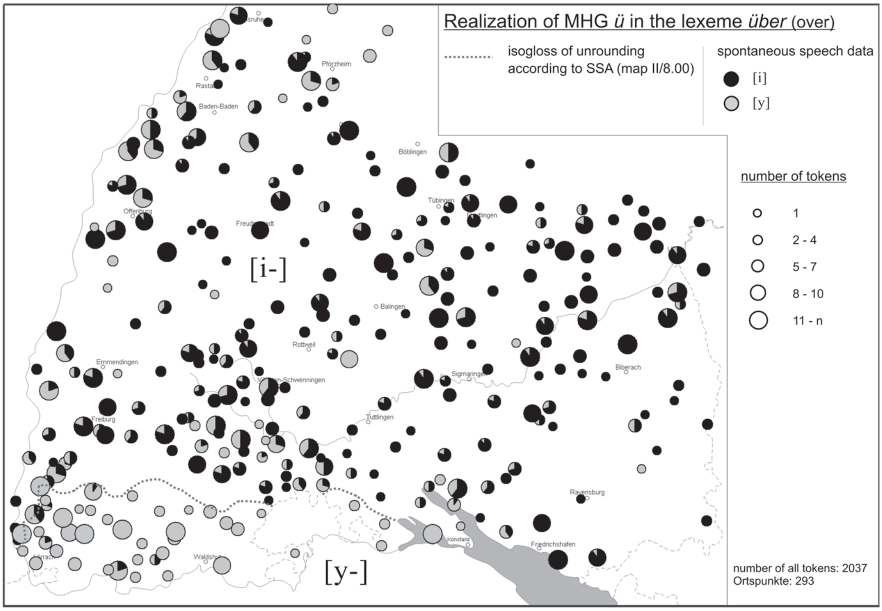


Figure 7: MHG ü – isogloss between the round and unrounded realizations according to elicited data for the words Hütte 'hut', schütten 'pour', and spontaneous realizations.

The visual distribution of the spontaneous speech data shows a dominantly vertical influence; the area close to the unrounding/rounding isogloss does not seem to be more affected than the rest of the old unrounding area. This conforms to a general dialectological finding for our area: if there is a south/north division, and if innovations spread horizontally, it is always the northern form that prevails. Since in the present case it is the "southern" (but in fact standard) form that is observed in the north, horizontal change is unlikely.

The fifth variant is the diphthongal vs. monophthongal realization of MHG *uo*. Fig. 8 shows the spatial distribution for MHG *guot* = std. G. *gut* 'good', with variation between /uə/ and /u:/).[7] Unlike the variables discussed so far, the monophthongisation of the MHG ingliding diphthongs (which originated in the Middle German area) never reached the Alemannic dialects of southwest Germany, but

7 There are two counterparts, i.e. MHG *ie* and *üö*, in which the same process of monophthongisation took place and which are not included in the present analysis.

stopped in the north of the area under investigation. Accordingly, both Wenker's elicited data and those of the SSA show a large diphthongal area.

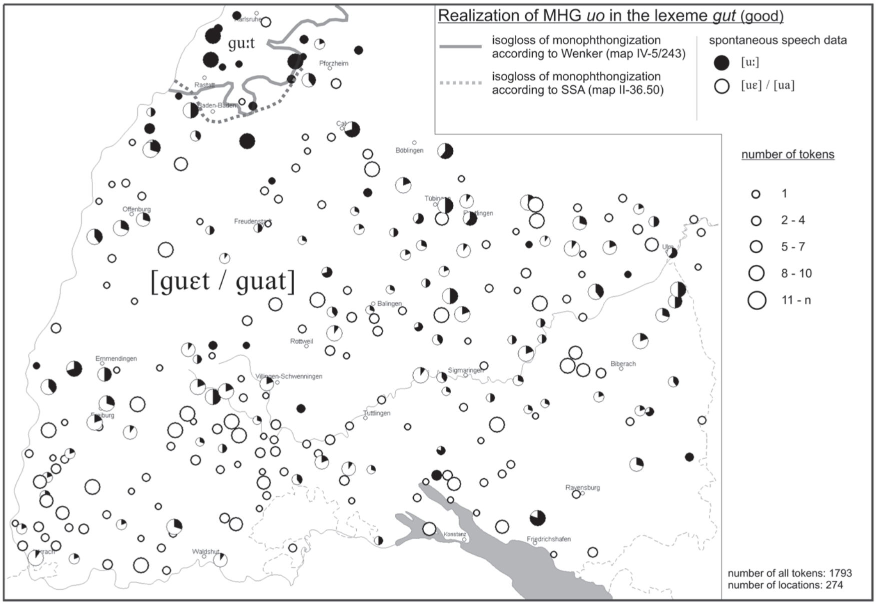


Figure 8: MHG uo – isogloss between the monophthongal (northern) and diphthongal (southern) realizations according to elicited data for the word gut, and spontaneous realizations

In the spontaneous speech data we find both monophthongal (innovative) and diphthongal (receding) realizations across the entire traditional diphthongal area. The more or less even distribution of the monophthongal forms again seems to be due to the direct or indirect influence of Standard German, as far as this can be ascertained on the basis of a visual inspection of the map alone.

Our next example (cf. Fig. 9) deals with a more complex spatial distribution, i.e. the development of MHG *ei*. The map only shows the results for the lexeme *heim* 'home'.[8]

While the map only shows the results for the high-frequency lemma *gut*, quantitative analysis also included *Bruder* 'brother', *Bub* 'boy', *Buch* 'book', *Buche* 'beech', *Fuß* 'foot' and *Schuh* 'shoe'.

8 In the quantitative analysis, we also included the lemmata *Fleisch* 'meat', *heiß* 'hot', *heißen* 'to be called', *Seil* 'rope', *Teig* 'dough' and *zwei* 'two'.

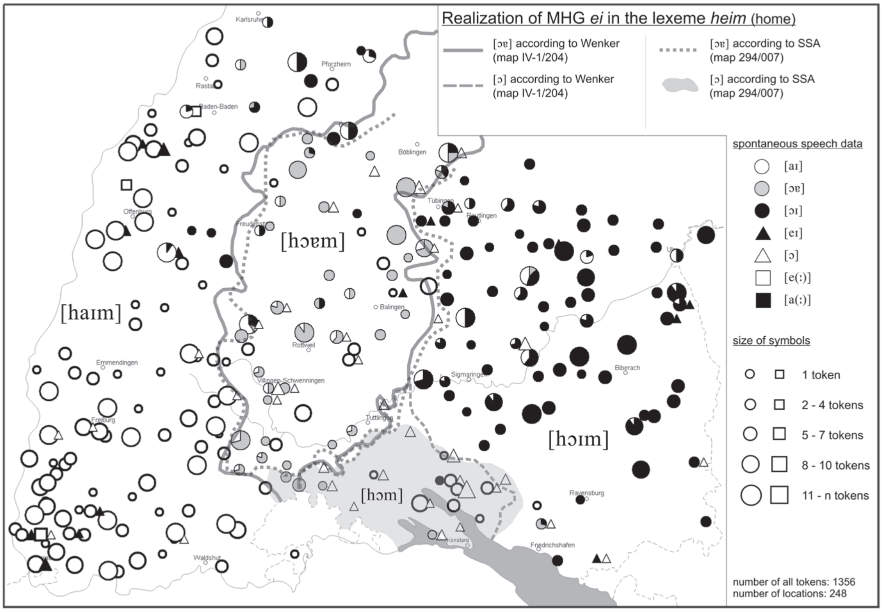


Figure 9: MHG ei – isogloss between three different diphthongal realizations (from west to east: /ai/, /oɐ/), /oi/) according to elicited data for the lemma heim, and spontaneous realizations.

Wenker's and the SSA's elicitation data for *heim* show three large areas; of these, the western-most one (/ai/) is also the standard form. In a middle area, the traditional dialects have a low schwa offglide (/oɐ/), and in the eastern part, MHG *ei* is realized as /oi/. The slight difference between the isoglosses of the *Sprachatlas des Deutschen Reichs* (Wenker) and the SSA indicate the possibility of a slow westward receding movement of the two dialectal forms. In addition, there is a small area in the south in which the old diphthong has changed into the monophthong /o/. The geographical distribution of the spontaneous speech data presents a complex picture. For quantification we defined the *b*-area as the one in which the realisation is traditionally /oɐ/, since this area shows most variation. A qualitative analysis of the distribution leads to the conclusion that the easternmost region is relatively stable, whereas the traditional /oɐ/ form is receding under the influence of the western and standard /ai/ form.

The last variable considered here is the diphthongization of MHG *ô*, a typical feature of the central Swabian subarea. The surrounding western and southern dialects traditionally have a monophthong instead of this diphthong, as does the standard variety.

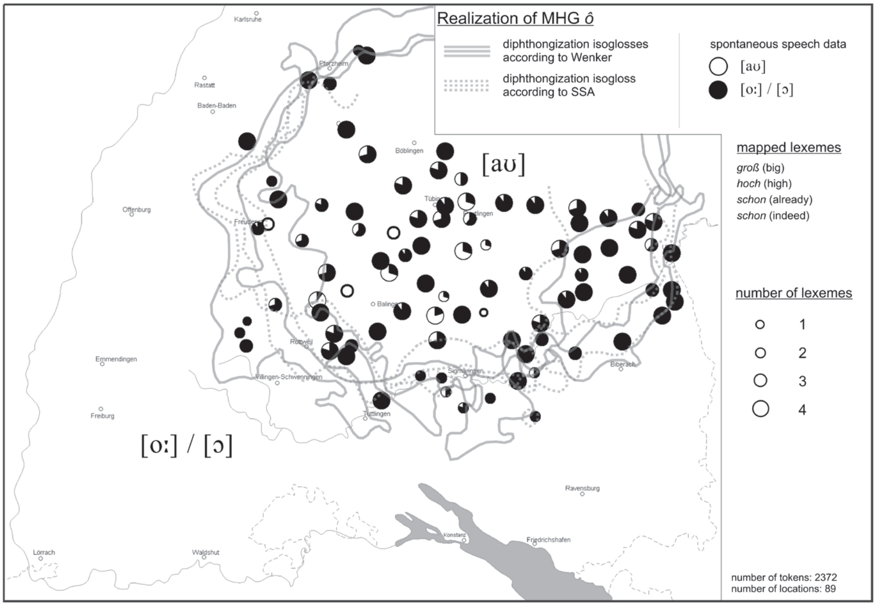


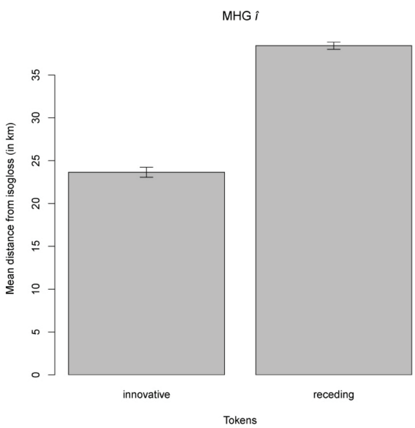
Figure 10: MHG ô – isogloss between the monophthongal and diphthongal (Swabian) realizations according to elicited data for groß 'big', hoch 'high' and the adverb schon 'already', and spontaneous realizations for the same lemmata plus the particle schon 'already'.

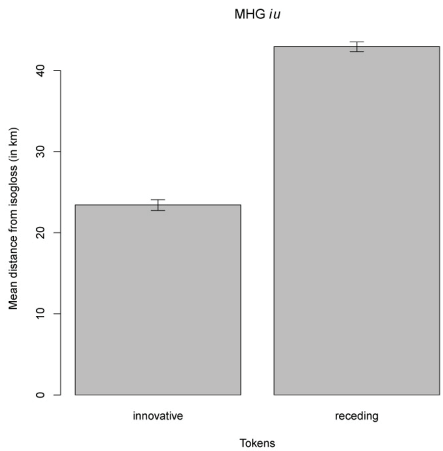
On the map, we see the traditional isoglosses as drawn by Wenker and the SSA for the words *groß* 'big', *hoch* 'high' and the adverb *schon* 'already'. A comparison between the geographical mappings of these elicited forms shows only minor changes; only at the edges do the diphthongal realizations seem to recede slightly. The spontaneous speech data, on the other hand, show a massive change towards the monophthongal realizations: 78.6% of all tokens are monophthongal. It is difficult to identify a clear spatial pattern, but the receding forms still seem to be somewhat more frequent in the centre of the Swabian area than in the periphery.

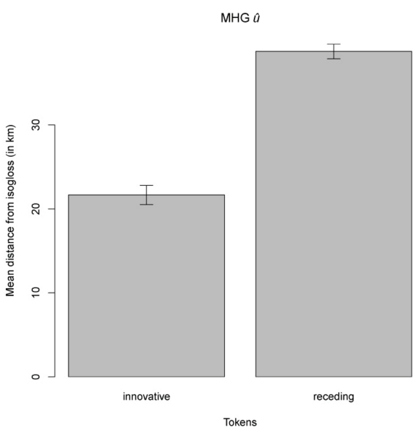
4. Some simple statistics on the seven variables

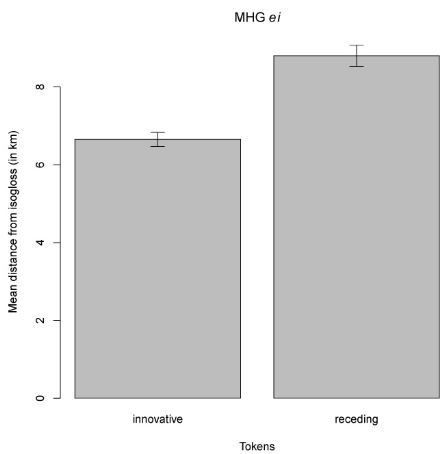
As we have seen, the qualitative inspection of the geographical distribution of the seven variables in the southwest German dialect space sometimes makes a preliminary interpretation possible, but it is often difficult to see a clear picture. Some innovative features in a *b*-area seem to cluster near the isogloss (particularly in the case of *î, û, iu*), but in other cases visual interpretation is inconclusive or only slightly suggestive. In order to have more solid measurements which, with the help of the two postulates above, can answer whether a given change is more horizontally or vertically conditioned, it is therefore advisable to turn to quantitative methods. In this section, a few simple statistics based on *distance* and *quadrants* (as outlined above) will be presented, which can be helpful in the interpretation of a feature's areal distribution.

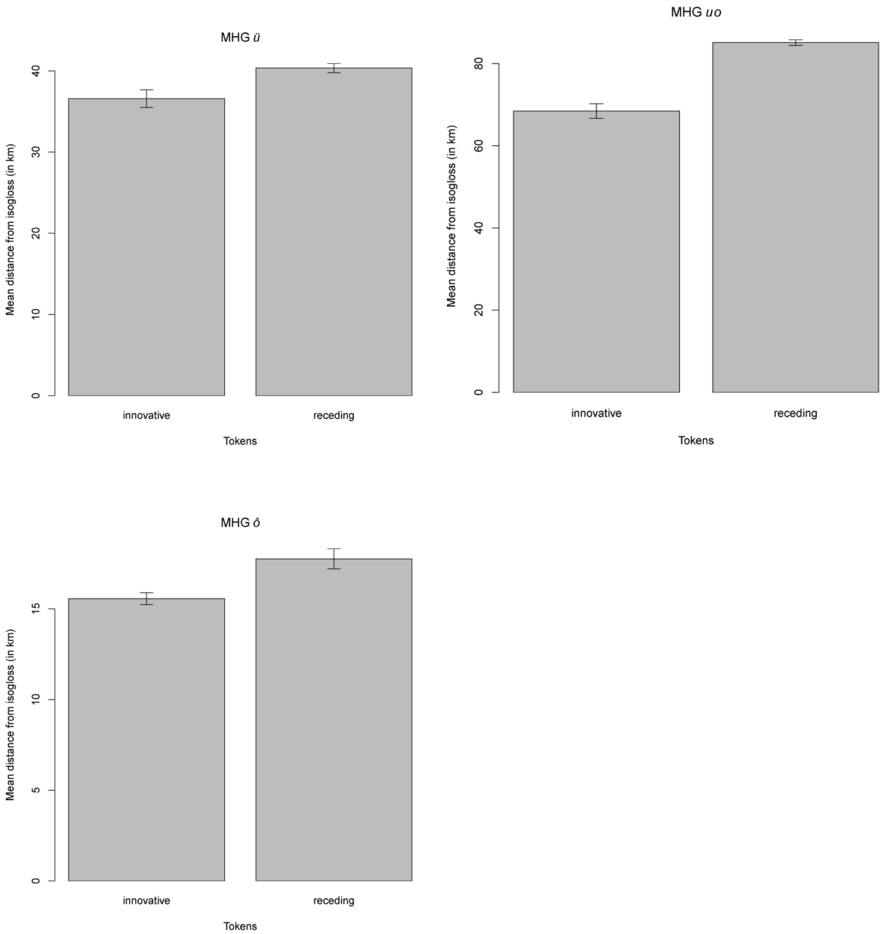
A straightforward parameter is the distance of the locations in which innovative tokens are found in the *b*-area from the isogloss that separates the *b*-area from the *a*-area. The more horizontal contact, the more innovative features will appear in the vicinity of the isogloss. A simple way of measuring this is the average distance from the isogloss to the innovative tokens compared to the receding tokens for each variable, as shown in Figs. (11-17).











Figs. 11-17: Average distance (and its standard deviation) of the innovative realizations from the isogloss for the seven variables (in kilometres).

This already gives a very first approximation: distance from the isogloss plays a larger role for *î, û, iu, ei* than it does for *ô* and *uo*, and even less for *ü*:

horizontal change *î, û, iu, ei* > *ô, uo* > *ü* vertical change

Of course, this is not a very reliable indicator, since the number of realizations found in each location is not the same. Locations with many realizations of the same kind influence the average more than those with few tokens. Since the absolute distance from the isogloss is not relevant for the interpretation of the data anyway, it is more interesting to correlate distance from the isogloss and phonological realization.

In order to do this, we used the quadrant method described above, i.e. we divided the total area into quadrants of 15 km^2 each. For each of these quadrants, the percentage of innovative vs. receding realizations was calculated. This resulted in simplified maps which show distributions such as the ones in Figs. 18 and 19 for the variables *î* and *ü*, respectively. As expected, the first variable shows a strong horizontal effect whereas the second one does not.

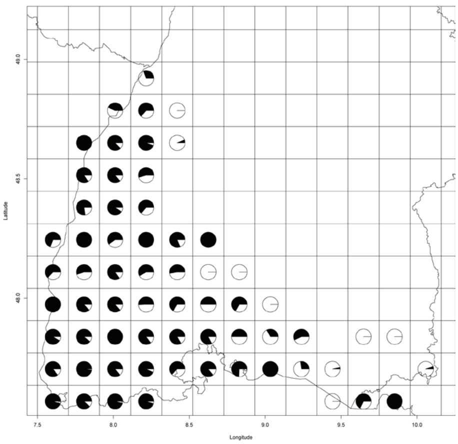


Fig. 18: Average realization of diphthongal and monophthongal realizations for î in 15 km^2 quadrants. Black sectors represent the proportion of diphthongal realizations within a given quadrant.

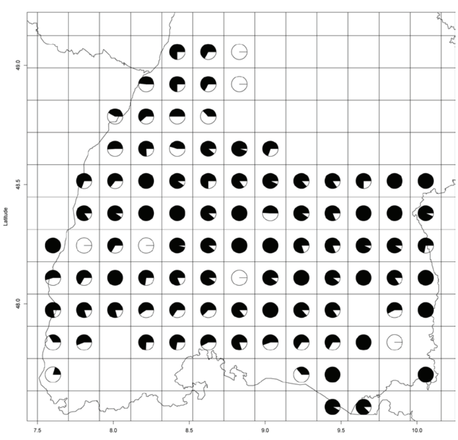
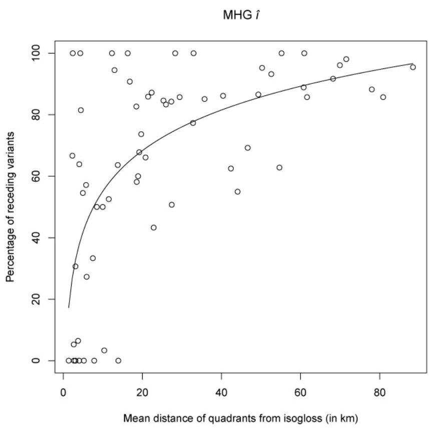
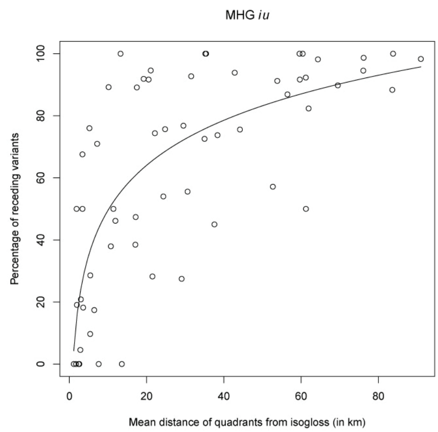
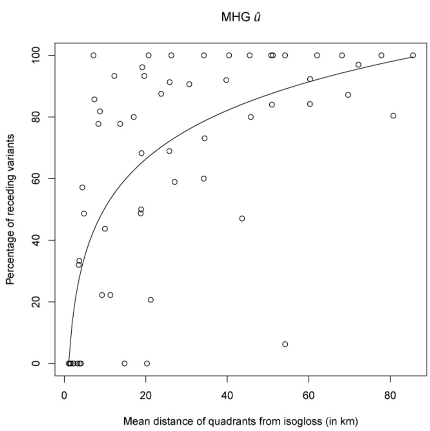


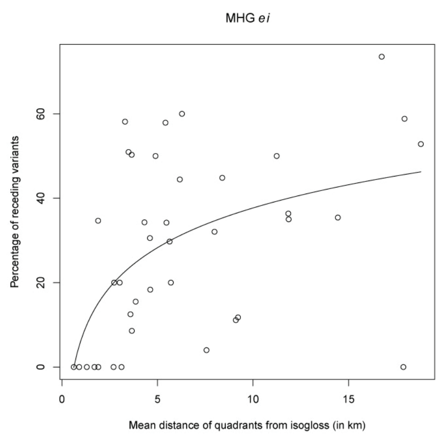
Fig. 19: Average realization of round (black sectors) vs. unrounded (white sectors) realizations for ü in 15 km^2 quadrants.

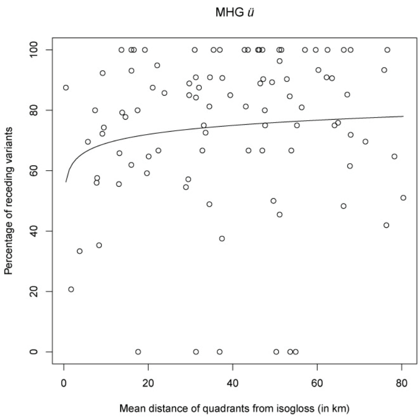
As a next step, we can now correlate the percentage of receding vs. innovative realizations in each quadrant with the mean distance of the locations contained in it from the isogloss. The results can be seen in Figs. (20)-(26). The highest correlations are reached when distance is log-transformed rather than used on its original scale (Nerbonne & Kleiweg 2007). This can be shown by comparing the R^2 values, which are interpreted as the proportion of variation not explained by the correlation and thus serve as goodness-of-fit measures for the corresponding regression; in all seven variables the regression with log-transformed distance shows better goodness values than the standard linear regression (cf. Table 1).

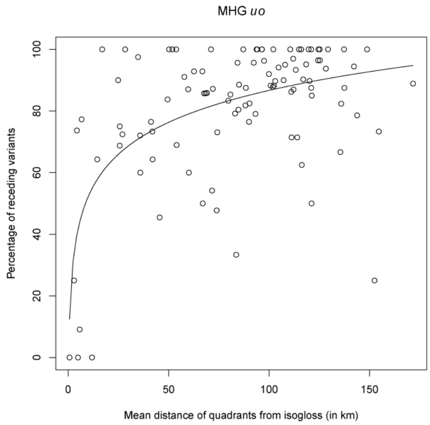


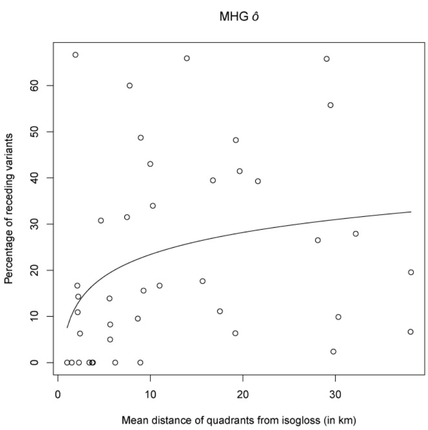












Figs. 20-26: Logarithmic correlations between percentage of innovative realizations per quadrant and the quadrant's distance from the isogloss (calculated as the average of all locations in a quadrant) for each of the seven variables.

All correlations, except for MHG *ü*, are highly significant (*î*: $p < .001$, *û*: $p < .001$, *iu*: $p < .001$, MHG *uo*: $p < .001$, MHG *ei*: $p < .01$). However, the strength of the correlation varies considerably. For *î, û, iu*, it is the strongest (Spearman's $\rho = 0.58$, 0.66 and 0.71, respectively); for *ei*, it is somewhat weaker but still strong (0.5); whereas the values for *uo* ($\rho = 0.36$) and particularly *ü* ($\rho = 0.14$) decrease considerably. This gives us a relatively precise picture which is also compatible with the qualitative analysis of the maps.

Variable	Spearman's ρ	R2 (linear)	R2 (logarithmic)
MHG î	0.5764 ***	0.3136	0.4013
MHG û	0.6612 ***	0.3368	0.4954
MHG iu	0.7123 ***	0.4446	0.5505
MHG ei	0.4965 **	0.1805	0.2626
MHG uo	0.3601 ***	0.1938	0.3651
MHG ü	0.1427	0.0108	0.0189
MHG ô	0.3837 *	0.0573	0.1078

Table (1) Spearman's ρ and R^2 values (linear and logarithmic) for the correlation between percentage of innovative realizations per quadrant and the quadrant's distance from the isogloss for each of the seven variables.

So far we have disregarded the seventh variable, *ô*. The quantitative results do not support a horizontal change: Spearman's ρ is quite low (0.38, $p < .05$), grouping this variable with *uo* and *ü*, for which no contact-induced change from the surrounding monophthongal dialects was expected on the basis of the qualitative analysis. However, in this case the overall correlation does not tell the whole story; rather, the variable must be decomposed into its lexical subvariables, i.e. the monophthongal vs. diphthongal realizations in the lemmata *groß* 'big', *hoch* 'high' and the adverb/particle *schon* 'already'. This reveals an important difference between the vowel in the adverb *schon* – by far the most frequent lemma with 1,114 (out of a total of 2,372 tokens, cf. Fig. 27) – and the vowel in the other words. A typical geographical distribution for these other lemmata is given in Fig. (28), using the example of *hoch* (199 tokens). While this distribution shows a concentric retreat of the diphthongal form into the inner central Swabian area, and therefore a clear horizontal in addition to the overall vertical change, this does not hold for *schon,* for which the standard monophthongs occur throughout the entire area. In this case, then, the question of whether a vertical or horizontal contact is generating the innovations must be answered on a case-by-case basis for the single lexemes. The most frequent word, *schon,* seems to be undergoing change as a consequence of primarily vertical contact with the standard language, while the other lemmata change less in the centre of the traditionally diphthongal area.

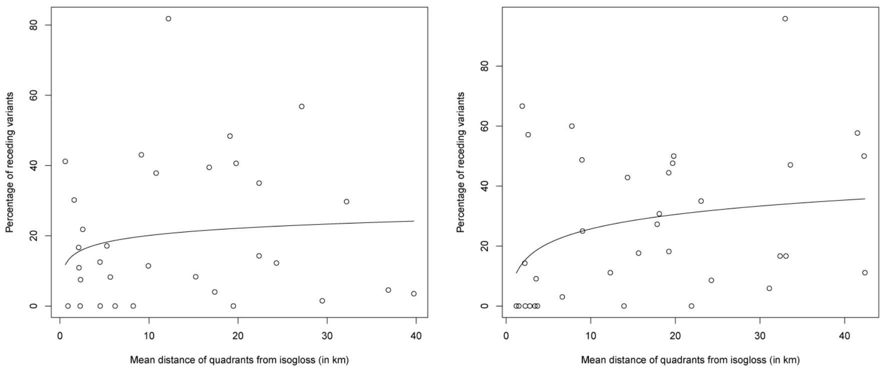


Fig. 27: Logarithmic correlation between percentage of innovative realizations per quadrant and the quadrant's distance from the isogloss (calculated as the average of all locations in a quadrant) for the variable ô in schon vs. hoch and groß.

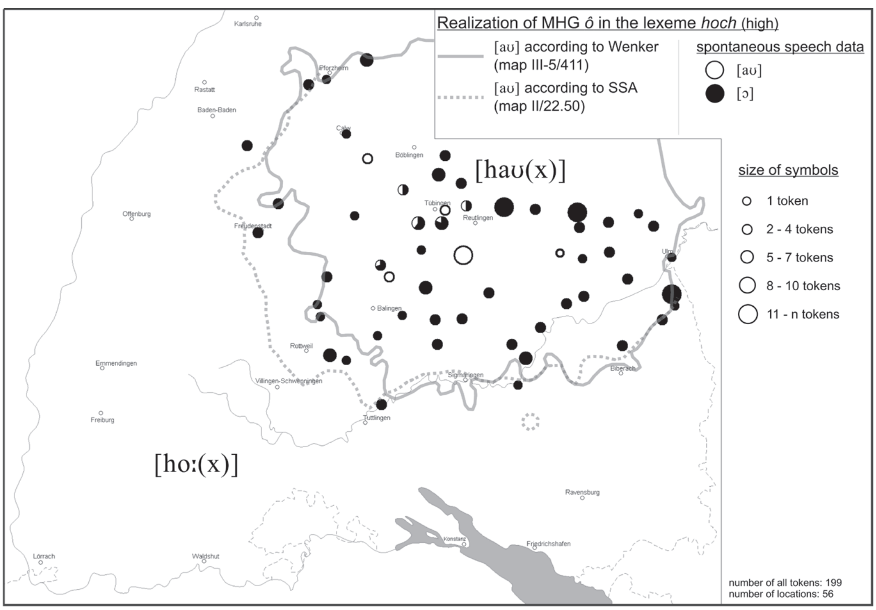


Fig. 28: MHG ô – isogloss between the monophthongal and diphthongal (Swabian) realisations according to elicited data for hoch ('high'), and spontaneous realisations for the same lemma.

5. Analysis by mixed logistic regression models

To investigate dialectal variation and its conditioning factors in more detail, we fit several logistic mixed effects models to the data of our seven variables. Logistic regression models provide an effective way of modeling the influence of multiple independent variables (or factors) on a binary outcome, in our case the realization of a word containing a receding or innovative phonological segment. As independent variables, we included factors that were hypothesized to be predictive for the realization of a dialectal or non-dialectal form: the gender of the informant, morphological complexity of the word form, and word frequency in spoken German based on Ruoff's frequency dictionary (1981).[9] As an extension to ordinary logistic regressions, mixed effects models allow for the inclusion of so-called random effects, which serve as adjustments to the intercept to accommodate non-repeatable effects and inter-subject or inter-item variability (Baayen 2008; Baayen, Davidson & Bates 2008). All our models include the identity of the speaker as a by-subject random effect to approximate speakers' idiosyncrasies, and the lexeme as a by-item random effect.

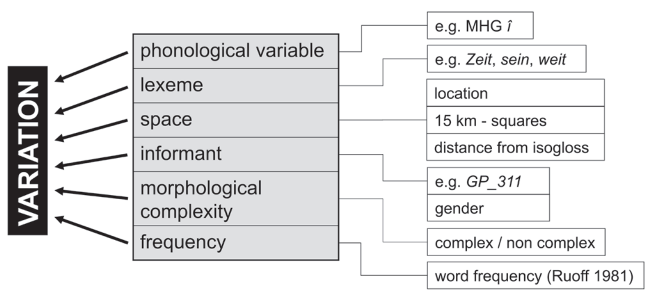


Figure 29: Factors incorporated into the mixed logistic regression model for the present study.

Since geographical space is the decisive factor in this discussion, our models differ in the way geography is treated. In all models geography is assumed to be an additional random factor, with quadrants of 15 x 15 kms as factor levels, representing the variation of the data between the quadrants. If the spatial distribution of receding and innovating tokens were equally homogeneous for all seven variables, this random factor should suffice to account for geographical variation. However, our previous analyses showed that our variables differ, and so we fitted three different models for each variable. In the first one, geography

9 These frequency counts seem to be particularly well suited since they are based on similar data, i.e. interviews in southwest Germany with mainly elderly people.

is modelled as a random factor only, thus assuming a fairly homogeneous spatial distribution. This model is then compared to two further models, in which we try to account for horizontal change by including the distance to the isogloss (in km) as a predictor. For each variable, these models will give an estimate (regression coefficient) for the predictor distance and a corresponding *p*-value. Those variables, for which the factor distance reaches significance, can then be identified as variables with a possible horizontal influence on the distribution of traditional and innovating forms. Despite the fact that a comparison of the estimates is not straightforwardly possible because of the differing sizes of the areas under consideration, it will give a first impression of how the importance of the distance to the isogloss varies between our variables. The difference between the second and the third model is the form of the distance predictor: in the second model, we add the distance to the respective isogloss as a linear predictor, while in the third model we used the log-transformed distance, which is assumed to correlate best with linguistic distance (see the discussion above). Furthermore, the probability of spurious effects can be reduced by comparing the consistency between the results of the two models.

Given the heterogeneity of our data, the model fits are very good: for all models, Somer's D_{xy} – a rank correlation coefficient between predicted outcome probabilities and observed binary outcomes – lies between .85 and .95, with higher values for models including the factor distance to the isogloss.

The non-spatial predictors show a fairly consistent pattern: if the factor *gender* reaches significance, it is the female speakers who use the receding forms more (contra most findings in social dialectology, cf. Labov 2001, ch. 8 and 11),[10] and in case of morphological complexity, simple words tend to be realized in the traditional dialectal form more than complex words. For frequency, the picture is less clear: while in the case of *iu, û* and *uo*, more frequent words are more likely to be realized in the traditional dialectal way, the opposite effect is found for *î* and *ü*.

The mixed regression model can now be used to verify whether the factor *distance* (distance from the isogloss for each token) serves as a valuable predictor for geographical space. For each of the seven variables, except of MHG *ü*, we have already found evidence of a highly significant correlation between these two variables (see Table 1 above). But unlike a mere correlation the present model fit possesses more explanatory strength as to the relevance of the predictor variable *distance*. This is due to the fact that the mixed regression

10 A cue to the interpretation of these findings is that gender is not significant in self-administered recordings where no explorator/linguist is present. This supports the hypothesis that women might accommodate more to the needs of the explorator (in this case, speaking dialect) than male informants.

model accounts for further predictor variables, which are in our case *gender*, *morphological complexity* and *word frequency*. These fixed factors can interfere with the factor *distance* as to their influence on variation. A logistic regression model incorporating all these factors assesses their relative importance in accounting for phonological variation. Hence *distance* will, in comparison to the correlation model above, prove to be even more relevant if it turns out to be of statistical significance within the mixed logistic regression.

Figure 30 shows the model estimates with .95 confidence intervals. Positive estimates mean a higher propensity toward the receding variant for higher distances and statistical significance ($p < .05$) is reached if the confidence intervals are strictly positive (or negative), i.e. do not include zero. With the exception of MHG *ei*, the factor *distance* reaches significance for all variables. However, the estimates for *î, iu* and *û* are higher than those for the other four variables, which indicates that the distance from the isogloss is more important for these variables than for *ei, ü, uo* and *ô* when it comes to predicting the maintenance of the traditional form in a *b*-area. This in turn suggests a horizontal influence of the neighbouring *a*-area in the case of *î, iu* and *û* and is in line with the results of the qualitative discussion and the simple statistics.

For the model with the log-transformed factor *distance*, the results are qualitatively similar to the linear models (see Figure 31). The difference is that, in addition to *ei*, *ô* does not reach significance, confirming that for these two variables distance seems to be irrelevant (in the case of *ô*, this is mainly due to the spatial distribution of the realization of *schon*, as we have seen above). But in comparison to the linear model fit, the estimate for *uo* is closer to those for *î, iu* and *û* and not markedly different from these any longer.

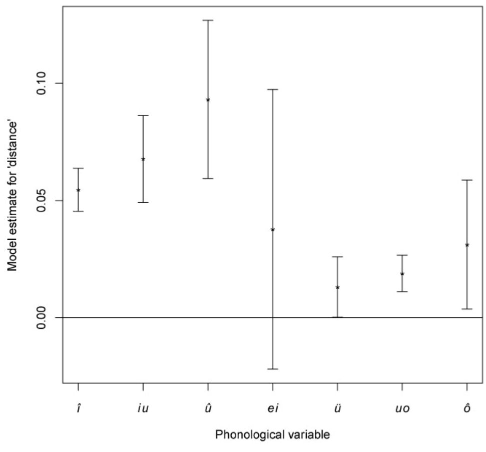


Fig. 30: Mixed logistic regression model estimates (.95 confidence intervals) including the factor 'distance'.

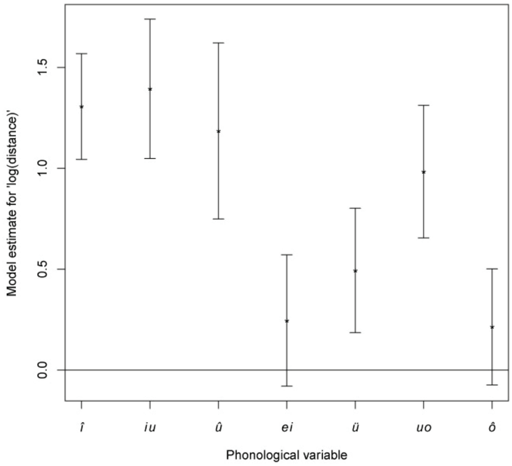


Fig. 31: Mixed logistic regressions model estimates (.95 confidence intervals) including the log-transformed factor 'distance'.

Another way of assessing the relative importance of the factor *distance* is to compare the variances (standard deviations) between different model outputs that contain a different set of incorporated factors each. Random factors allow a model to have different intercepts for the various levels of each factor. The standard deviation, which measures the variance within these intercepts, is thus a good measure of how much variance there is with respect to each factor. The less standard deviation is observed the less unexplained variation is left in this factor.

In our case we will produce three different model outputs: First we will take the factor *distance* out of the model and calculate a logistic regression only regarding the remaining predictor variables *gender*, *morphological complexity*, *frequency* and the geographic random factor (encoded on the quadrant level). If the standard deviations get higher, there is more unexplained geographical variation and the model loses explanatory strength. Therefore inclusion of the variable *distance* should improve the model significantly. Secondly we will calculate the model by exchanging the factor *distance* with *log-transformed distance*. The relative increase or decrease of standard deviations shows again which of the two factors improves the model and is thus of greater explanatory strength.

Figure (32) shows the standard deviations of the geographic random factor for the three models for all seven variables (calculated without *distance*, with *distance*, with *log-transformed distance*). For MHG *î, iu* and *û* there is a significant decrease in variance if *distance* is added to the model, with log-transformed distance yielding an even clearer decrease for *iu* and *û*. For the other four variables, the decrease is smaller, reflecting the lower estimates for the factor *distance*. In addition, we observe that the standard deviations of the model without *distance* are considerably higher for MHG *î, iu* and *û* than for the other variables. This indicates that, over all, there is more geographical variation within the data of MHG *î, iu* and *û* than within the tokens of MHG *ei, ü, uo* and *ô*. In sum, regression analysis including random factor variances shows that including the predictor *distance* explains more variation for those variables which undergo horizontal change.

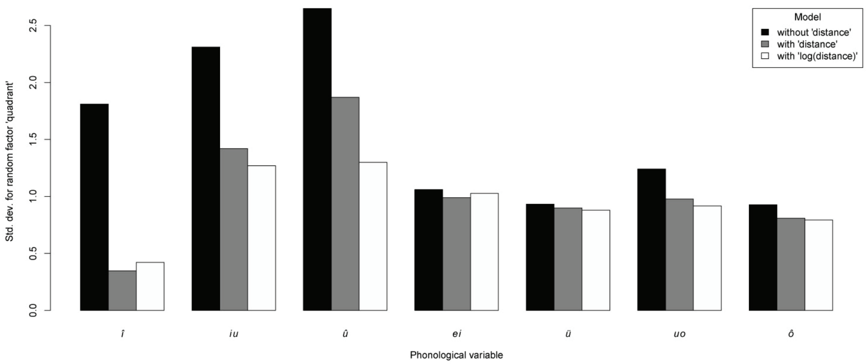


Figure 32: Standard deviations of the random factor 'geography' when the fixed factors 'distance' and 'log-transformed distance' are included/excluded

Comparing these results to the qualitative discussion we conclude that regression-based analyses are a good instrument to identify groups of subsamples ('variables') within a large sample. Strictly speaking, however, this method does not allow us to claim a significant difference between the two groups of variables (more horizontal vs. more vertical change). To do so, we fitted the second and third model to the entire dataset and included an interaction between the factor *distance* and a categorical predictor encoding the seven variables. As the reference level of the interaction we chose MHG *ei*, the only variable for which *distance* did not reach significance in any of the previous models. For the remaining six variables the model yields an interaction term, which indicates whether the *distance* has a significantly higher (or lower) effect for the respective variable than for MHG *ei*. The results show that the interaction terms for *distance* with the variables MHG *î, iu* and *û* are significantly different from MHG *ei* ($p < .001$; $p < .001$; $p < .01$), while the interactions for MHG *ü, uo* and *ô* do not reach significance ($p > .2$). There is, then, a significant difference between two groups of variables, with one group (MHG *î, iu* and *û*) showing a strong influence of the factor distance on the observed linguistic variation and a second group with no such horizontal component (MHG *ei, ü, uo* and *ô*).

6. Conclusions

Recent advances in computer-based cartography, corpus technology and statistical tools for analysing variation in large corpora have made it possible to approach the relationship of space and language in novel ways. In this paper, we have applied these tools to a relatively simple but at the same time central question of modern dialect change. For at least 100 years, the main forces at work in dialect change in Germany and other European countries have been the dialects' contact with each other or with the standard language. It is generally believed that the latter, vertical type of contact is becoming more prevalent (cf. Hinskens, Auer & Kerswill 2005, Bertinetto 2010). However, it is difficult to prove this trend, particularly for a language such as German in which the standard cannot be located in geographical space. In this case, dialect change due to vertical contact cannot be read directly from a map representation of variation. In this paper, we have discussed several qualitative and quantitative methods to address the question. Applying these methods to the dialects of southwest Germany, we have presented a differential analysis which groups together variables for which horizontal change still plays a role and which allows us to distinguish them from those which are more subject to direct or indirect influence of the standard language.

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