Mechanisms of Language Change

Vowel Reduction in 15th Century West Frisian
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Arianus Pieter Versloot

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Promotores: Prof. Dr. G. J. de Haan
Prof. Dr. J. F. Hoekstra (Christian-Albrechts-Universität, Kiel)

Copromotor: Dr. W. Visser (Fryske Akademy, Leeuwarden /
Rijksuniversiteit Groningen)

Beoordelingscommissie: Prof. Dr. V. J. J. P. van Heuven (Universiteit Leiden)
Prof. Dr. T. Hofstra
Prof. Dr. Ir. J. Nerbonne
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1. Introduction

1.1 Central research question: mechanisms of language change

This study takes a detailed look at language change and considers how and why it takes place. The research has been supported by analysis of the decline in the use of unstressed, full vowels in the Frisian language between 1300 and 1550. For example the word-final /a/ in Old Frisian /sit-ta/ ‘to sit’ > Modern Frisian /sit-ta/. The reasons for choosing this subject are as follows:

- Written Frisian texts from ±1300 until 1550 are particularly suited to this kind of research. They are technically easily accessible in a digital database, they are dated, can be localised and cover a long period of time, making them ideally suited for monitoring language change;
- Diachronic linguistics illustrate how languages develop and evolve, while synchronic approaches underline the communicative validity and systematicness of language at any moment in time. The understanding of the phenomenon 'language' may benefit from insight into the mechanisms of language change that respect both the intrinsic dynamics and the synchronic validity.

The arguments behind this study are given in four stages:

- Firstly, the corpus of historical texts is analysed for their suitability for historical phonological research. Most scholars of Frisian are not convinced that spelling different vowels in unstressed syllables (<a>, <e>, <u> and <i>) reflects the different phonemes in the language of the time (§ 3.1). It will be shown that the mediaeval Frisian texts used constitute a reliable and accurate source for this type of research (§ 1.3);
- The second stage is the actual retrieval of linguistic facts from the historical sources. This provides considerable detailed information about Frisian phonology over the period ± 1300 - 1550, with a focus on vowels in unstressed syllables. Within the constraints as outlined at the first stage, this presentation of facts will be theory-free as far as possible (chapter two);
- The third stage is a phonological interpretation of the data. Chapter three presents a traditional phonological analysis of the data. The phonological analysis indicates that some additional phonetic feature may have been prevalent in 15th century Frisian. The character of this feature is discussed separately in chapter four. Arguments are provided for the assumption that 15th century Frisian had two contrasting tone contours, similar to those in modern Norwegian and Swedish;
- In chapter five, two dynamic models of language change are presented, illustrating that language change can be the result of deterministic
processes and as a result can be highly predictable. The detailed reconstruction in chapter two is needed to formulate, calibrate and test the models in chapter five.

The introduction section 1.2 contains:

- A brief introduction into the Frisian language: 1.2.1;
- An explication about the language sources used: 1.2.2;
- A description of language period labels applied: 1.2.3;
- An outline of the main linguistic changes in Frisian during the studied period, as far as these are relevant for the understanding of this subject: 1.2.4;
- Delineation of the main theoretical problems of language change in diachronic and synchronic approaches: 1.2.5.

From § 1.3.2 onwards, almost every section is followed by a section summary, to structure the content and facilitate browsing through the study.
1.2 Introducing the subject
1.2.1 The Frisian Language

Frisian is a West Germanic language, traditionally spoken on the southern littoral of the North Sea in what are now the Netherlands and Germany (map 1.1). Frisian is linguistically divided into three main dialect groups: West, East and North Frisian. Versions from the different groups are mutually barely intelligible. The West Frisian dialects are generally mutually intelligible, so West Frisian constitutes a single-speech community. Within the small region of the North Frisian dialects, mutual understanding is often problematic. There is an old and deep contrast between the North Frisian dialects from the islands and the mainland as a result of different stages of immigration (8th century / 10th century; cf. Sjölin 1969, 3).

Nowadays, East Frisian is only spoken in the municipality of Saterland. Sources ranging from the 17th to the early 20th century are available in Frisian as it was once spoken in the Harlingerland, on the island of Wangerooge and in Land Wursten. The last three dialects share several linguistic features (cf. detailed discussion below). They are sometimes referred to as Weser Frisian. One accessible and reliable source of information about the Frisian language, its history and sociological position, is the Handbook of Frisian Studies (Munské 2001a).

The Frisian language area was more extensive in the past than it is nowadays. The

![Map 1.1: Frisian language area around 1200 and present day. The map includes references to regions and places mentioned in the text.](image-url)
largest Frisian speaking community is currently found in the Dutch province of Fryslân. A recent survey revealed that 54% of the population of Fryslân speak Frisian as their ‘mother tongue,’ or about 330,000 people (Provincie Fryslân 2007, 9). The number of native speakers of Frisian in Germany is probably no more than 7,000 (cf. Walker 2001, 267; Fort 2001, 410). These days all ‘mother tongue’ speakers of Frisian are at least bilingual, speaking Frisian and Dutch or Frisian and High German. Frisian is an officially recognised minority language, both in the Netherlands and Germany. Modern West Frisian has a written standard form and has gained some position in the educational system and the media.

In the West Germanic dialectal continuum, ranging from English to High German, Frisian is historically the nearest relative of English. Both languages belong to the so-called group of North Sea Germanic languages. Also, Old Saxon and north-western varieties of Dutch belong to or belonged to this group. North Sea Germanic consists of a rather vage collection of shared linguistic relics and innovations (cf. Nielsen 2001, 512ff). Typical examples of North-Sea Germanic phenomena are:

- Nasal drop before fricatives. For example: Proto-Pan Germanic */gans/ > Proto-North Sea Germanic */gons/ > */gôs/ > Modern English goose, Modern West Frisian goes /gûs/, Low Saxon Goes /go:s/, contrasting with Dutch gans /gans/, High German Gans /gans/;
- Palatalisation of Proto-Germanic /k/ before front vowels. For example: Latin cæsus > Proto-Pan Germanic */kæsju:s/ > Old English */Old Frisian /ke:s/ > Modern English cheese, Modern West Frisian tsissors /tsiss/, contrasting with Low Saxon Kees /kêss/, Dutch kaas /kâs/, High German Käse /ke:sa/.

These historical similarities should not detract from the fact that no variant of Modern Frisian is intelligible alongside any form of Modern English, while, with some effort, Modern West Frisian, for example, is fairly understandable for speakers of Modern Standard Dutch.

As North Sea Germanic languages, Old English and Old Frisian share some features with the North Germanic languages. For example, the Old Nordic word gös ‘goose’ with the aforementioned nasal drop before the fricative. A unique Frisian-North Germanic parallel is the accent shift in the products of the Proto-Germanic /eu/. For example: Old Frisian bíðda ‘to offer’, Modern Frisian / West-Terschelling dialect bijde /bij.de/, Modern Icelandic bijða, cf. Old English bēðan, Old High
German *bieten* and Modern High German *bieten* [bi:tn]. Often, these North Sea Germanic parallels date back more than a 1000 years. Separate to this is the impact the Danish language had on the neighbouring North Frisian dialects, since the colonisation of that region by Frisians in the 8th century. The close language contact between North Frisian and Danish lasted until the decline of Danish in Southern Jutland during the 19th century.

This study deals with part of the history of West Frisian, so when reference is made to modern Frisian forms, this will generally be from the standard spelling of Modern West Frisian. Where relevant, examples from other dialects are given. There are three clearly differentiable dialects of Modern West Frisian:

- The dialect of the small town of Hindeloopen in the south-west is a rather archaic dialect, more or less 'petrified' in the 16th century;
- The dialect of Terschelling resembles late 18th century north-western dialects from the mainland;
- The dialect of Schiermonnikoog combines many archaic traces from the 16th century with some intensive phonological innovations. The language of the mid-16th century *Proverbs*, written by Reynier Bogerman (De Boer 1900), can be traced back to the region Dongeradeel in the far north-east of the mainland. This language form is an almost direct precursor to the modern Schiermonnikoog dialect (cf. Spenter 1968, 14).

Typologically, Modern West Frisian resembles Modern Dutch in many aspects. Both are not only geographically but also typologically positioned between English and High German. The consonant system of Modern West Frisian resembles the Dutch system. The vowel system of Modern West Frisian is rich in diphthongs compared to other West Germanic standard languages (Bussmann 2004). Modern West Frisian is a mostly analytical language, with some reflexes of the former synthetic system. Two genders (as in Dutch; English 1, High German 3), two plural formation suffixes -en and -s (as in Dutch; English only -s; High German has more than four categories). Just like Dutch and English, Frisian lost the historical verbal subjunctive. In the common present tense verbal paradigm, Frisian has four different forms to mark the six different person-number combinations (three persons in singular and in plural). English has two, Dutch three and High German five different forms. Distinct among other West Germanic languages is the
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Retention in Frisian of two different weak verbal classes and two different endings for the infinitive. The infinitive in -e is mainly applied in verbal functions. The infinitive in -en has primarily nominal functions. The syntaxes of Dutch and West Frisian are rather similar. One of the most prominent differences is the word order of verbal clusters.¹

1.2.2 Main relevant sources
Apart from some scarce runic evidence of Frisian from as early as the 6th century, the oldest attestations to Frisian are from the 12th or 13th centuries. Since the 14th century, there has been a continuous, albeit sometimes limited flow of written West Frisian. The oldest texts are written in a fairly archaic language. This archaic language stage of Frisian is found in parts of two late mediaeval West Frisian codices, one known as *Unia* (Siebs 1895) and the other as *Jus Municipale Frisonum* (Buma/Ebel 1977) as well as a somewhat richer text corpus from adjacent regions towards the east, where Frisian was widely spoken at the time (cf. map 1.1).

From the present West Frisian speaking region, about 1,200 charters, which are written in Frisian, have been preserved. Apart from a single charter originating from 1329, they cover the time frame between 1378 and 1550. They have been published in four volumes of the series *Oudfriesche Oorkonden* (OFO I-IV). The attested charters are formal texts and juridical and administrative writings from private and public sources.

The mediaeval charters present us with an excellent source for diachronic language research. The precise date on the majority of the charters offers the opportunity to monitor both the introduction of linguistic innovations and the decline of older forms. The charters cover most of the transition period from archaic mediaeval Frisian to early Modern Frisian. The charters can only be a suitable source for studying language change, when they reflect the actual phonology of the language. This point will be discussed in § 1.3.2. The charters are not only dated, but can also be connected with specific regions of the West Frisian language area. Miedema (1986) and Vries (1986) have shown that the West Frisian charters can be used for historical dialect-geographical research. This specific aspect is discussed in § 1.3.4.

Many of the processes that are subject to investigation in this research, are well covered by the data from the charters. However, some processes started earlier, in the 14th century. The sole charter from 1329 is too limited to provide a proper insight into the 14th century developments. To extend the scope back into the 14th

¹ In the last three to four decades, there has been a heavy tendency to conform to the Dutch pattern.
century, one has to rely on the mediaeval Frisian codices. The most important of these is *Unia*. The text of this codex, written in 1477, has remained unpublished and has only been preserved in a 17th-century copy. The codex was lost in the 18th century. The language of *Unia* contains the most archaic language forms from the region of Fryslân. Most of the texts in *Unia* must have received their linguistic form long before 1477. However, because nothing is known about the time the texts received their attested linguistic form, the dating of the linguistic features can only be done by an indirect method. The language of this manuscript is analysed for the purpose of this investigation in § 1.3.8.

The codex *Jus Municipale Frisonum* (abbreviation *Jus*) seems more complicated in its linguistic structure than *Unia*. The preserved codex is from 1530 but the first part of it was probably written in 1464. *Jus* is most likely from the region around Sneek (Johnston 2001, 575). It is written in a language that in some aspects is as old as the late-14th century charters. For example, the use of the letter <a> in the unstressed syllables: <habbanc>, <habbath> instead of Middle Frisian <habben> and <habbet>. These archaic forms in *Jus* are accompanied by more recent forms. In spelling conventions, the text is clearly 15th century, with explicit marking of long vowels and frequent rendering of Old Frisian /ð/ and /þ/ (spelled <th>) by <d> and <t> (cf. § 1.3.2). The archaic linguistic traces in some sections suggest that parts of the text from 1464 have been copied from an even older codex from the late 14th century, being partly adapted to the language of the 15th century. This causes a complicated linguistic layering. Therefore, the codex is only used occasionally.

Other mediaeval codices from the West Frisian region are linguistically dated from the 15th century, a time sufficiently covered by the charters. They are not considered further here. Incidental reference will be made to some mediaeval Old Frisian codices, marked with the labels B, E1, F, H, R1, R2 (cf. Johnston 2001).

The advances in the data analysis are the result of the availability of the texts in a digital form. This enables data analysis, using database programs and Geographical Information System (GIS) software.

1.2.3 The Periodisation of Frisian and terminology used

The mediaeval attestations to Frisian are chronologically contemporaneous with for example *Middle English* and *Middle Dutch*. Traditionally they are labelled *Old Frisian*. Sjölin (1969, 16-18) showed a contrast between a ‘classical’ and a ‘post-classical’ Old Frisian. Sjölin’s labels build upon both linguistic and spelling differences. The demarcation lies roughly in the year 1400. The label *Mid Frisian* was up till now, only applied to West Frisian language attestations from 1550 to 1800. See Bremmer (2001) for an overview of the discussion in the last century.
The typological labelling of the older attestations have been a topic of discussion between De Haan (2001, 188ff.) and Versloot (2005, 266ff.). Both agree, to abandon the label *Middle Frisian* for post-mediaeval West Frisian language forms and to use it for hitherto ‘post-classical Old Frisian’ forms of mediaeval Frisian, the language of the 15th and early 16th century. De Haan’s opinion that all mediaeval Frisian deserves the label *Middle Frisian* is contested by Versloot, who provides arguments to call the archaic language type from the 14th century and earlier (late-) *Old Frisian*, in spite of its relatively late attestation (Versloot 2005, 288).

In this thesis, *Old Frisian* is the language from the 14th century and earlier. For West Frisian, the archaic stage is represented in the oldest sections of the codex *Unia*. Other parts of *Unia* and a scarce number of late 14th century charters are written in a form of *late-Old Frisian*. Unless stated otherwise, *Old Frisian* applies to Frisian sources from the current province of Friesland. The language of the time after around 1550 will be referred to as *Modern Frisian*. The term *early-Modern Frisian* will be used for specific forms of the language from the 17th and 18th centuries. In the context of this study, *Modern Frisian* equals *Modern West Frisian*. The adjective ‘West’ will eventually be used to express a contrast with East and North Frisian. Examples taken from the transitional period between Old Frisian and early Modern Frisian will appear under the label *Middle Frisian*. The bulk of the charters can be assigned to this Middle Frisian period (cf. table 1.1):

<table>
<thead>
<tr>
<th>time frame</th>
<th>± 1300</th>
<th>± 1300 - 1400</th>
<th>± 1400 - 1550</th>
<th>± 1550 - 1750</th>
<th>± 1750 -</th>
</tr>
</thead>
<tbody>
<tr>
<td>in this study</td>
<td>Old Frisian</td>
<td>(late-)Old Frisian</td>
<td>Middle Frisian</td>
<td>(early-)Modern Frisian</td>
<td>Modern Frisian</td>
</tr>
<tr>
<td>current labels</td>
<td>classical Old Frisian</td>
<td>post-classical Old Frisian</td>
<td>Middle Frisian</td>
<td>Modern Frisian</td>
<td></td>
</tr>
</tbody>
</table>

Table 1.1: Period labels for Frisian

As an example of late-Old Frisian, a citation from one of the oldest original charters is given:

> Wi her *Haia curith* to *Tunawerth* and *Webka Reynsma* vuse gamech duath kuth and kanlik alda ghenim ther thit bref herath oftha siath leza .... (OFO I-4, 1390)\(^4\)

---

\(^4\) “We, master H. *curith* in *Ternaard* and W.R., our countryman announce and let know to all those, that hear or see this letter reading ...”
The language of the charters from the 16th century is, with some spelling correction, fairly comprehensible for modern speakers of West Frisian.

\[
\text{Wij trije brooren neisk[reaun] belije en bekenne mei dit jinwurdiqe skiedbrief en kwitânsje hoe dat wy binne onder elkoar akkordearre ....} \quad \text{(OFO II-374, 1541)}^3
\]

In modern spelling, this would be:

\[
\text{Wy trije bruorren neisk[reaun] belije en bekenne mei dit jinwurdiqe skiedbrief en kwitânsje hoe dat wy binne onder elkoar akkordearre ....}
\]

**Old West Frisian - Old East Frisian**

Apart from the temporal differences, there were of course dialectal variations in Old Frisian. A tradition exists to distinguish between Old West Frisian and Old East Frisian (cf. Bremmer 2001 for an overview). The boundary between these two groups was to be found at the eastern limit of the modern West Frisian language area. Within so-called ‘Old East Frisian’, it is the outstanding character of the Old Frisian dialect of the region Riustringen (cf. map 1.1) that is of special interest within the framework of this study (Boutkan, 1996). Its language is found in two codices from the 14th century, labelled R1 and R2. The labels Old West Frisian and Old East Frisian will occasionally be applied as strictly geographical designations. ‘Old West Frisian’ means: Old Frisian language forms as they are attested in sources from the region where nowadays West Frisian dialects are spoken, mutatis mutandis for Old East Frisian.\(^6\) Old West Frisian and Old East Frisian do not necessarily differ from each other, nor are both groups internally necessarily homogeneous.

### 1.2.4 Main relevant developments in West Frisian between 1300 and 1600

Extensive changes have taken place in the West Frisian language between the late 14th and the early 16th centuries, changes that are also known to have taken place in many other Germanic languages.

---

\(^3\) “We, three brothers mentioned, confess and confirm with this present letter of arbitration and receipt how that we have agreed among each other...”

\(^6\) With the sole difference being that nowadays most Modern East Frisian dialects are extinct.
These are the main developments, relevant for this study:

- Abandoning of case system and reducing grammatical gender contrast from three to two genders (Hoekstra 2001b, 776-778);
- Simplification of inflectional morphology (idem);
- Degemination (Versloot 2001b, 774);
- Lengthening of short root vowels in open syllables (Versloot 2001b, 769);
- Reduction of unstressed vowels (idem).

The reduction of unstressed vowels is the main focus of this study. Lengthening of short root vowels in open syllables and degemination affect the conditions for reducing unstressed vowels. The reduction of unstressed vowels has serious implications and is recursively affected by the inflectional system. That is why these processes are introduced here.

**Case system and grammatical gender**

Old Frisian had four cases in three grammatical genders, as in Standard High German and Modern Icelandic. This system was gradually abandoned during the Middle Frisian period. So, Old Frisian distinguished for example:

<table>
<thead>
<tr>
<th></th>
<th>‘the stone’</th>
<th>three genders: definite article</th>
</tr>
</thead>
<tbody>
<tr>
<td>nom. sg.</td>
<td>thi stên</td>
<td>masculine</td>
</tr>
<tr>
<td>gen. sg.</td>
<td>thes stênis</td>
<td>feminine</td>
</tr>
<tr>
<td>dat. sg.</td>
<td>tha stêne</td>
<td>neuter</td>
</tr>
<tr>
<td>acc. sg.</td>
<td>thenne stên</td>
<td></td>
</tr>
</tbody>
</table>

In the Middle Frisian language of the early 16th century proverbs, written by Reyner Bogerman (De Boer, 1900), we find a subject-object system for three genders. In Modern Frisian the distinction between the grammatical masculine and feminine gender has been abandoned for nouns and adjectives. Functional relations are expressed with the help of prepositions and syntactic structures, as is the case with Modern English and Modern Dutch:

\[
\text{de stiën} \text{'the stone'}, \text{de saak} \text{'the case'}, \text{it brêf} \text{'the letter'}.
\]

subject, (in)direct object de stiën, possessive construction fan de stiën, etc.

---

7 Only the West Frisian dialect of Schiermonnikoog has three grammatical genders in nouns and adjectives.
A.P. Versloot: *Mechanisms of Language Change*

The exact process of simplification and final abandonment of the case and gender system is not the subject of this thesis, but could be traced precisely with the help of the charter corpus.

**Inflectional morphology**

Old Frisian had several inflectional classes, partly distinct for gender, so for example:

- nom./acc. pl. masc. *stênan* 'stones'
- nom./acc. pl. neuter *land_*, 'parcels'
- nom./acc. pl. fem. *seka* 'cases', *sister(j)* 'sisters'

In Modern Frisian, almost all nouns end in *-en* or *-s* in the plural, according to phonological patterns: *stiennen*, *launen*, *saken*, *sisters_*. Less extended reductions have taken place in the inflectional patterns of verbs.

**Degemination**

In Old Frisian, a phonological opposition existed between long and short consonants. This is no longer the case in Modern Frisian, where consonants are always short:

- Old Frisian: *setta* [set:a] 'to put'
- Modern Frisian: *sette* [sete]

Sometimes, when the long consonant was shortened, the preceding vowel could be lengthened, as in Modern Frisian *stôk* [stok] 'stick' < Old Frisian *stek* /stok:/, *bôle* [bole] 'bread' < Old Frisian *bulla* /bol-la/. This so-called compensatory lengthening is no more than a tendency and is prevalent in the northern part of the language area (Spenter 1968, 16; FAND-database, 1980/95). The degemination of long consonants is discussed in § 2.2.

**Lengthening in open syllables**

Old Frisian short vowels have often been lengthened in open syllables:

- Old Frisian: *sone* 'son' with /o/, *dagen* 'days' with /a/
- Modern Frisian: *soan* with [o.ə], *dagen* with [a]

The lengthening process is not as common as it is in for example Dutch and most of the North Germanic languages. The lengthening in open syllables is the subject of § 2.3.
Reduction of unstressed vowels
The development of vowels in unstressed syllables is the main object of this study. In Old and Middle Frisian texts, the letters <a>, <e>, <i>, <u>, and in the older periods also <i>, are applied to render vowels in unstressed syllables. Modern Frisian has predominantly /a/ in this context, regularly written <e>, in some suffixes also <i> such as in -lik [lik] (cf. English -ly). The current position on the phonological status of written mediaeval <a>, <e>, <i> and <u> is formulated by Boutkan (2001, 619):

“[...] the bulk of O[ld]frij[sian]. attests to the merger of all vowels in unstressed syllables to /a/.”

Sjölin (1969, 18) describes the spelling in the charters as a “[... willkürliche Orthographie [...]]”.

According to Boutkan and Sjölin, Middle Frisian and perhaps even Old Frisian had only /a/ in unstressed syllables. These opinions should not detract from the fact that in the oldest charters and codices, many forms are written with <a> and <u>. These spellings match the reconstructed historical phonological application. For example:

Old Frisian: (wī) <habbaθ> ‘we have’; <makia> ‘to make’; <sekum> ‘cases (dat. pl.)’
Modern Frisian: (wy) hawwe, meitisje, takta (general plural form), where e = [a].

Many Old Frisian vowels were not only reduced in quality in the subsequent periods, but could also be subject to syncope and apocope:

Old Frisian: dore ‘door’, faren ‘sailed (past. part.)’
Modern Frisian: doar̥, fearn

The details of these developments are monitored in chapter two, in particular in § 2.4, and discussed in detail in chapter three. Current opinions are evaluated in detail in § 3.1.

1.2.5 Basic views on the mechanisms of language change
Since the early beginnings of the historical linguistics of Germanic languages, scholars have assumed a causal relationship between the Germanic root stress and
the reduction of subsequent sounds in the word (for instance, Streitberg 1896, 29).

In Indo-European, the stress could be both on the root and on inflectional endings. For example. Latin: *'vidi 'I saw', vi'di'stis 'you saw*. In Germanic languages, the intensity stress was concentrated on the root. For example Gothic *'wait 'I know', 'witin 'you know'. The sounds of unstressed endings were subsequently reduced. The reduction or even disappearance of inflectional endings meant a loss of grammatical function. This inevitably caused the collapse of the Old Germanic inflectional system and a transition towards more analytical languages (Von Polenz 1972, 20).

This phonetically-based intuition may seem fairly logical. But from a synchronic, functional point of view it is difficult to understand. If a speaker from the year 800 was able to acquire a certain phonological grammar that allowed for a wide range of vowels and consonants in an unstressed position, functionally loaded by the archaic Germanic (originally Indo-European) inflectional grammar system, why should this change? The archaic grammar had evolved and existed for several generations. Being functional and possible, there seems to be no evident force to cause a change in the system (cf. for similar considerations Zuraw 2003, 139).

Evidence of this perspective can be seen in modern Icelandic. There is hardly any Germanic language with such strong and consistent intensity stress on the first syllable of every word, yet at the same time, Icelandic is also the Germanic language with the most archaic inflectional system with three different vowels /I, a, û/ in an unstressed position, still in full use. Geographical isolation, together with the status of the language and the level of literacy of the population are widely mentioned as relevant factors (Karlsson 1989, 52-54).

Historical linguistics shows that detailed reconstructions of former phonology and morphology can be achieved. An imperative sequence of stages in the development of languages is questionable, but at least retracing seems possible. Neogrammarians argue that the cause of changes was to be found in 'speech' (Paul 1920, 32). From a Neogrammarian perspective, the direction of changes was
determined by ‘convenience’ (“Bequemlichkeit”), i.e. of articulation (idem, 56, 57). Paul contends that it is impossible to give any general indication about the nature and direction of this ‘convenience’ force. The problem with this view is that what is ‘convenient’ in one case can remain without implication in another. The case of final devoicing (for example, Frisian bèd [bɛːt] and English bed [bɛd]) provides a good example. Final devoicing is a strong tendency in many stages of most Germanic languages. If it is for the sake of ‘convenience’, how can it be that Modern English can easily do without it?

The concept of ‘convenience’ is reformulated as ‘markedness constraints’ in Optimality Theory (OT). OT-constraints often express some kind of articulatory inconvenience that is to be avoided (Kager 1999, 5). In an OT framework, differences between languages or between two stages of one language can be the result of different constraint rankings. According to the theory, there is no natural ranking of constraints. The constraints are universal, but their ranking is languagespecific and the principle of ‘strict domination’ favours one constraint above the other (idem, 11, 12). This implies the same uncertainty as in the Neogrammarian approach, where language change is somehow linked to ‘convenience’, but no definitive indicator can be found to test the theory. Thus every account of the past becomes a ‘just so’ story. Things happened as they did for a reason, not imperatively, but somehow logically. If developments are not imperative, the likelihood of reliable reconstructions of the history of languages diminishes and predictions for the future become impossible.

This study considers language\textsuperscript{11} as a deterministic dynamic system, governed by self-organisation. Such systems can exhibit chaotic behaviour. To my knowledge, this is not a fully established theory. This study attempts to contribute to the development of such a theory. Basic concepts of this approach are outlined in § 1.4. Application of these concepts is found in the models in § 5.1 and 5.2. The data analysis of chapter two preceding the elaboration of the theoretical concepts is in itself a contribution to Frisian linguistics. Section 1.3 constitutes the first stages of this study. How is written language material of late mediaeval Frisian used to investigate the phonological and phonetic changes in the language over that period?

\textsuperscript{11} In this approach, ‘performance’ and ‘competence’ are not separated; every utterance (in historical material ‘spelling form’) is treated equally. There is no a priori contrast between a grammatically correct form and a ‘slip of the pen’.
1.3 Methodological preliminaries

In this section, several methodological preliminaries will be discussed. Firstly, a purely technical description is given on how the data was collected from the digital charter edition (§ 1.3.1). The question is then raised about spelling and spelling tradition. What are the implications of extracting phonological or even phonetic information from the written sources (§ 1.3.2)? The outcome of that section forms the basis for a closer definition of the grapheme, phoneme and phone concepts for the purpose of this study (§ 1.3.3). The step towards mapping geographical differences is explained in § 1.3.4, followed by a practical instruction on how to read the graphs and maps (§ 1.3.5). The differences between the language forms in original charters and copies, and their implications for the use of the sources is addressed in § 1.3.6. Apart from the relationship between spelling and phonology, the size of the corpus also poses a methodological problem. Is it large enough to warrant general statements? Are observed trends, for example, statistically reliable? Such questions are discussed in § 1.3.7. In the final section (§ 1.3.8) the use and interpretation of the data from the codex Unia are outlined.

1.3.1 Collecting the data

At this moment, the entire corpus of Frisian charters, city administration books and letters from the period before 1600 are being digitally lemmatised at the Frisian Institute of the University of Groningen. The information is already available on card indexes, kept in the institute, and is being converted into a digital database. This digital database will provide the opportunity to quickly find any form of lemma. A complete digital text edition of the charters are a prerequisite for this lemmatisation. Such a digital edition, created at the same institute in Groningen, is already available and has kindly been made available for this project. This digital text edition follows the printed edition of the charters (OFO I-IV), improved with corrections from Vries (1984).

Because the digital database with lemmatised information was not available when the research was carried out, specific spelling forms of a given lemma were selected, using regular expressions with the aid of a Python computer script. This method can be used as long as the lemma in question does not have too many homonyms. To allow for relevant corpus counts, the lemmas have to appear with substantial frequency. The question of absolute frequencies and statistical reliability is discussed in § 1.3.7.

12 Regular expressions are character combinations extended with additional options for wild cards, alternative characters, etc. To give an idea of the possibilities, the regular expression s[ae]c?k[ea]?’ will return positive matches including: sek, sek, sek, sak, sak, sak, sak, sek, etc. forms of Old Frisian sak ‘case’, but not, for instance, sek or sak. Etymological cognates are English sake, Dutch zaak and German Sache.
Most of the percentages in this study have been rounded off on integer values (whole numbers). This research uses around 100 data tables, some containing several thousand records. Including all such data in this publication, would exceed a reasonable size. The data underlying this study will be made available on the author’s personal website at the Fryske Akademy: www.fa.knaw.nl.

As an example of a data table from the charters, table 1.2 shows the beginning of the working table of seke ‘case’. The complete table contains 876 records, including 443 from original charters. The legend of the table is given underneath the table. Tables of this kind are the basis for all the graphs, tables and maps presented in this publication.

<table>
<thead>
<tr>
<th>Chnr</th>
<th>Root</th>
<th>Ending</th>
<th>Case</th>
<th>Text</th>
<th>Year</th>
<th>Loc</th>
<th>o-c</th>
<th>Author</th>
</tr>
</thead>
<tbody>
<tr>
<td>20001</td>
<td>seck</td>
<td>a apl</td>
<td></td>
<td>nwy wta wtiott; ende alle secka by riehtha in da sind eralle, from waser(s) derer 1)</td>
<td>1378</td>
<td>Fra</td>
<td>e</td>
<td>-</td>
</tr>
<tr>
<td>20001</td>
<td>seck</td>
<td>a apl</td>
<td></td>
<td>degebm II riecht degebm; alle secka to bij riechten, efter daem men monscha to mosian.</td>
<td>1378</td>
<td>Fra</td>
<td>e</td>
<td>-</td>
</tr>
<tr>
<td>20001</td>
<td>seck</td>
<td>e nsg</td>
<td></td>
<td>engh seke wem, derr dat sind riecht naet fan seyl, dat to riechtanze by da persona</td>
<td>1378</td>
<td>Fra</td>
<td>e</td>
<td>-</td>
</tr>
<tr>
<td>20002</td>
<td>seck</td>
<td>a nsg</td>
<td></td>
<td>hitte (e) also owen seksa Thema 2); se ina lande nat bincscha ne mogha ane wo1 to</td>
<td>1379</td>
<td>Wun</td>
<td>qc</td>
<td>-</td>
</tr>
<tr>
<td>20002</td>
<td>seck</td>
<td>in x</td>
<td></td>
<td>jeftha ethics 1); sekin seka hem th haem fan Voracht jeftha fan alken genevies leden,</td>
<td>1379</td>
<td>Wun</td>
<td>qc</td>
<td>-</td>
</tr>
<tr>
<td>30001</td>
<td>sak</td>
<td>e nsg</td>
<td></td>
<td>ende in that sake that these daick wanne mit maekte dudlen und Astenynyngha that</td>
<td>1381</td>
<td>Lit</td>
<td>c</td>
<td>-</td>
</tr>
<tr>
<td>30001</td>
<td>sak</td>
<td>e nsg</td>
<td></td>
<td>that sake that his hit naet ane dwe als hit fore screwan is als that mene hara water</td>
<td>1381</td>
<td>Lit</td>
<td>c</td>
<td>-</td>
</tr>
<tr>
<td>30001</td>
<td>sak</td>
<td>e nsg</td>
<td></td>
<td>tjida schellar ene tilla hald ja hoda tot Temeza, and is that sake that dessa feets</td>
<td>1381</td>
<td>Lit</td>
<td>c</td>
<td>-</td>
</tr>
<tr>
<td>10002</td>
<td>seck</td>
<td>a apl</td>
<td></td>
<td>manighfael spoeka, ende wy thorse feesrseyla seke habraa harecht ende atte, na</td>
<td>1386</td>
<td>Lit</td>
<td>qc</td>
<td>-</td>
</tr>
<tr>
<td>10002</td>
<td>seck</td>
<td>im dpl</td>
<td></td>
<td>hit fore fan alle tha sekim ther sind schoen en Dooya darsh, jeftha al ther after ther ma</td>
<td>1386</td>
<td>Lit</td>
<td>qc</td>
<td>-</td>
</tr>
<tr>
<td>10002</td>
<td>seck</td>
<td>e dsg</td>
<td></td>
<td>fremolaiken soneman in ther seke teiseha Hetta Heringha to Manninge, fan ene zgho,</td>
<td>1386</td>
<td>Lit</td>
<td>qc</td>
<td>-</td>
</tr>
<tr>
<td>10003</td>
<td>seck</td>
<td>e dsg</td>
<td></td>
<td>seke ende fan th haende scales ende sender seka to haldame.</td>
<td>1397</td>
<td>Ldn</td>
<td>c</td>
<td>-</td>
</tr>
<tr>
<td>40001</td>
<td>seck</td>
<td>e dsg</td>
<td></td>
<td>seke ende fan th haende scales ende sender seka to haldame.</td>
<td>1397</td>
<td>Ldl</td>
<td>o</td>
<td>-</td>
</tr>
<tr>
<td>20003</td>
<td>seck</td>
<td>e dsg</td>
<td></td>
<td>dis secke damer angher handa zige jeftha spoeka fan comma der dis sylobe naeet nogeleck</td>
<td>1402</td>
<td>Lit</td>
<td>oo</td>
<td>-</td>
</tr>
</tbody>
</table>

Table 1.2: Example of a part of a data table from the charters: Old Frisian lemma seke ‘case’

Chnr = chart number; e.g. 20001 = OFO II, nr. 1, 30001 = OFO III, nr. 1, etc.;
Root = root of the token (token = single appearance of a lemma); Ending = ending of the word; Case = number and case, e.g. dsg = dative singular; apl = accusative plural; Text = fragment from the charter containing the token; Year = year that the charter was written; Loc = location of the charter, based on the toponyms, supplemented with information from identified scribes (cf. § 1.3.4); o_c = original (o) or copy (c); qc = 17th century edition from the original, see § 1.3.6; Author = identified scribes (not in the example, because authors of the oldest charters are unknown).
In the fourth column, the paradigmatic interpretation is given. This is necessary to determine the status of the endings. Is it a dative singular, a nominative plural, etc.? Different numbers and cases can be expressed with different endings, especially in classical Old Frisian. Later, in the 15th century, the case system was abandoned and historically ‘incorrect’ endings were applied in several instances. The paradigmatic classification given is primarily of a functional nature. That means that a form is categorised as a dative singular if it corresponds to the syntactic and semantic function, even if the ending does not comply with the historical dative singular ending. This can be of great importance in determining a correct judgement of the development (cf. § 2.4.3.4).

<table>
<thead>
<tr>
<th>Root</th>
<th>Ending</th>
<th>Line</th>
<th>Text</th>
<th>Class</th>
<th>Gnr</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>mak</td>
<td>ade</td>
<td>885</td>
<td>were thir bi thir cloth of makede. so sere it warra tine sma</td>
<td>A</td>
<td>855</td>
<td>Older 'Skelenarisch'</td>
</tr>
<tr>
<td>mae</td>
<td>ad</td>
<td>2224</td>
<td>thir fan thirthom gur also maced se mit tre and</td>
<td>A</td>
<td>869</td>
<td>Formulary for Opening a Thing Session</td>
</tr>
<tr>
<td>mak</td>
<td>aden</td>
<td>194</td>
<td>thir thir hough makedun to Rome, and mlayer some aller cret ree&gt;</td>
<td>A</td>
<td>874</td>
<td>What is Law? (Haet is riecht)</td>
</tr>
<tr>
<td>mak</td>
<td>ad</td>
<td>1377</td>
<td>'haid sto' thir thir chapelle use maked is. Tha rtho panningen acht thi 'fira Farra nite' nzech ne</td>
<td>A</td>
<td>627</td>
<td>The Seventeen Statutes</td>
</tr>
<tr>
<td>maek</td>
<td>at</td>
<td>5777</td>
<td>sereth hir van gode seat and maeke annen algod fan</td>
<td>A</td>
<td>876</td>
<td>Authentica Riecht</td>
</tr>
<tr>
<td>mak</td>
<td>ad</td>
<td>5228</td>
<td>hir to wine lodec. habbar maked and brocht in een</td>
<td>A</td>
<td>876</td>
<td>Foroegung this riechtis (Processus Judicis)</td>
</tr>
<tr>
<td>mak</td>
<td>ian</td>
<td>5175</td>
<td>meint to maken.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>maek</td>
<td>ad</td>
<td>3695</td>
<td>Thio himpoage sed makedat wasssa ma scrife under thilla</td>
<td>A</td>
<td>647</td>
<td>Foerdugung this riechtis (Processus Judicis)</td>
</tr>
<tr>
<td>maek</td>
<td>at</td>
<td>3616</td>
<td>se an eind maeke van thir seke ther ma on kyft</td>
<td>A</td>
<td>647</td>
<td>Foroegung this riechtis (Processus Judicis)</td>
</tr>
<tr>
<td>maek</td>
<td>ad</td>
<td>4828</td>
<td>makedat and recknat. and hi Wainhir</td>
<td>A</td>
<td>902</td>
<td>Compensation Tariff of Wymbritseraddeel</td>
</tr>
<tr>
<td>maek</td>
<td>at</td>
<td>5107</td>
<td>forret diert jinist hem maeke just the by anna preser toos</td>
<td>B</td>
<td>885</td>
<td>Statutes of the Leppa</td>
</tr>
<tr>
<td>mak</td>
<td>at</td>
<td>4368</td>
<td>Alle disse horte sent maked to gane to riechta by</td>
<td>C</td>
<td>889</td>
<td>Compensation Tariff of Dongeradeel</td>
</tr>
</tbody>
</table>

Table 1.3: Example of a data table from the codex Unia: Old Frisian lemma makia ‘to make’. The special aim of this table is to trace the transition from single consonant spelling in for example, Old Frisian makad (past. part.), towards double consonant spelling, Modern Frisian makke (past. part.) c.f. § 2.2. Root = root of the token; Ending = ending of the word; Line = line in the digital text edition used; Text = fragment from the codex containing the token, corresponding to the line given; Class = grouping of texts in three classes according to linguistic character, see. § 1.3.8. The texts of group A are ordered according to a tentative sub-classification, not shown in the table, reflecting the linguistic age of the text; Gnr = the so-called ‘Gerbenzon’ number: the Gerbenzon-index is an index on the entire mediaeval Old Frisian corpus where every text has a unique number. Texts can appear in different codices in different editions; Title = English title of the text.
The text of the codex *Unia* has not yet been published. A preliminary digital text edition is available at the Fryske Akademy. This text version was available for this research. It should be noted that the transcription is not yet complete, but the parts available are assumed to be well transcribed. This text was also searched with regular expressions. An example of a data table from *Unia* is given in table 1.3. The question of how the text was used and dated is presented in § 1.3.8.
1.3.2 Spelling and spelling tradition

Written charters from the period 1378-1550 have been used to obtain information about phonological and phonetic features of the Frisian language and their variation in time and space. The first issue that has to be clarified here is whether the charters are suitable material for answering questions on pronunciation at the time of writing. Are written texts embedded in some form of spelling tradition that filter and mask the phonological details and the phonetic features of the spoken language of the time? What was the relationship between spelling and pronunciation in Fryslân in the 15th century?

The attested charters are primarily juridical and administrative texts. They belong mainly to formal registers. They are definitely not transcriptions made by a trained linguistic scholar. The spelling used in the charters is the result of several factors. Written pieces were prepared and drafts were copied into neat versions. For archiving purposes, copies could be made from the original. There are some instances where multiple versions of one charter have been preserved. For example, OFO II-3 with two parallel old copies. Was the text dictated by one of the participants in for instance a peace agreement, or did a clerk prepare the piece, using his private formulations and spelling habits? In cases of agreements between multiple parties, representatives of which party wrote the text? All kinds of situations might have occurred (cf. Rem 2003, 52-53). As the charters are formal pieces of writing, it may be assumed that the authors were careful in their writing. What we see must have been a reasonable and acceptable spelling.

Established spelling and loose spelling traditions

Was there a spelling tradition mediaeval authors could rely upon? Were authors looking at a previously applied spelling in older texts or were they trying to write as they spoke, as far as that was possible? What would be the pattern of spelling and spelling changes in the charters if spelling traditions existed at that time? According to the qualification of ‘random spelling’ as applied by Sjölin (1969, 18, cf. § 1.2.4), there would be little hope in expecting any meaningful conclusion from the spelling in the charters subject to a reconstruction of sounds actually realised.

In the modern situation of established languages, spellings are fixed and then implemented for long periods. Texts are almost entirely homogeneous in spelling. Individual, generational and geographical differences in pronunciation and grammar are (almost) entirely obscured by the spelling conventions. Spelling changes are discrete and fairly consistent in their application. This was definitely not the case in 15th-century Fryslân.
In a less centralised society, such as the mediaeval county of Holland\textsuperscript{13}, the spelling might be somewhat looser. Spelling is relatively homogeneous for clusters of authors. For instance, from one scriptorium or chancery. Changes in the pronunciation are only shown with delay, if at all. Established traditions may be responsible for the appearance of archaic forms. Geographical peculiarities are filtered and replaced by more traditional forms. As authors are explicitly reflecting on their spelling, their choices are more categorical than incidental. Personal variation will be the result of ‘mistakes’.

The possibility of an Old Frisian spelling tradition
Was there anything like a Frisian spelling tradition in the 14\textsuperscript{th} and 15\textsuperscript{th} century? Meijering (2005, 200) asks in his review of Bremmer 2004:

“Hoe verklaart [Bremmer] dat reeds de vroegste friestalige documenten, ja zelfs losse woorden in een Latijnse context, zo’n consistente spelling vertonen? Waar komt die vandaan?”\textsuperscript{14}

This suggests something like an Old Frisian spelling tradition. Traditions are per se the result of a gradual evolution. Bremmer (2004, 78) suggests something similar when writing about a 13\textsuperscript{th} century author being: “vertrouwd [...] met het geschriven Oudfries van zijn tijd.”\textsuperscript{15} One can only be ‘familiar’ with ‘the written Old Frisian’ if a substantial number of texts, exhibiting some kind of spelling tradition is assumed.

This so-called classical Old Frisian spelling tradition comprises the following spelling conventions (Sjölin1969, 17, 29-30; Bremmer 2004, 78):

\begin{itemize}
  \item Vowel length is not indicated with an additional subsequent vowel;
  \item Geminate consonants are written with a double consonant sign;
  \item Historical /ð/ and /þ/ are written <th> and not <d> and <t>;
  \item Historical unstressed full vowels are written, so: <alra> instead of later (spelling) forms like <alre>, <aller>, <alder>.
\end{itemize}

\textsuperscript{13} Unlike the international practice, Holland covers only the western part of the current Netherlands (cf. England not to be confused with Great Britain).

\textsuperscript{14} How does [Bremmer] explain that the earliest documents written in Frisian, even isolated words in a Latin context, already show such a consistent spelling? Where does it come from?

\textsuperscript{15} Being familiar with the written Old Frisian of his time.
It is not necessary to postulate on an independent Old Frisian spelling tradition as the reason for the existence of those spelling practices in the Old Frisian texts. These practices comply with the spelling conventions of Latin: No vowel length indication, double consonants where appropriate and circumscribing the Greek letter θ with <th>. There is no problem with full vowels in either stressed or unstressed syllables. Every medieval writer of Old Frisian, familiar with Latin, would ‘re-invent’ the so-called ‘classical Old Frisian spelling’.

There is little evidence that a substantial corpus of Frisian texts existed, to establish an independent Old Frisian spelling tradition. Bremmer (2004, 85-86) states that Frisian was hardly written before 1200 and Latin remained the main written language in Fryslân in the 13th century and even later (idem, 71).

Spelling practices in the Middle Frisian era

Also, in the 15th century, the circumstances for the development of an independent Frisian spelling tradition were not favourable. There was no leading writing centre in Fryslân, such as a feudal court or any form of central government. Scriptoria were dispersed over monasteries and city chanceries (Vries 1993, 65). Initially, professional writers were literate in Latin and Dutch and later in Frisian. Several attended universities in the Low Countries or adjacent regions, including Leuven and Cologne (idem, 68). There were no universities in Fryslân at that time. Every literate person in Fryslân was acquainted with Middle Dutch (idem, 66). Several text types were exclusively available in that language and none at all in Frisian (idem, 61 ff.). The importance of Dutch as a written language is also illustrated by the fact that Dutch was a serious alternative for several individuals in the 15th century, even for private use (idem, 68-69). So if there was any spelling tradition that writers were familiar with in Fryslân in the 15th century, it was Dutch.

The conclusion is that there was no socio-cultural basis for an independent Frisian spelling tradition that could mask personal, temporal or geographical variations. The number of Frisian texts was too limited and the practical confrontation with non-Frisian texts too intense in the period 1200 to 1550. People writing in Frisian were familiar with spelling conventions, particularly Latin in the earliest times, and Dutch from the 15th century onwards. People knew how to write a language, they did not know how to write ‘standard(-like) Frisian’. The solution lay in writing the language as they spoke it, with the graphical means they were familiar with.

The word choice and syntax of the charters, for example, in the standard formulas, may be highly defined by the genre of formal, juridical texts, that were often influenced by Latin and Dutch examples. In choices between morphological endings and the quality of unstressed vowels, the authors had nothing to rely on other than their own competence of Frisian and their familiarity with written
Dutch and Latin. The choices may have been somewhat conservative, due to the careful writing process, but the outcome reflects existing contemporaneous phonological and morphological variations in the spoken language.

Section summary:

• There was no independent spelling practice for Frisian during the Middle Ages;
• Authors of Old and Middle Frisian used existing conventions from other languages they were familiar with;
• The presumed ‘Old Frisian spelling tradition’ is the result of an ad hoc application of Latin spelling conventions;
• Middle Dutch spelling practices were used for Middle Frisian.
1.3.3 Phones, phonemes and graphemes

Since the introduction of structuralism into linguistics, a sharp distinction is made between:

- The sound or phone - usually considered the field of phonetics;
- Its categorical interpretation in a semantically contrastive context as a phoneme;
- Its representation in conventional spelling systems, grapheme.

This was a large methodological improvement. Within that framework, one is able to raise questions for instance on the relationship between spelling and pronunciation or the interaction between allophony and sound change. The methodological separation between grapheme, phoneme and phone induced scepticism about their interrelation. Some scholars had become reluctant to formulate any positive statements on pronunciations in the past and preferred a strictly graphematical analysis.\(^\text{16}\)

In this study, spelling is assumed to be phonemic in principle. In some cases allophonic variations and phonetic details are expressed. This resembles the practice of broad phonetic transcriptions. The default interpretation of the mediaeval spelling in this study is that \(<a>\) represents /a/ which is expressed in speech by [a], etc. In several aspects, the Latin and Middle Dutch spelling conventions were different. These differences must be taken into account.

Reading Old and Middle Frisian phonemes through Latin and Middle Dutch spelling conventions

The spelling conventions of Latin and Middle Dutch result in some deviation from the default hypothesis. Latin and Middle Dutch have different systems to represent (or not represent) the length of vowels and consonants.

There was a transition in the early 15\(^{th}\) century from Latin-based spelling practices towards a spelling practice that kept pace with that of Middle Dutch. In the Latin-

---

\(^{16}\) Sjölin (1970, 104) formulates a strictly theoretical point of view: “Eine ‘graphonemische’ Interpretation der graphematischen Daten ist in diesem Zusammenhang strenggenommen nicht relevant, da wir nicht wissen, inwieweit der Text der Hs. auch als Lautung realisiert wurde.” (‘A ‘graphonomic’ interpretation of the graphematic data is, strictly speaking, irrelevant, because it is unknown to what extent the text of the codex was realised as acoustic sounds’). However, this is the introduction to a section with the title: “Schriftbild und Lautung” (‘spelling and sounds’). Following this opening statement, Sjölin articulates several observations on pronunciation in mediaeval Frisian, based on spelling contrasts or, on the contrary, the absence of them. So despite Sjölin’s theoretical renouncement, he does draw phonemic and phonetic conclusions from written mediaeval texts.
based spelling practices, vowel length is not indicated. So, late 14th century
<herath> represents /hɛræt/ ‘(we) hear’, while <seke> represents /sɛkə/ ‘case’.
In Middle Dutch vowel length is indicated, applying the following system
(examples from Middle Dutch):

- Short vowels in closed syllable are written with a monograph,
e.g. <dat> = /dat/ ‘that’;
- Long vowels in closed syllables are written with a digraph,
e.g. <doer> = /dɔər/ ‘through’;
- Long vowels in open syllables can be written with either a monograph or
  a digraph, so both <zonen> and <zoenen> represent /zɔːnən/ ‘sons’.

The shift in orientation from Latin spelling practices towards Dutch practices can
be illustrated by the spelling of the Old Frisian word fore, Modern Frisian foar ‘for’.
Originally the word has a short root vowel: /fɔə/. The short root vowel is
lengthened in open syllable in the 14th century, making /fɔːə/. After 1390 the final
schwa is dropped, making /fɔː/.

<table>
<thead>
<tr>
<th>time frame (approximation)</th>
<th>phonological form</th>
<th>spelling</th>
<th>spelling tradition</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 1300</td>
<td>/fɔə/</td>
<td>&lt;fore&gt;</td>
<td>Latin</td>
</tr>
<tr>
<td>14th century</td>
<td>/fɔːə/</td>
<td>&lt;fore&gt;</td>
<td>Latin</td>
</tr>
<tr>
<td>&gt; 1390</td>
<td>/fɔː/</td>
<td>&lt;for&gt;</td>
<td>Latin</td>
</tr>
<tr>
<td>&gt; 1430</td>
<td>/fɔːr/</td>
<td>&lt;foer&gt;</td>
<td>Middle Dutch</td>
</tr>
</tbody>
</table>

Table 1.4: Interpretation of vowel length according to Latin and Middle Dutch
spelling practices.

Due to the process of degemination of long consonants, a reverse interpretation
is applied to the consonants. In the older parts of Unia and the oldest charters,
double consonants mark phonologically long consonants, complying with Latin
spelling practices. In more recent texts and charters, double consonants were used
to show the shortness of preceding vowels in accordance with Middle Dutch
writing practices (cf. Hofmann 1969). The interaction between the actual
phonology of geminate consonants and the spelling of consonant digraphs is
discussed in § 2.2.3.
The ‘prototype’ of a sound comes close to, but does not equal the generative concept of underlying phoneme. Allophones for example, can represent two prototypes, but one underlying phoneme.

<table>
<thead>
<tr>
<th>Time frame</th>
<th>Phonological form</th>
<th>Spelling</th>
<th>Spelling tradition</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; ± 1400</td>
<td>/sɛt-ta ~ lɛza ~ dɛdθ/</td>
<td>&lt;setta ~ lessa ~ dede&gt;</td>
<td>Latin</td>
</tr>
<tr>
<td>&gt; ± 1450</td>
<td>/sɛt-a ~ lɛza ~ dɛdθ/</td>
<td>&lt;setta ~ lessa ~ dede&gt;</td>
<td>Middle Dutch</td>
</tr>
</tbody>
</table>

Table 1.5: Interpretation of consonant and vowel length according to Latin and Middle Dutch spelling practices.

So, information about vowel length in the Latin spelling tradition, and consonant length in the Middle Dutch spelling tradition can be obtained solely from indirect evidence.

**Schwa (ə)**

A special case is <e> and <i> in unstressed position. In older stages of the Germanic languages, there was no /ə/. Written <e> and <i> in unstressed syllables reflected something like /e/ or /ɛ/ and /i/ or /ɪ/. But in Old and Middle Frisian, the letters <e> and <i> alternate in positions where historical phonological reconstructions suggest /θ/. Middle Dutch had /θ/ and this sound was most often rendered as <e>, sometimes also <i>, <ə>, <o> or <u> (Pijnenburg 1997, 80). For <e> in unstressed syllables, the default interpretation will be: <e> ~ /θ/ ~ [ə]. In the data analysis in § 2, the tokens spelled with <e> and <i> are kept apart. The case of alternation between <e> and <i> in unstressed syllables is analysed in detail in § 3.6.

**Phonetic notation and real-world realisations**

The phonetic sign [a] is a container for a theoretically endless range of actual realisations. In real performance, there are measurable differences in formant contrast and length between [a] in word-final position, syllable final position, and protected [a], in isolated words or in allegro speech, etc. even for one speaker. This variation goes beyond the possibilities of the International Phonetic Alphabet. As an example, the IPA allows for three different length categories, but in reality, the length can be measured on a continuous scale in milliseconds with acoustic equipment. The IPA sign [a] represents an abstract realisation of /a/: the prototypical realisation.\(^\text{17}\)

\(^{17}\) The ‘prototype’ of a sound comes close to, but does not equal the generative concept of underlying phoneme. Allophones for example, can represent two prototypes, but one underlying phoneme.
The following analysis will show that the key to the answer about the cause, order and direction of changes can be found in the variation that lies in performance variation. Some spelling practices even seem to be an expression of it. Therefore, the interpretation of sound features will benefit from an approach where actual realisations of one phoneme are not considered as uniform members of a discrete group, but as clusters of appearances, to be measured on continuous scales. A fluid interpretation of the concept phoneme results in a blurred transition between phoneme, allophone and phone (cf. Pierrehumbert 2003, 183 & 192).

Prototypical realisations and some aspects of performance variation are language-dependent. On the other hand, some of the performance variations seem to be universal, because they are controlled by articulation constraints. These constraints are the consequence of general characteristics of the human speech organ and its articulatory control. They are bound by the biological and physical substratum. For example, the formant contrast of vowels produced in fast speech are less than the formant contrast of the same phonological vowel in slower speech. This phenomenon is for example observed both in Frisian and Japanese (De Graaf 1986, 17-19). Because physical laws are universal both in place and time, and the human species has not changed significantly during the past 1000 years, one may assume that many phonetic performance effects were the same in 1400 as they are now. For example, when modern measurements show that the intensity volume of [a] is larger than that of [a], that fact is taken to be valid for the 15th century as well. After all, all notations with ‘[ ]’ concerning historical data are, strictly speaking, hypothetical.

**Notation legend**

Within the framework of the default hypothesis of identification of grapheme with phoneme and prototypical phonetic realisation, it is sometimes difficult to choose an appropriate notation. Below the reader finds the interpretation that is given to the several notations in the course of this study, beginning with the written characters:

- **<a>:** The character ‘a’ on paper; the basic idea is that the author wrote that character because its sound value in Latin and/or Dutch was the closest match with the sound that he perceived in his own native language intuition;

- **/a/** A meaningful sound category in the language, distinct from /o/, /e/ or any other phoneme by creating different meanings in (semi-)minimal pairs. This phoneme has a prototypical realisation;

- **[a]** The prototypical realisation of /a/: the most open sound of all language sounds and of relative short duration, etc. The phonetic...
notation [a] is still covering a wide range of performance variation in duration, formant contrast, etc.;

• -a This is meant to be a diachronic notation. It is, for instance, used to mark the infinitive ending of a verb, expressing the following implicit assumptions:
  - <a> is the almost exclusive notation for infinitives in the Old Frisian sources,
  - it probably reflected the phoneme /a/,
  - it was prototypically realised [a],
  - after 1490 it was increasingly written as <e>
  - in early Modern Frisian it was finally pronounced as [ə],
  - etc...

Section summary:

• The spelling of Old and Middle Frisian was phonemic in principle. In some cases allophonic variations and phonetic details are expressed;

• The default interpretation of the spelling is a one-to-one match between grapheme, phoneme and phone;

• This interpretation needs corrections for diverging practices of Latin and Dutch in the representation of vowel and consonant lengths;

• Phonetic variation is measured on a continuous scale;

• Bio-physically induced sound patterns are universal in time and space.
1.3.4 Mapping the charter language
When the spelling reflects the major traces of phonology, geographical variations may also be reflected in the spelling. In other languages, extensive research has taken place into the methodological possibilities and constraints of historical dialect maps. In Germany the key word in this discussion is *Schreiblandschaft*, meaning ‘spelling landscape’ (König 2001, 95). This term indicates observed geographical variations in written sources, while leaving open the question about the precise relation between written and spoken language. For late mediaeval Frisian, an example of an historical dialect map can be found in Miedema (1986), whereas Vries (1986) discusses dialectal features of one individual author. Miedema relies on text content to locate the sources. Vries focuses on the author’s biographical data.

Where does one locate the linguistic information on the map? A charter can be the result of an interaction between two or more parties which do not necessarily come from the same region. Was the text dictated, was it a prepared written concept, who dictated it and whose clerk wrote it? (Rem 2003, 24-28)?

Rem (idem, 23) formulates several criteria to decide on the suitability of mediaeval Dutch charters for language geographical investigations. She suggests that “the local dialect” can be found in charters where:

- The parties involved come from the same place or region;
- There is no-one with a high social status involved. A count or duke for instance, may employ clerks from a wider region and his chancery might develop a non-local writing tradition whose legibility was aimed at reaching a wider audience.

In a Frisian context, everything is basically from the ‘same’ region from the perspective of the Low Countries. In § 1.3.2, it was shown that there was no feudal court or dominating cultural centre in Fryslân at the time that could develop a uniform language.

A combination of location methods was used for the Frisian charters. To identify the origin of the charters, place names in the text are particularly suitable. For example, names of dwelling places of the people involved, geographical objects mentioned in an agreement or will, etc. These give a clue to the background of the parties, hopefully including the person that defined the linguistic character of the text. For several charters, the names of the authors are known (Vries 1984 & 1993) as well as parts of their biographical data.
In the onomastics department of the *Fryske Akademy*, a database has been prepared with all the toponyms from the charters.\(^\text{18}\) Every object was located and, where possible, identified with modern objects. For location reference, modern municipalities are used. The default approach was to allocate a charter in the centre of the municipality most frequently, not necessarily as an absolute majority, mentioned in it. This association was carried out with a simple database operation on the charter toponym database. There are several uncertainties connected with the outcome. The author or clerk may have come from another region or may have lived there but originated from another region. The author is most likely, but not necessarily the person who developed the linguistic character of the text. As many factors are uncertain, the linking by toponyms was the only option available for the majority of the charters.

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\(^{18}\) The author would like to express particular gratitude to Karel Gildemacher for providing this database at an early stage of this research (published in Gildemacher 2008). The geographical method presented in this section was in fact the key to the analysis that resulted in this thesis.
The application of the toponomy location method provided an opportunity to test the results. If the method were too fuzzy and unsure, no consistent maps could be expected from the data. But test maps drawn after the application of the toponomy localisation already appear to be consistent in their geographical distributions. This is implicit proof of the validity of the method.

The topographic base is shown in map 1.2. The region north-west of Leeuwarderadeel was ‘undyked’ marshland at that time. It is in the modern municipality of Het Bildt. The lakes and moors are shown to illustrate the geographical limitations of the cultivated area. They are not repeated in the legend of other maps. The south-east was particularly scarcely populated. There are very few charters from those regions. The borders correspond to the communities (deelen) and cities of the late Middle Ages. It should be kept in mind, that the allocation is done on the basis of the modern municipalities. The majority of the modern municipalities correspond to old ones. Some are the result of merging two old ones. For example, the modern municipality of Skarsterlân is the result of amalgamating Doniawerstal and Haskerland. The point ‘Skarsterlân’ is on its capital Joure, lying near the common border of the two former municipalities, in the heart of the new one.

To improve the statistical reliability of the maps, in some cases the data has been aggregated from municipalities to six larger regions. The regional division can be found in map 1.8 (cf. § 1.3.7.4).

This toponomy allocation method was checked with the information obtained from identified authors (Vries, 1984 & 1993, and some additional non-published information provided for this research by Vries). The content of information about these authors varies. Sometimes it is simply an anonymous handwriting that has been recognised on several charters. Sometimes the name is known, while sometimes only the function is known, without any additional biographical data. For example, one of the identified authors is a ‘citizen in Harlingen’. The interpretation applied in this study is that he came from Harlingen or at least had been living there for so long, that he had assimilated his speech to that of other citizens of the city. But we can’t be certain.

The charter database table contains 1,247 localised items. For 289 of them, the writer’s hand has been identified in at least a part of the main text (excluding the cases with identified handwriting on the dors). This means that known handwritings can only be used as a partial check. In 53% of the overlapping cases, the localisation based on the toponyms, complies with that based on the authors. That is a majority, but it would imply that almost half of the locations are wrong. Also, instances where charters were assigned to adjacent municipalities were
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initially counted as ‘wrong’, like Leeuwarden instead of Leeuwarderadeel, Bolsward and Harlingen instead of Wûnseradiel and Sneek instead of Wymbritseradiel (or vice versa). These errors do not significantly affect the general picture. Assuming those cases are ‘correct’, raises the overall level of correctness to 62%.

Of the remaining 38% of mismatches, 20 per cent points are due to the wrong allocation of texts written by Hemma Oudda zin. He is the most productive author in the corpus. Hemma Oudda zin is (or is one of) the author(s) of 116 charters in the database, or 9% of all the charters. He was city clerk of Leeuwarden and deputy-mayor of Tytsjerksteradiel, but was probably born in Bolsward. He owned estates and houses in neighbouring municipalities that are mentioned in the charters with toponyms. As city clerk of Leeuwarden, he often assisted in compiling charters. Using the toponomy method, texts written by him were allocated in the municipalities of Ferwerderadiel, Bolsward, Dongeradeel, Dantumadiel, Franekeradeel, Tytsjerksteradiel and Boarnsterhim. Only 41% of the charters written by Hemma were assigned to Leeuwarden or Leeuwarderadeel using the toponomy method.

Looking at the reliability from the perspective of the individual municipalities, it appears that municipalities towards the south and west of Fryslân, or those further away from Leeuwarden, had a match of around two-thirds between the toponomy method and the writers’ method. Due to the impact of Hemma Oudda zin, the match between these methods was only about a quarter in municipalities directly surrounding Leeuwarden and further to the north-east. (For example Dongeradeel, Tytsjerksteradiel and Littenseradiel). The language of the city of Leeuwarden (and on a lower level for the cities Harlingen, Bolsward with Wûnseradiel) distorts the data from the neighbouring countryside regions. In instances where it was known, the locations were corrected for information from the known authors. The information about the texts written by Hemma Oudda zin correct the large distortions in the regions surrounding Leeuwarden. After this correction, the geographical reliability of the countryside regions around Leeuwarden is much better now than the aforementioned one-quarter. It is unlikely that another highly productive writer was present among the authors of the anonymous charters who has not been identified by Vries. Still, some individual mismatches will remain.

Looking at the city of Leeuwarden itself, 93% of the charters assigned to the city by the toponomy method are also linked to Leeuwarden according to identified authors. This means that typical peripheral dialectal features rarely appear in the centrally located city by incorrect geographical assignment. Such peripheral features will appear where they ‘belong’, but their proportion might be

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19 cf. Vries (1993, 190) and § 2.3.4.2.
underestimated due to the influence of city writers. Given the combination of
toponyms and identified handwritings along with the assumption that no other
highly productive writer will be found among the anonymous charter authors, the
overall reliability of the locations can be estimated at over 70%.

In practice, linguistic information in peripheral regions is very consistent in the
maps. The default geographical opposition in Fryslân in the 15th century is
between the south-west and north-east. In extreme positions, ’typical dialectal’
features very often constitute over 75% and sometimes 100% of the attestations
allocated in that region. This supports the reliability of the applied method.

Section summary:

- The West Frisian charters are localised using dominant
toponymic references in the texts;
- This toponymy method was corrected for instances where
the author has been identified and his place of origin is
explicitly known;
- The overall reliability of the localisations is over 70%.
1.3.5 Reading instruction for maps and graphs

Graphs and maps are of great importance in this thesis. They are not merely illustrations, but form an integral part of the text. In this section, the reader will find explanations on how to read and interpret the graphical representations.

Variants from tables such as 1.2 are categorised into classes, counted and depicted in graphs. Making a classification implies neglecting irrelevant facts and aggregating variants that belong together from a specific perspective. Table 1.6 shows the changes in the ending of the dative plural in the noun seke ‘case’ in absolute numbers.20 The graph’s focus is the transition from the archaic ending <um> with secondary forms <em> and <im> against the modern plural form <en>. The archaic ending of the nominative and accusative plural <a> is attested in the function of a dative plural in a few instances. Irrelevant in this perspective is for instance, the spelling of the root consonant as <k> or <ck>, as is the quality of the vowel before the <m>. In graph 2.1 for example, it is the difference between <k> and <ck> that counts. The data in the table and graphs are divided into time frames. The limits of the time frames are a result of pre-analysis of the material. The first time frame starts in 1378 (plus the single charter from 1329).

The most common time frames are those used in table 1.6.

<table>
<thead>
<tr>
<th>case ending</th>
<th>-1430</th>
<th>1430-1460</th>
<th>1460-1490</th>
<th>1490-1510</th>
<th>1510-</th>
</tr>
</thead>
<tbody>
<tr>
<td>-Vm</td>
<td>2</td>
<td>6</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>-a</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>-en</td>
<td>0</td>
<td>1</td>
<td>10</td>
<td>12</td>
<td>5</td>
</tr>
</tbody>
</table>

Table 1.6: Number of attestations to the dative plural of seke showing the distribution of different endings in several periods, using original charters.

Reading table 1.6 in the time frame up till 1430, there are two instances of a dative plural of seke in the original charters. These are OFO I-2, 1386 <sekim> (cf. table 1.2) and <seckum> (OFO I-28, 1418). The form was categorised as -Vm, meaning vowel + <m>. That implies that 100% of the attestations from that period belong to the class -Vm. Between 1430 and 1460 there are eight instances of a dative plural of seke in the original charters. Five times <um> and once <em> making a total of six for the class -Vm. The forms <secken> and <seeka> are both found once. The latter is the form of the accusative plural, appearing in a dative context. The spelling -Vm covers six out of eight cases or 75% in the time frame 1430 to 1460. The figures are shown in graph 1.1.

20 As mentioned in §1.3.1, the classification ‘dative plural’ is a functional-syntactic one. After 1490, there is no longer a formal contrast between dative plural and nominative/accusative plural.
Graph 1.1: Graphical depiction of the data in table 1.6.

Map 1.3: Distribution of cases of plural of ‘son’.
The vowels of the word ‘son’ in Old Frisian have a complicated history. It is an old u-stem, cf. Riustringen Old Frisian sunu, ‘son’. The following maps show the making of an historical dialect map. The last map in the series (map 1.7) is the type that is used in the rest of the thesis. The data table is similar to table 1.2.

The plural of ‘son’ appears in the charters as <z/so(e)nen>, <z/sonnen>, <z/senn en>, <z/sinnen>. The focus of categorisation in this example is the presence of <o> in the root. Forms without <o> represent phonological /senn/ or /sin n/. The alternation between /e/ and /i/ is not relevant for this categorisation. Forms with <o> represent phonological forms like /senn/ or /sinn/. The difference between long and short vowels may be important from an etymological point of view, but this map series is concerned with the opposition between front–back: /e/, /i/ ~ /o/. Map 1.3 shows the geographical distribution of the data, against the background of the topography of Fryslân of the 15th century (see map 1.2). In charters linked to municipalities like Dongeradeel, Heerenveen or Wymbritseradiel only one plural form is found. In Franekeradeel there are 11 tokens designating the plural form of ‘son’ and 17 in Leeuwarden, etc. The circle size for one and two attestations is the same. The map caption includes the period covered by the data. In this case it is quite a long period. Graph 1.2 shows the temporal distribution of the variants of ‘son’. At first glance, it shows that the <e>/<o>-ratio does not really change through time. The overall percentage of forms with <o> is 29%. The idea of a temporal trend can safely be dismissed and the data from the entire period can be used to draw a map. This is different to a distribution as found in graph 1.1. When the diachronic changes are large, not all the data may be shown on one map, because temporal and geographical variations could interfere.

21 The vowels of the word ‘son’ in Old Frisian have a complicated history. It is an old u-stem, cf. Riustringen Old Frisian sunu, other Old East Frisian texts sune. The palatalisation and delabialisation in the Middle West Frisian plural looks like an instance of i-mutation, cf. Icelandic has sunur · sunir (sg. · pl.), Old Saxon and Old High German tend to level all the u-stems to the i-stems, with i-mutation, cf. Modern High German Sohn · Söhne. But the Middle Frisian vowel might also fit in a wider pattern of spontaneous palatalisation, like Modern Frisian sune ‘sun’ < Old Frisian sune (Hoekstra 2007). This raises the question of where the vowel /o/ in the singular comes from. It might be Dutch (Modern Dutch zoon), but the archaic Older ‘Skeletmaricht’ in the codex Una (cf. § 1.3.8) has only <sone>. There is a general tendency in West Frisian to lower /a/ to /o/ (Hoekstra 2001a, 723), for example, Modern Frisian komme ‘to come’ [komə] < Old Frisian kuma. During this transition, a Vowel Harmony effect became apparent in the Older ‘Skeletmaricht’. The root vowel /a/ is dominant in the infinitive <kuma> and the third person singular present indicative <kum(j)h>-, but in the conjunctive present, the /o/ prevails: <corume>. The same effect will be the cause for the early transition from /u/ > /o/ in the word sune/sone.
Graph 1.2: Ratio of plural forms of ‘son’ with <e> and <i>, counted as <e> or <o>, between 1431 (oldest plural) and 1547 (youngest plural).

Map 1.4: Categorised data; the numbers represent the percentage <e>. 
Following the categorisation of the data, the categorised data can be shown on the map at the municipality’s central point with pie charts. This is shown in map 1.4. The size of the circles still reflects the number of attestations per municipality. The pie charts show the ratio between the forms of $<o>$ and $<e>$. The figures next to the pie charts show the percentage of forms with $<e>$. For instance, in Franekeradeel there are 11 attestations to plurals of ‘son’ in original charters: one time $<zoenen>$, the rest $<sinnen>$ or $<sennen>$. A portion of 91% ($= 10/11$) of the pie chart is grey, representing the forms with $<e>$. The number ‘91’ is shown next to the pie chart.

The map reveals that forms with $<o>$ are only found in the centre and north-east of the province. The south-west has only $<e>$. Two points east of Leeuwarden have only $<o>$, suggesting a trend from south-west to north-east.

This trend is illustrated using cartographical interpolation techniques. A trend surface is calculated using the percentages in the map points. The trend surfaces in the maps in this thesis are calculated with the interpolation technique called moving average. The area of the province Fryslân is divided into a grid of very small points of 100 x 100 metres, like the pixels in a digital camera. For every pixel in the grid, a value is calculated on the basis of the point values in the vicinity. Municipality points exercise influence within a maximum radius of 25 kilometres. The closer the municipality point, the larger the impact.

Map 1.5 shows the trend surface that was computed from the percentages in map 1.4. The applied method may result in a difference between the computed surface value and the original percentage of the municipality point. For example, at the point of the municipality of Franekeradeel, with 91% $<e>$ forms in the plural, the trend surface has a value of 71%. Measuring the map reliability is discussed further in § 1.3.7.7. The outcome of that discussion is that reliability is lower in the far north-east, with 0% $<e>$ in Leeuwarderadeel and Tytsjerksteradiel and 100% in Dongeradeel. The general trend is reliable. The detailed pattern with a secondary high in Dongeradeel is questionable.
In some municipalities there is no data at all. This is why regions have been marked with a hatch. This is not necessary for a municipality such as Littenseradiel, despite the lack of data. The applied calculation technique is an interpolation method. The algorithm was designed to compute values between points. Littenseradiel is surrounded by points, providing a reliable interpolation. At the edges, there is no interpolation but an extrapolation. This is less reliable and therefore those regions have been marked with a hatch.

The value of a trend surface is relative. All kinds of parameters can be adjusted to enhance the map image. It is possible to change the focus of the map by using a visualisation technique. Map 1.6 is based on exactly the same data as map 1.5, including the trend surface. The only differences are the settings of the grey tone scale. The different settings of the grey tone are accounted for in the legend. The grey tone scale in map 1.6 runs from fully black for 100% \(<e>\) to fully white for \(\leq 80\% <e>\). In map 1.5 the boundary values are 90% and 10%. The focus of map 1.6 is therefore on the region with almost exclusively plurals of ‘son’ without an \(<o>\). The less significant contrast in the north-east is thus encompassed.
Map 1.6: Adjusting the trend surface's grey tone scale.

Map 1.7: Complete map of the plural of ‘son’ in the 15th and early 16th centuries.
Map 1.7 shows the combination of the maps 1.4 and 1.5. The adjustment made here is that the grey tone range is the same as in map 1.4, but the most extreme value has a lighter grey tone, to make the pie charts more legible. The trend surface shows the general tendency of the feature, in this case the root vowel. The pie charts display the underlying data, including the absolute number of attestations, reflecting an indication of the reliability.
1.3.6 Original charters and copies
When dealing with spelling practices on the assumption that they somehow reflect the phonological system of the authors, the original documents are used for initial evaluation. Old and contemporaneous copies (copies made at the same moment as an original charter for administrative use) have also been considered as 'originals'. In a few instances where very little material is available, other copies have been studied to get an impression of the possible variation. This problem is particularly apparent in the oldest period.

Christian Schotanus
In 1658, Christian Schotanus published several charters in the Tablinum of his “De Geschiedenissen Kerkelyck ende Wereldtych van Friesland Oost ende West.”. Three of the twelve charters from the 14th century are found in his material, including the oldest charters: OFO I-1 from 1329, OFO I-2 from 1386 and OFO II-2 from 1379. Three more charters from the time frame before 1430 are known from the text editions provided by Schotanus. These charters were not copied by a more or less contemporaneous clerk who took an interest in the juridical content. For Schotanus, who lived more than 200 years later, adapting the language of the charters to his own language was not a serious option, as was the case for a copyist in for example 1430, when copying a piece from 1390. The Schotanus text editions are rather philological. The consistent archaic language form in the texts, without any hyper-correct exaggeration, supports this point of view. Unfortunately, copies made by Gabbema in the 17th century do not show the same reliable character. The information from the charters published by Schotanus are regularly included in the tables and graphs.

Copying practices
Comparing spelling in the originals with that of the copies tells us something about the way spelling tended to be altered during the copying process. When studying the spelling of a copy, one has to wonder whether it was the spelling / language of the original author or was it adapted to the language of the copyist? Or a mixture of both? The following example illustrates the strategies of copyists towards archaic language forms in the originals. Before 1460 and after 1490 the common endings of *seke* ‘case’ were:

<table>
<thead>
<tr>
<th></th>
<th>&lt; 1460</th>
<th>&gt; 1490</th>
</tr>
</thead>
<tbody>
<tr>
<td>singular</td>
<td>-e</td>
<td>o / -e</td>
</tr>
<tr>
<td>nom./acc. plural</td>
<td>-a</td>
<td>-en</td>
</tr>
<tr>
<td>dative plural</td>
<td>-um / -en</td>
<td></td>
</tr>
</tbody>
</table>

Table 1.7: Case endings of *seke* in the 15th century.
The difference between the plural forms on the one hand and the singular on the other is:

- The endings -um and -a were replaced by -en after around 1460/1490;
- The ending -e remained a geographical variant of ø23 in the 16th century: seek / seeke. In other singular nouns, the ending -e also remained very common.

Graph 1.3 shows the spelling of the dative plural, the nom./acc. plural and the singular forms of seeke in originals and copies. For a copyist in the period after about 1470, the archaic plural forms were odd and perhaps even confusing. The proportion of these archaic endings in the copies of old charters is half, or less than that of the original ones. That means that copyists tended to replace them by modern forms. In the singular, the old form <seeke>, instead of the modern <seck>, might have been noted as ‘uncommon’ or dialectally marked, but it was an acceptable contemporaneous form. Therefore, there is no systematic replacement of the old form by the new one. So copyists seem to have had different (unconscious) strategies towards features that were outdated at the time of copying.

Graph 1.3: Archaic endings in original charters and copies.
The dative plural of seeke was written with the archaic ending -um (-e/im) in 60% of the relevant tokens from the period 1430 to 1460 in original charters, but in only 30% of copies made of charters from that same period (note: the copy was made later), etc.

23 Note that [ø] and /ø/ represent a rounded, mid-high, fronted vowel, but a single ø equals ‘zero’/empty/nothing.
and those, that may have been marked in specific cases, but still fitted into the morphological and phonological system of the language.

An extensive study of the language in originals and copies will probably produce a more detailed impression of the impact of copying on the alternation of the spelling. One possibility of such an investigation is that some copies could be included in the counting of the ‘originals’, broadening the basis for quantitative analysis.

Section summary:

• For historical analysis, tokens, preferably from original charters, are used;
• Some old copies and unique text editions from the 17th century are also used;
• The linguistic characteristics of a copy can be the product of both the original and the characteristics of the language at the time of copying.
1.3.7 Data size and statistical reliability

1.3.7.1 The implications of counting features from an historical corpus

The charter corpus has a fixed size. Historical data cannot be expanded by additional surveys. It is, therefore, extremely important to estimate the reliability of the patterns observed, especially when the absolute number of attestations is limited. In § 1.3.2 and subsequently 1.3.4 it was claimed that the original charters can be used to make historical and geographical reconstructions of 15th and early 16th century Frisian language. This section is concerned with the statistical aspects of the data's reliability.

Corpus linguistics is concerned mainly with frequencies, the relative proportion of variants at a given time, place and in a certain style genre, the shift of the proportions through time, place and styles, etc. The strength of this approach lies in the mass of the data. Ask one person on the street and he has a personal opinion. Ask 200 people and the sentiment of the country is known. If the selection of people who answer the question is random, there is no need to consider an individual's background. That is the power of statistics, and thus the power of corpus linguistics.

This is not the first quantitative linguistic investigation, and there are other Frisian language studies using corpora. So far historical investigations have tended to be philological, like the Gosses (1928) and Boersma (1939) analysis of a part of the Frisian charter language.24 In historical Frisian language research this study is innovative given its size and detailed reconstructions of variations in time and space.

This section deals with questions such as: Which characteristics of the data, apart from the philological ones discussed in § 1.3.2, are important for assessing the reliability? How are these expressed with statistical methods? Can the reliability of the corpus be measured, and how reliable are the findings? The reliability of random samples increases with a larger numbers of responses. How many attestations are needed to make valid observations about the variation of language

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24 It would be an underestimation of the efforts made by Gosses and Boersma not to mention a few words on their research. Their research is compatible from a conceptual point of view. The authors are very much aware of the historical dynamics of their material and this author shares Gosses' opinion on the phonological reliability of the data (Gosses, p.11-12). Where this study covers the total language area, they consider it to be an advantage to have only charters from a limited radius to avoid dialect mixture. Whilst this author agrees with many of their observations, extensive reference to their results would take considerable effort (their publications make rather difficult reading) and the harvest would be limited. This study relies on observations carried out during the course of this particular research. Comparison with the work of Gosses and Boersma is left to others.
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in time and space? An example of these questions is as follows:

In § 2.4.3.2 (graph 2.6), the example of *habbath* is used. In the first time frame 1379 to 1400, 50% of the relevant tokens use the ending *<at(h)>* while 50% take *<et(h)>*. The percentages are based on eight tokens from five original charters. What is the distribution of tokens with an *<a>*? Are they all concentrated in one or two charters and what would it mean to the overall picture if precisely those charters were missing by a fate of history? Is the data evenly dispersed over the charters? Should the tokens be counted per charter or per token? What does it mean for the statistical reliability? And what do the observed patterns of distribution tell us about the linguistic reality behind the tokens?

1.3.7.2 The concept of ‘random’

The first prerequisite of reliable statistical outcomes is that the data form a random selection and hence a representative selection from reality. The second one is the demand for a sufficient number of observations. Even when the selection is random, the number of observations must be enough to capture all variations. Throwing a die once is a completely random act, but this single act is not enough either to capture all the variants (‘1’ to ‘6’) or to get a realistic impression of their relative importance (each 1/6). Does the charter corpus represent a representative selection for the purpose of linguistic reconstruction and does it offer a sufficient number of observations?

What does the concept of ‘random’ imply? Random means that the way the selection of examples were drawn from the total population did not systematically favour any of the available variants. The question can be split into two sub-questions:

1) Is the charter corpus a random and representative selection of all the charters that ever existed?
2) Are the tokens in the charters a random and representative selection of the language at the time?

1.3.7.3 Random preservation

The first question is difficult to answer, because it is not known how many old charters were lost.\(^{25}\) However, decay and fire, the main enemies of old charters, are

\(^{25}\) It may be possible to get some indication of it, by looking at inventories of charters from the earlier centuries, some of which have been preserved. A systematic comparison has not yet taken place, but the overall impression of O.Vries, who identified some of these lists, is that the preserved charters are only a fraction of those which once existed (kindly communicated to the author by O. Vries).
not interested in spelling variations, i.e. there seems to be no reason why some spelling forms would be favoured by the loss of charters. The only possible example are three of the oldest charters, published by Christian Schotanus in 1658. They were (indirectly) preserved because they were old. Old means linguistically archaic and from that point of view, the total of the corpus has become slightly more archaic because of this special antiquarian interest of Schotanus. One may argue the language (Frisian, Latin, Dutch) affected the preservation or destruction of the charters. However, this influences the numbers of charters in different languages. There is no apparent reason why charters, for example, spelling <habbath> would be destroyed and those spelling <habbet> preserved. The fact that <habbet> is a more recent form and that time influences the number of charters preserved is another issue (see later).

One sub-aspect of preservation which does influence spelling forms is copying. Many charters have only been preserved as copies, often from the same century. Older charters whose content was of special interest to users could be copied for further use. A copyist, for instance, could favour a given spelling or adjust them to his own language practice (cf. § 1.3.6). For copyists from the 15th and 16th century, the language of the older charters was basically regarded as the same language as their own. This meant that re-spelling the text was an improvement rather than a distortion, for example, eliminating archaic forms that could affect the comprehensibility of the text. The old charters edited by Schotanus are not considered to be ‘copies’ but rather as old text editions. Using (text editions of) original charters avoids the problem of selective re-spelling by copyists.

On the whole, there seems to be no reason why only spelling forms would show any relation with the probability of preservation. This means that in this respect the corpus of original charters may be regarded as a random selection.

1.3.7.4 Random selection from language forms
Putting all forms from the corpus together would still not constitute a representative selection of the language from the charters. The corpus exhibits major changes over time and space. In graph 1.1, there are only two tokens of a dative plural of seke in the first time frame up to 1430, but 13 between 1490 to 1510. In the total corpus, the more recent language forms are over-represented. To overcome this, the corpus is cut into shorter time frames, as was done in graph 1.1 and 1.2. The total number is 100% per time frame and the different variants are computed as a proportion of that. Graph 1.1, depicting the temporal development of the dative plural ending -um (-em / -im) reveals a clear temporal skewness, graph 1.2, showing the ratio of plural forms of ‘son’ with <e> and <i> or <o> as the root vowel, shows stability over time.
Also, the geographical distribution is not balanced. No less than 30% of the original charters are connected to Leeuwarden while the next 11% of the charters are from Boarnsterhim (cf. for references to municipalities here and in the forthcoming sections, map 1.2). There is no direct link to population density, even though charters from scarcely populated south-eastern regions are rare.

A third source for distortion is the combination of time and location. The oldest preserved charters are predominantly from the centre and north-east of Fryslân. The oldest original charter from the north-east region is from 1390. The oldest one from the South-West (Gaasterlân, Nijefurd, Lemsterland) is from 1443. For most municipalities, there are original charters from the 16th century, so geographical distortion is especially prevalent in the earliest periods. The number of original charters per region up till 1430 ranges from 15 in the North-East to nil in the South-West (map 1.8).

Map 1.8: Mapping regions and number of original charters until 1430. In the text, for example, ‘South-West’ (with capitals) refers to the specific region delineated in this map; ‘south-west’ is a general geographical reference.
Dialect maps can correct unbalanced geographical distributions. However, maps can suffer from temporal imbalances in the distribution of the charters over the regions. How this is counterbalanced is illustrated in map 1.9, showing the spread of <a> spelling in the ending of *bitaliane* ‘to pay (gerund)’ and *bitalad* ‘paid (past part.).’ Variation can only be studied over the period it occurred. The last attestation to <a> in the ending in an original charter is in OFO IV-33 (1468): <bitellath>. Therefore, the selection is limited to the period before 1470. To control temporal distortions in geographical distribution, an average year of attestations per municipality is calculated. These are the years shown in map 1.9. The average is calculated over the tokens, not over the charters amounts. Map 1.9 shows the average date of the attestations from the pie chart for Nijefurd, with relatively young charters, as being 1456. The pie chart for Dongeradeel is based on tokens with an average date of 1454: one <a> from 1451, one <a> from 1465 and one <e> from 1467. It is no surprise that the oldest attestation is with an <a>, but the two tokens from 1465 and 1467 are entirely contemporaneous with attestations
from the south-west. On average, most points lie between 1450 and 1460, so the map can be regarded as reflecting the situation from the middle of the 15th century. The data has also been checked for average years of spelling $\langle a \rangle$ or $\langle e \rangle$. In Leeuwarden for example, the average for tokens with an $\langle a \rangle$ is 1454 and 1452 for the tokens with an $\langle e \rangle$/<i>. This may serve as an example that temporal differences play no role in map 1.9.

Graph 1.2 is an example where the spread of the data had no influence on the variation. In that case the map can safely be drawn from data from the entire period. Assume a situation with variant A in the South-West and B in the rest, with no shift through time. The under-representation of charters from the South-West in the oldest time frames would suggest an increase of variant A in graphs of type 1.1 and 1.2. This can be encompassed by a proper dialectal evaluation of the data. The South-West is represented in the later time frames. Wûnseradiel and Bolsward, not entirely in the south-west, but often 'south-western' in their language, are both well represented, Wûnseradiel with even the next to oldest charter.

In the relation between changes in time and space, the former appears to be dominant. The tendency of the changes is similar in the whole of Fryslân: habbah 'you/they have' finally becomes habbe and dore 'door' changes to doer. Only in a few cases do the geographical differences become (semi-)permanent contrasts, but the dialectal variations are mostly a matter of differences in timing. In one area a change may appear earlier or later, but the tendency is the same. In a few cases the trends are divided up per region, such as the case of replacing $\langle -a \rangle$ with $\langle -en \rangle$ in the feminine plural form in seka (map 2.10).

The conclusion is that temporal and geographical variations have to be taken into account in order to balance distortions in the charter corpus.

1.3.7.5 Central concepts: variation and variance

In the previous sections the following conclusions were drawn:

- Given the absence of an independent Frisian spelling tradition in the 15th and 16th century, the spelling is likely to be highly phonetic/phonological, applying Latin or Dutch spelling conventions of that time (§ 1.3.2);
- The corpus of original charters is probably random for the aspect of spelling (§ 1.3.7.3);
- The corpus is not random for temporal and geographical variation, but can be corrected for skewness that is the result of such variation (§ 1.3.7.4).
The next step is the question of statistical reliability. Selection of tokens from the corpus may be 'random' and the spelling may represent something 'phonological', but are the trends in the material also 'real', or is the corpus too small and the observed trends only a result of random variations? Key concepts in this discussion are variation and variance.

1.3.7.6 Variation in time and space: testing the time trend

For both the variation in time and space, statistical reliability can be computed using standard statistical tests. The \( \chi^2 \)-test of goodness of fit (further referred to as the 'chi\(^2\)-test') provides the probability that:

- A given distribution deviates from an expected one by chance;
- Two distributions deviate from each other only by chance.

Further reading on the \( \chi^2 \)-test of goodness of fit can, for example, be found in Moore & McCabe 2003, 620 ff; Field 2005, 682 ff; online information, plus several practical on-line calculators are found on: http://faculty.vassar.edu/lowry/webtext.html. Whenever the chi\(^2\)-test is used to detect significant patterns in data, the details are presented in the appendix 1.

To illustrate how the chi\(^2\)-test works, the following example is provided: Ten observations distributed over two variants are provided with a default hypothesis of 50% chance for the occurrence of either variant, for example, two sides of a coin. That means the most likely number of observations is five per variant. Assume the following observations of variant A and B:

<table>
<thead>
<tr>
<th></th>
<th>Expected</th>
<th>Observed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variant A</td>
<td>5</td>
<td>3 (30%)</td>
</tr>
<tr>
<td>Variant B</td>
<td>5</td>
<td>7 (70%)</td>
</tr>
</tbody>
</table>

\[ \text{Chi}^2 \text{-test, } p = 20.6\% \]

The \( \text{Chi}^2 \)-test outcome of \( p = 20.6\% \) expresses the probability that this skewed observation sample (i.e. 3 vs. 7 instead of 5 vs. 5) or an even more distorted one may occur, given the assumption (null-hypothesis) that the underlying probability is 50-50% (Moore & McCabe 2003, 441). This probability, expressed in

\(^{26}\) Another useful calculator is the built-in function of Microsoft Excel: =CHI.TEST (observed;expected), returning the p-value of the observed distribution.
percentages or in decimals, is the probability-value of the test. The threshold of the p-value, the so-called significance level, is usually positioned at 5% or lower, depending on the aim of the study (Moore & McCabe 2003, 462). The computed p-value of 20.6% is not low enough to interpret skewed observations as a significant deviation from the null-hypothesis. Because there are so few observations, the deviation between 'observed' and 'expected' is not significant in this example.

In the following example, the number of observations is three times larger (30 instead of 10), but the relative proportion of the observations A and B is still 30% and 70%:

<table>
<thead>
<tr>
<th>Variant</th>
<th>Expected</th>
<th>Observed</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>15</td>
<td>9 = 30%</td>
</tr>
<tr>
<td>B</td>
<td>15</td>
<td>21 = 70%</td>
</tr>
</tbody>
</table>

Chi^2-test: p = 2.8%

Due to the larger sample set, the observed distribution is now significantly different from the expected 50-50% distribution. With the p-value < 5%, the test tells us that it is unlikely that the underlying probability on variant A or B is indeed 50%. However, it does not tell us what the underlying probability is, nor how great the probability is that it would be 30-70%. In the rest of this study there are two chi^2-test applications:

- A specific, observed distribution is evaluated against a probability established in another dataset. This is the same type as the previous example;
- A set of observations on for example, variation at the ending of the dative plural in the charters, presented in table 1.6. and graph 1.1, can be split according to a relevant linguistic feature, such as 'long root' versus 'short root', or according to time, such as 'data older than 1460' versus 'data younger than 1460'. Taking the latter example, it is possible to pose the the question: is the difference in the relative distributions of the different endings for the two sub-sets the result of chance (the null-hypothesis), or is the variation, at least partly, the result of the factor time? The null-hypothesis states that both endings appear in a similar proportion in both time frames. The actually observed attestations for the contrasting endings are compared with each other and with the average, based on the sum of both amounts. Also here, the chi^2-test returns a p-value that can be
compared with the defined significance level of 5%. In this case, the p-value is 0.0002% (see the appendix 1 for the exact figures).\(^\text{27}\) In this case it is possible to conclude that time plays a role, but the p-value is not a measure for the impact of the factor time. There are different measures for this. One of these will be discussed later in this section.

The latter type of comparison with the help of the chi\(^2\)-test is predominant in this study.

To use the chi\(^2\)-test properly, several limitations need to be taken into consideration. Two of them are:

- Number of attestations / observations per cell;
- Number of cells.

There is a problem with the reliability of the chi\(^2\)-test for very small numbers of observations, which is regularly the case while working with historical data. The average of all cell values should be five or more and the smallest expected count should be one or more (Moore & McCabe 2003, 626). For small numbers, there is an alternative test, the Fisher Exact (Probability) Test (Nijdam & Van Buuren 1980, 481; http://faculty.vassar.edu/lowry/webtext.html, sub-chapter 8a, including an on-line calculator). Where relevant, the chi\(^2\)-test and Fisher's Exact Test were both applied, mostly with the same conclusions regarding statistical significance. The outcomes are included in the appendix 1.

For 2 x 2 tables, the measure of \(\chi^2\) is structurally too high, according to some statisticians. They suggest a correction of the \(\chi^2\)-value. This is the so called Yates' correction. This correction is discouraged by others (Field 2005, 686). In the appendix 1, the test parameters of \(\chi^2\) and p-values are provided both with and without Yates' correction. In most instances it does not affect the interpretation of the test.

The statistical measure of correlation is illustrated with the same dataset of the dative plural of *seke* 'case' (table 1.6. and graph 1.1). The chi\(^2\)-test suggested that time plays a role in the distribution of <em>/im/> versus <en> or <a> with a p-value <0.1% for the contrast before or after 1460. But how strong is this time effect? The chronological trend can be expressed in another way, by showing the correlation with a regression line that symbolises the trend (Moore & McCabe

\(^{27}\) When the p-value < 0.1% (0.1% = 1:1000), the exact value is not given, but simply “<0.1%”
In this example, a linear regression line is computed, shown with a dashed line in graph 1.4, i.e. a straight line from 100% to 0%. The regression line expresses the assumption that the application of the ending <um> (<em>/im>) declined steadily between 1420 and 1500. The $r^2$ (the coefficient of determination) expresses the level of variation in the real data that is explained by the regression line (Fields 2005, 148; Moore & McCabe 2003, 144). The possible value ranges from 0 = no trend, to 1 = exact match. The value of 0.94 is very high and confirms the direction of the chronological trend.

But this is not the whole story. The coefficient of determination may be very high, but we must consider the option that the observed (high) correlation is the result of chance (Field 2005, 126). In particular in the case of a low number of points, this is a crucial aspect. Here we are working with similar p-values and the usual threshold of 5%. For evaluation it is relevant whether or not we presuppose a direction of the relationship, expressed by a climbing or falling trend line. In this case, we may assume that the Old Frisian ending -um is gradually replaced by the reduced ending of -en, so the line in graph 1.4 is expected to go down. In other instances it may be of interest to know if there is any trend at all. The former assumption asks for a so-called one-tailed test, the latter, a two-tailed one (cf. Field 2003, 657 ff.).

In the extreme case of only two points, there is always an $r$ of 1. But the reliability of the correlation is very low given a random positioning of the first point, it depends only on the second point.
In the case of the dative plural ending in graph 1.4, the p-value for a one-tailed test is 1.6%, so it may be assumed that the observed trend is not the result of mere chance. The high coefficient of determination ($r^2$) of 0.94 shows that 94% of the observed variation in endings is explained by the factor time.

There is one more aspect of this type of correlation that should be mentioned here, namely that this correlation is based on averages. In Moore & McCabe (2003, 165-166) this topic is mentioned in an example about the correlation between age and the mean height of children. As individual children of the same age show variation in height, the correlation between age and the average height per year group will be higher than the correlation between the age and height of every individual child.

In this study, this problem is more complex to overcome. The underlying corpus data is discrete and often binary. A token has the ending <um> (or <e/im>) or it does not. As a test, the underlying binary data of graph 1.4 is plotted with the year of the charter date on the X-axis and the binary score 1 = <um> (or <e/im>), 0 = other on the Y-axis.

Graph 1.5: The correlation between binary raw data and time. Data from the dative plural of seke (cf. graph 1.4).

When using the individual data, the coefficient of determination falls to 0.51, which is still a strong correlation (cf. Field 2005, 32, where $r^2 = 0.25$ is already referred to as a “large effect”). On the other hand, the number of observations increases from 4 to 39. The p-values (one- and two-tailed) are both < 0.1% (Note: this example is not in the appendix 1). This has little effect on the interpretation. There is still a significant and substantial correlation between time and the reduction of the dative plural ending in the word seke ‘case’. Also, here, the data...
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suggests a transition period between 1420 and 1500.\textsuperscript{29} The problem of averages versus individual data is not covered further here.

In summary, the chronological dispersion of the tokens is not merely a coincidence (confirmed by the \(\chi^2\)-test). The trend is definitively explained by a linear downward movement (\(r^2 = 0.94\)). As a result it is likely that the dative plural ending 
\(-um\) (\(-em, -im\)) disappeared from (written) West Frisian language between 1420 and 1500.

For the root vowel of ‘sons’ (graph 1.2), the probability that the observed deviations per time frame are purely coincidental is very high, indicated by a p-value of 94\% (\(\chi^2\)-test). The regression line gives an \(r^2\)-value of 0.1. The likelihood of this weak trend was tested with a two-tailed test. The p-value is 90.1\%. Thererfore, the computed correlation of 0.1 is most likely the result of chance. Both statistical tests confirm the absence of a temporal trend in the distribution of \(<e>\) and \(<o>\) in the root vowel of ‘sons’, at least during the period 1431-1547.

\textit{1.3.7.7 Testing the spatial trend}

It is possible to verify the statistical reliability of not only time trends but also geographical trend surfaces (cf. map 1.7 and 1.9). Map. 1.7 is based on the percentages of plural forms of ‘son’ with an \(<e>\) or \(<i>\) per municipality. In the following table 1.8, the observed values are compared with computed surface values:

\textsuperscript{29} Note that the oldest attestation in the data of an other ending than \(<um>\) (or \(<e/im>\)) is from 1456: \(<secka>\) OFO II-40: ‘...ende hiera frionden toe wessen in neelika seeka.’ This illustrates a disadvantage of grouping data in classes. This attestation and another one from 1458 fall within the class ‘1430-1460’. Different class boundaries would give different averages. What is important here is the fact that both the correlation based on class averages and the one based on individual data provide similar results. The outcome of the analysis based on the individual data also gives another clue: if the reduction of the dative plural ending was a linear process, it seems to be mere chance that there are no attestations from an earlier date than 1456. A more common model for transitions in languages than a linear trend is the so called S-curve (cf. Ke 2004, 216-218).
The assumption is that the computed trend surface is an idealised representation of the real variation, whereas individual point values may exhibit a stochastic deviation from that position. The difference between values in the points and trend surface values in column four is an indication of the accuracy of the data and its approximation by the trend surface. The standard deviation of the differences between actual point values and surface values is 21%. The isolated points in the north-east (Tytsjerksteradiel, Leeuwarderadeel, Dongeradeel) fall beyond the standard deviation. These point values are based on a limited number of tokens. This is in part a coincidence, because the computation of the trend surface was not weighted by the number of tokens per point. Weighting the token frequency would not help this map, because the points for Tytsjerksteradiel and Dongeradeel are far removed from other points with more tokens. Weighting is only useful in a map such as 1.9, where there are points with few attestations and extreme values (for example, Menaldumadeel 100%, Leeuwarderadeel 0%) near to points with more attestations and more intermediate values. A low token frequency does not necessarily lead to a high deviation from the trend surface. This can be seen in table 1.8 in the points of the south-west, for example, Wymbritseradiel and Skarsterlân, where both have one token and a deviation from the trend surface of only 5% and 8% respectively.
The reason for different levels of deviation is the relationship between (assumed) real values and token frequency. We can assume that in the reality of the time, the percentage of forms with an <e> was ± 40% in the north-east (cf. Leeuwarden 46%) \(^{30}\), but 0% in the south-west. With one token, the observed point value can only be 0% or 100%. This is close to the expected values of the south-west, but automatically causes a large deviation (40% or 60%) in the north-east. Points with only one token will therefore show a higher deviation in the north-east than in the south-west (cf. following section on variance).

The correlation between point and surface values is depicted in graph 1.6. The relevance of the spatial trend surface can also be tested against the hypothesis that values are a stochastically defined pattern of spatially homogeneous data with an average of 71% with an <e>. It is possible to test the correlation between the observed points and the surface graph and this constant average value. The

Graph 1.6: Point and computed surface values for the 'sons'-map (map 1.5 and table 1.8)

\(^{30}\) It is difficult to obtain more accurate information on the situation in the north-east at the time. In the singular, forms with an <e> appear in the entire language area in a small proportion of ± 30%. In the modern dialects, Terschelling has sin, plural sinnen. In the eastern dialect of Terschelling, that form is archaic and competes with soan(s) (Boggen 1976, lemma sin, Knop 1954, 34, who already noticed the different distribution of forms with <o> over singular and plural in the charters). Bogerman (Dongeradeel ± 1540) has a singular <soen, soon> and no plural attested. Modern Schiermonnikoog dialect has seen, pl. senen and seun, pl. senen/-s (Visser/Dyk 2002). The latter form can be the modern representation of the Bogerman form (cf. Modern Schiermonnikoog dialect hou < OF hou 'sock'), but also a Hollandic loanword (cf. Dutch dialects from Holland: swen). The Schiermonnikoog form seen shows that forms with an <e> were indeed present in the north-east. The old singular - plural opposition in the root vowel is lost in every modern dialect.
correlation between the point values and the trend surface is 0.88. The correlation between the point values and a constant average is 0.21. Not only is the correlation between the point values and the surface much higher than between the point values and an average value, but also the probability of the former is much greater, p < 0.1%, for the trend surface, compared to p = 24.3% for the average value. This can be read as: the arithmetic correlation between the point values and the average is only 0.21 (on a scale 0 - 1), while it is most likely (24%) that this correlation is the result of chance. The geographical trend surface is a much better approximation of the spatial variation.

To overcome problems with low frequency in the north-east, data can be aggregated at the level of the regions (cf. map 1.8). This produces map 1.10. The trend remains the same as in map 1.7, but the curious ‘high’ in Dongeradeel, based on strongly dispersed values in the north-east, has now disappeared. The standard deviation for the differences between point and surface values has been reduced from 21% to only 9%. Graph 1.7 shows the relation between the point values and the trend values.

Map 1.10: Preference for the vowel <o> or <e> (/i/) in the plural of ‘son’, computed from data aggregated at regional level.
The correlation between the surface values and the point values is now 0.94. The correlation with the constant average of 71% has increased to 0.53, due to the fact that extreme deviations in Leeuwarderadeel and Tytsjerksteradiel (-34 + -39%) have now disappeared. For the correlation with the trend surface, \( p = 0.2\% \), for the correlation with the average, \( p = 14.1\% \). Given the observed distribution, a geographical trend is highly likely and the computed surface values are a better approximation of the observed token frequency than the assumption of a monotonous spatial pattern.

The following paragraph briefly examines the geographical pattern of map 1.9. Spelling with an `<a>` appears in 33% of the tokens in the relevant time frame.

The correlation of all the individual point values with the surface values is 0.59 \( (p = 1\%) \) and 0.53 \( (p = 2\%) \), with the average value of 33%, (data not in the appendix 1). This is due to the fact that there are several points with one token (6x) or 2 (2x) with extreme point values (0% or 100%). This results in a strong deviation in the trend surface, as described for ‘sons’. Therefore, the trend surface has been based on a weighted calculation, where the influence of the points with few tokens was reduced. When leaving out the points with only one token, as shown in graph 1.8, the correlation between point values and trend surfaces increases to 0.74 \( (p = 1.1\%) \), while the correlation with the average remains on 0.57 \( (p = 5.4\%) \). When aggregating the data per region \( (n = 6, \text{df} = 4) \), the correlation between observed values and trend surface values is 0.92 \( (p = 1.0\%) \), while the correlation between observed values and the average value is only 0.28 \( (p = 29.7\%) \) (data not in appendix 1).
The conclusion from these two examples is that computed geographical patterns can be statistically significant at the level of both region and municipality. Individual percentages of points with only one or two tokens within regions with an expected percentage not close to 0% or 100% must be viewed cautiously. Clusters of points with low token frequencies, whose values are confirmed by trend surface and the adjacent point values, are a solid indication of a statistically significant trend. This is the case in map 1.7 and 1.9 in the south-west of Fryslân, for example. These two cases are based on 49 (‘<s>’) and 61 (‘<a>’) tokens. All the maps presented in this thesis are based on a similar, and often higher number of tokens, increasing the statistical significance. The statistical significance is not explicitly evaluated for every map or temporal graph, unless special circumstances, such as low frequencies or odd distributions, give cause for this.

1.3.7.8 Variation and variance: statistical context
Apart from variations in time and space, a phenomenon can show variations in a time frame and from within a limited region. Map 1.9 shows that speakers from the north-east used an <a> when spelling bitalad/bitaliane approximately 50% of the time. When split up into time frames and regions, there are often only a few relevant tokens per item. The impact of chance or a mistake in the searching script increases significantly. One token can make a significant difference to percentage points. What is the best way to count the data from the charters? Per token or per charter? Counting per token increases the impact of multiple attestations in long texts. Counting per text increases the influence of solitary occurrences in texts. The solution to this question lies in the concept of variance.
Variance is an indicator of the level of difference between individual appearances of a variable. This can be best illustrated by the following example: At a given point in time and space - (for example, in the middle of the 15th century in the language of Leeuwarden and close surroundings) two alternative forms compete with each other and have an overall appearance frequency, assuming that this can be determined, of 1:2. There are two models of reality which could have such a proportion of forms as an outcome:

Model I: One-third of the authors uses variant A and two-thirds variant B. This implies that the variance per author is minimal, for instance, completely predictable after the first observation in a text, but for the corpus, maximal: Charters from three different authors are needed to establish the 1:2 ratio, but per author, one form is sufficient. In this model it is preferable to count per text or even per author;

Model II: Every author uses both alternatives in the ratio 1:2 in a random alternation in his writings, (for example, within one charter). If this is applied consistently, the individual variance equals the population variance. With a sufficient number of tokens to track the variation with a significant estimation, it is possible to deduce the variation among the entire population. If the inter-speaker variance is zero, it does not matter whether there is a long text from one author or two shorter ones from two authors, assuming that both are representative for that period and region. In this model, token count is the preferred method.

Traditional dialectology looks for the ‘real, authentic dialect form’. Generally there is only one. Alternation is regularly interpreted as ‘dialect mixture’ or ‘intrusions’ from other dialects or the standard language, factors that ‘disturb’ the ‘pure’ dialect.

A rule-based grammar model generally produces one correct output form. With optional rules or local free rule ordering, the existence of variants can be modelled into language. These kind of variables and optional rules, which produce a stochastically fluctuating performance, where likelihood is for example, controlled by sociolinguistic factors, is not really the core business of traditional rule or constraint-based grammars. In a sociolinguistic framework, variations in speech by one speaker is a rule rather than an exception and may have semantic implications. By choosing a specific level of variation (archaic - modern, low - high, regional - standard, etc.), the speaker can achieve communicative goals. Seemingly stochastic variation can become meaningful in a sociolinguistic framework.
What are the implications of the two models in the way data is interpreted in an historical corpus? Assume a feature X with two alternating forms A and B. In this example both forms show a 50-50% distribution among speakers of one contemporaneous speech community. Suppose the existence of a mini-corpus containing two charters with three tokens per charter each, exhibiting feature X. The total number of tokens is six. Independent of the models, three attestations to A and three to B would be expected.

In model I, each charter shows only one variant. This is either 3x A or 3x B, as each author complies with his own ideal dialect/grammar. In this model, it is necessary to count the features per charter. In fact, it is not relevant how many tokens are found per charter/author, because each author uses only one form. The chance of finding 50-50% distribution in model I is 50%. However, there is also a 50% chance that one finds two charters/six tokens with only variant A or B (cf. table 1.9).

<table>
<thead>
<tr>
<th>Number of tokens A</th>
<th>Number of tokens B</th>
<th>Model I</th>
<th>Model II</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>6</td>
<td>25.00%</td>
<td>1.56%</td>
</tr>
<tr>
<td>1</td>
<td>5</td>
<td>0.00%</td>
<td>9.38%</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>0.00%</td>
<td>23.44%</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>50.00%</td>
<td>31.25%</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>0.00%</td>
<td>23.44%</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>0.00%</td>
<td>9.38%</td>
</tr>
<tr>
<td>6</td>
<td>0</td>
<td>25.00%</td>
<td>1.56%</td>
</tr>
</tbody>
</table>

Table 1.9: The probability of finding different distributions of variant A and B in feature X in two texts with three relevant tokens each and a stochastic probability of 50% for each of the variants. In model I, an author only uses one variant, in model II the author varies according to the given stochastic probability in every instance of feature X. Take note: In model I the probability is 25% that variant A is found 0x and variant B 6x. In model II the probability of this distorted distribution in the observations is only 1.56%, etc. The probability of finding the ‘real’ 50-50% distribution (3x A and 3x B) is 50% in model I and 31.25% in model II. The probability of finding a completely wrong impression of only A or only B is 50% in model I and only 3.12% in model II.

Table 1.9 shows that the probability of finding the ‘ideal’ value of 50-50% might be greater in model I. The advantage of model II is that the probability of missing one variant is much lower. In model II the probability of observing a portion of variant A between 34% and 67%, meaning a maximum error of 17 per cent points, is 78%, which is reasonably good for a corpus with only two texts and six tokens. Model II is not only closer to the reality of sociolinguistics, if it is a correct model of the corpus, it would increase the reliability of the observations compared to
The variance is the square of the standard deviation. In model I, the values for "A" are 1 (= 100%) and 0. The standard deviation is 0.71 and the variance 0.5. For model II, the figures for "A" are 0.6 (= 60%) and 0.4 (= 40%). The standard deviation of those figures is 0.14, the variance 0.02.

What does this imply for the concepts of variation and variance, assuming the corpus indeed shows the expected ratio between A and B: 50%-50%? In model I, the variance is much higher and as a result so is the probability of finding biased results.

Corpus variance influences chances of coming to the correct conclusion based on random selections from the attested corpus. There are two additional factors:

- Number of variants;
- Ratio/proportion of the variants.

The greater the number of variants involved, the larger the selection needed to get a reliable impression of the actual variation. To have three variants represented in the material, at least three tokens are needed. To get a valid impression of their distribution ratios, more data may be necessary. This research is mostly concerned with binary variables: <a> or <e>, one consonant or two, etc. This increases the validity of the observations.

The skewness in variant ratios has two consequences. Getting an accurate impression of the presence of low frequent variants is difficult with a limited number of tokens. If a variant appears in 10% of the cases in reality and there are only three tokens, there is a 72% chance that the low frequent variant is missed and 28% chance that its proportion will be overestimated, showing a presence in the material of ≥33%.

---

31 The variance = the square of the standard deviation. In model I, the values for “A” are 1 (= 100%) and 0. The standard deviation is 0.71 and the variance 0.5. For model II, the figures for “A” are 0.6 (= 60%) and 0.4 (= 40%). The standard deviation of those figures is 0.14, the variance 0.02.
The mirror effect of the distortion is that a skewed ratio of two variants gives a great chance of finding the correct dominant form. This effect was already shown in the previous section on the reliability of geographical interpretations. In the case of 'sons', in the rather homogeneous south-west, the single token observations confirmed the general trend. Given a probability of the variant <e> in almost 100%, single token observations will most likely be 100% <e>. In the north-east, with a probability of about 50%, the chance of getting a strong deviation between low frequent observations and the real proportion is much greater: with one token 100% and with two tokens still 50%.

1.3.7.9 Variant mixture in practice
To be able to decide between the validity of model I or II, a series of words has been investigated for the level of mixture that appears in the charters.

The mixture of forms in one charter is only possible if two conditions are fulfilled:

- The two variants must be co-existing at that time;
- A charter must contain at least two tokens for the relevant form to be able to show different variants in one charter.

An example of seka/ seken will be illustrated here in detail. Further information is given in the appendix 1. The question is: Are authors using the old and the modern form in one text? The old and modern endings of seka/seken coexisted between 1460 and 1500. From this period, there are 36 original charters with at least one relevant token, a nominative or accusative plural form of the noun seke. Twenty one tokens have the ending <a> and 30 the ending <en>. Therefore, based on the token count for this period, the mixture of both variants is 41% to 59%. When counting per charter, there are 18 charters with an <a> and <19> with an <en>. Subsequently, at the level of the charters, the mixture is 49 - 51%.

Eleven charters fulfill the condition of a minimum of two relevant tokens. These 11 charters contain 26 relevant tokens (average of 2.4 tokens per charter). In only one charter are both endings applied. This is OFO IV-75, 1487 from Leeuwarden, with three tokens: Twice <a> and once <en>. This means that only one out of 11 charters (= 9%) that could exhibit a mixture of forms, does so. Counting the tokens, three out of 26 tokens (= 12%) appear in a so-called 'mixed' charter.

The results are summarised in table 1.11:
Table 1.11: Quantification of linguistic 'mixture'

This leads to the following expressions of 'mixture':

- An overall 'token mixture' of 41% correlates with an actual level within the charters of 12%.
- Counting the charters, 9% of mixed charters (in fact only one example) correlates with an overall 'mixture' of 49%.

The following cases have been studied (details can be found in the appendix 1):

<table>
<thead>
<tr>
<th>seka vs. seken</th>
<th>-a</th>
<th>-en</th>
<th>% mixed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1460-1500</td>
<td>21</td>
<td>30</td>
<td>41%</td>
</tr>
<tr>
<td>All tokens in this period</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All charters in this period with an attestation to...</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>18</td>
<td>19</td>
<td>49%</td>
</tr>
<tr>
<td>Tokens in charters with at least two examples</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Charters with...</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>both -a and -en</td>
<td>only -a or -en</td>
<td>% mixed</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>23</td>
<td>12%</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>10</td>
<td>9%</td>
<td></td>
</tr>
</tbody>
</table>

Model II predicts that the level of mixture in individual charters is related to the overall mixture of the language at that time. The closer the ratio is to 50-50%, the greater the probability that mixture appears in individual charters with two or three relevant tokens. Graph 1.9 illustrates this relationship. On the X-axis the observed proportion of the less-frequent variant is used (either per charter or per token). On the Y-axis the actual level of mixture (again in tokens or in charters) is shown. The discussed example of seka-seken can be found at the coordinates (49,9) of the charter-count and (41,12) of the token-count in graph 1.9. The graph confirms the formulated expectation that the level of mixture in the charters reflects the proportion of alternative forms in the total corpus. The correlation with a linear

-65-
regression is slightly higher in the token count, but the trend is obvious in both methods. It shows that it is almost irrelevant which method is applied.

In the mixed charters, the ratio between the variants is usually between 1:2 and 1:1. There may be two reasons for this:

- Because most mixed charters have only two or three relevant tokens, the proportion of either variant is likely to be ½ or ¾. However, in the example of sek(e) (singular) with 29 tokens in mixed charters, the proportion is still 38% so it is not necessarily the data format that causes this effect.
- Even during ‘mixed’ periods, not every part of the language area was a ‘mixture zone’. While mixture of forms is most probable in actual mixture or transition zones, the proportion of mixtures in those mixture zones was not necessarily the same as the proportions of the two competing forms.

The implication of model II is that “the individual variance equals the population variance”. Graph 1.9 shows that individual variance reflects population variance. The mixture of alternative forms in single charters is not a matter of ‘errors’ but it mirrors the variation of alternatives that existed in the speakers’ community at that time and place.

Graph 1.9: Correlation between the overall presence of variants in the language (expressed in variant-probability, X-axis) and the level of variant mixture in individual charters (Y-axis).
1.3.7.10 Token count or charter count?

Van Reenen (1997) uses Middle Dutch charters to reconstruct dialectal variations in late medieval Dutch. Heeroma (1935, 4) uses charters from Holland and adjacent regions to reconstruct the base-level dialect (the oral forms, used by the middle and lower classes) from mainly the 15th century. Both scholars apply a form of charter count. Heeroma’s assumption is that local dialect features are regularly levelled out by supra-regional scribal practices and dialect mixture (Heeroma 1935, 7-8). Incidental appearances are in his approach a key to the ‘real, spoken dialect’. For example: /ste:n/, spelled <stien>, is the common Middle Dutch word for ‘stone’. In Holland, the form is spelled <stien> for example, in dialect texts from the 17th century from the region of Holland, and is /stin/ in contemporaneous archaic dialects from Holland. When <stien> occasionally appears in some charters from a city in Holland, Heeroma takes that exact feature as the map form. He considers the occasional cases of <stien> in the charters as the manifestation of the local dialect form.

Van Reenen counts every charter with at least one attestation to variant A or B. With this method, Van Reenen stresses the presence of minority forms. This is only attractive when you are rather sure about the location of the charters. It is a weakened effect of the Heeroma method.

Let us consider the outcome of their methods, by evaluating a fictional example, where variant A is a rather common form and variant B a dialectally limited form; both charters are from the same location:

<table>
<thead>
<tr>
<th>Charter 1</th>
<th>Variant A</th>
<th>Variant B</th>
<th>‘Heeroma’</th>
<th>‘Van Reenen’</th>
</tr>
</thead>
<tbody>
<tr>
<td>Charter 2</td>
<td>2</td>
<td>0</td>
<td>‘not relevant’</td>
<td>A</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Heeroma</th>
<th>A: supra regional</th>
<th>B = 100% dialectal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Van Reenen</td>
<td>two charters = 67%</td>
<td>one charter = 33%</td>
</tr>
<tr>
<td>Token count</td>
<td>three tokens = 75%</td>
<td>one token = 25%</td>
</tr>
</tbody>
</table>

Table 1.12: The impact of different counting techniques on the interpretation of variation.
Heeroma expected competition between more or less standardised supra-regional language and local dialect forms. Charter one, with two non-dialectal forms, is not considered to be very interesting, whereas the appearance of variant B in charter two brings Heeroma to the conclusion that variant B is the only autochthonous dialectal form of that location. For the type of data Heeroma assumes, this is a reasonable evaluation method.

The token count stresses high frequent forms. This only works when authors are not bound by any standardised form and when they are inclined to reflect mixture of forms in the spoken language in their writing. The absence of a Frisian standard spelling is discussed in § 1.3.2, the latter aspect is illustrated in § 1.3.7.9.

Therefore, even if in reality the differences between token count and charter count are not very great in the studied examples from the charters, a number of points can be made in favour of token count:

- The conclusion from graph 1.9 is that the actual mixture of forms in the charters at the level of tokens reflects general trends in variation in forms;
- Token count offers an elegant solution for the problem of how to count mixed charters;
- Token count increases the number of attestations and thus the statistical reliability of the observed trends in graphs and maps.

Despite these advantages, there is also a disadvantage:

- A few instances can be found in the material where relatively large sources with a consistent preference for one variant do in fact influence the overall picture: staeete ‘estate’ in § 2.3.3.3, Hemma Odda gin’s hitalit ‘paid’ (§ 2.4.3.1) and mændezi ‘Monday’ (§ 2.3.4.2), for ‘for’ in the early 16th century in OFO III, 39, foet / feet / fott (§ 2.3.4.1) from Dongeradeel.

There are two more aspects of mixture that have yet to be mentioned:

- A form of mixture treated in the previous section: geographical mixture, for example, two charters from one location with homogeneous attestations, creating a geographical mixture. The geographical mixture appears to produce significant patterns (cf. § 1.3.7.7);
- Mixture of language forms of authors over different charters: for the items investigated and used in graph 1.9, between 0% and 50% of the identified authors shows variation in the (original) charters. Therefore, even when an author uses only one variant in one charter, he may very
well vary between forms over the totality of his writings and speech. This reinforces the trend in graph 1.9.

A study of variant mixtures in the charters shows that a mixture of variants is usual, consistent and produces statistically significant patterns. The intrinsic variation in the language resembles the data model II described in § 1.3.7.8. This model is supported by sociolinguistic observations and has technical advantages for the data reliability. Data model II is best served with a token count. Because there are few charters with several tokens for one item, the token count becomes quite balanced. Individual cases of distorted frequency distributions will be countered, for example, by geographical interpretations, where all attestations fall under one point, eliminating their impact on the overall image.

Section summary:

• There are sufficient reasons to assume that spelling variations in the original charters are a random sample of linguistic patterns of the time;

• Spatial interpolation techniques produce maps that are linguistically consistent and are confirmed by statistical testing;

• Variation within texts reflects linguistic variations in the speech community, making it unlikely that spelling variations are the result of erroneous or careless spelling;

• With a careful eye for temporal, geographical and individual distortions of the data, token counting is a sound and statistically beneficial way of evaluating data.
1.3.8 The language of Unia

The codex Unia contains the most archaic preserved Old West Frisian texts (cf. § 1.2.2). The texts in the codex are not linguistically consistent and include several linguistic 'layers'. Sections of the text come from different eras and are not always from the same region. This implies that the linguistic variation found in the codex Unia can be caused either by diachronic or dialectal variation. The available text is a copy of a copy which perhaps originated from even older copies. The challenge of this analysis is to estimate at what time the different sections of the text received their linguistic shape.

For this analysis, the preliminary transcription made by Dirk Boutkan was used, counting 5799 lines. The text was split into sections (following Siebs 1895, 14-29). Each section contains independent content. Some texts that are available in the codex, are missing in the transcription, such as the Tale of Charlemagne and Redbad. An example of a selection from the text, with indication of sections, is presented in table 1.3.

<table>
<thead>
<tr>
<th>n = number of tokens</th>
<th>OFO I-1 (1329)</th>
<th>charters 1379 - 1405</th>
<th>charters 1405 - 1430</th>
<th>last regular recordings</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;and(e)&gt; ~ &lt;ende&gt;</td>
<td>100% (n=13)</td>
<td>42% (n=112)</td>
<td>4% (n=280)</td>
<td>1418</td>
</tr>
<tr>
<td>&lt;him/hine&gt; ~ &lt;him&gt;</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
<td>last &lt;hine&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1386; first acc. &lt;him&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1418</td>
</tr>
<tr>
<td>&lt;thet/that&gt; ~ &lt;dat&gt;</td>
<td>100% (n=11)</td>
<td>84% (n=50)</td>
<td>43% (n=54)</td>
<td>± 1435</td>
</tr>
<tr>
<td>&lt;him&gt; ~ &lt;hem&gt;</td>
<td>100% (n=1)</td>
<td>75% (n=4)</td>
<td>67% (n=3)</td>
<td>after 1440: &lt;10%</td>
</tr>
<tr>
<td>&lt;um&gt; ~ &lt;em/-im&gt;</td>
<td>82% (n=11)</td>
<td>20% (n=40)</td>
<td>24% (n=54)</td>
<td>± 1500</td>
</tr>
</tbody>
</table>

Table 1.13: Linguistic criteria for the dating of the Unia sections. The archaic form is the first form mentioned in column one, the more modern form follows the ‘~’. The percentages correspond to the archaic forms. ‘last regular recordings’ is the last year that the archaic form was attested as part of a more or less continuous temporal array. Incidental attestations in later years may occur.

To estimate the date of the different sections, the charter OFO I-1 from 1329 is a useful anchor point in the 14th century. Therefore linguistic criteria are needed.
to show diachronic variations between the language of the charter OFO I-1 from 1329 and the old charters from the period 1379 to 1430. A section in Unia, complying with the language of charter OFO I-1 and differing from the late 14th century charters, can be dated from the early or middle 14th century. The following five criteria have been used. These criteria preferably appear in their archaic form in the charter from 1329 and are subject to a rapid modernisation in the charters from about 1400. The figures from table 1.13 are shown in graph 1.10.

The conjunction *ande* ‘and’ was replaced by Middle Dutch *ende* in the late-14th and early 15th century. All attestations to *ande(e)* in the charters after 1405 are from the north-eastern region. After 1418, *<ende>* is the only form. In the sections of the Opstalsboom Statutes of 1323, Statute of the Dean of Wisdom and the ‘Dongra Bota’ on average 22% of the instances of the conjunction are archaic forms. These three sections constitute the youngest part of the codex *Unia* and are at least younger than 1380. They are further referred to as group C. In the rest of the codex the figure for *<and(e)>* lies over 90%.

The second criterion is that of a distinct form for the accusative of the masculine singular pronoun, Old Frisian *hine* (in contrast with the dative *him*). The form *hine* appears in the charter from 1329 and the last attestation in the charters is from 1386. The oldest instance of *him* as an accusative form in an original charter is
from 1418. That makes the year 1400 an appropriate guess for the abolition of the form \textit{hin} in Middle Frisian.\footnote{The form \textit{hin} is attested as a pronoun for the 3rd person sg. in Modern West Frisian (WFT, volume 8, \textit{hin IV}). The description of the word in the WFT dictionary suggests a direct continuation of the Old Frisian form \textit{hine}. That, however, seems highly unlikely. There are few instances of <hen> in charters from 1452 and onwards, only one original (from 1515, OFO III-39, Littenseradiel). In this original example, the word is in the position where a dative singular could be expected: "[...] Doeke hat betelle hen [...]" \equiv 'D. has paid him'. This would appear to be a case of incidental phonetic reduction of [\textit{dm}] \rightarrow [\textit{dn}], as in a few instances from early-Moder West Frisian, for example text 1626A: \textit{du wohte wihe wert daten en huch hawte [...]} 'you should know where you put him'.} The \textit{Statute of the Dean of Wirdum} and the 'Dongra Bota' contain no instances of \textit{hin} and do contain examples where \textit{him} is used as an accusative form:

"... hit en se thet \textit{hem sijn} personna farra wrogia .." (\textit{Statute of the Dean of Wirdum})

"... ende \textit{hem} haldey ende nacht ..." ('Dongra Bota')

This criterion supports a post-1400 dating of the texts in group C. There are no relevant examples from the Opstalisboom Statutes.

The Old Frisian form of the neuter article and conjunction <\textit{thet}/\textit{that}> is replaced by <\textit{dat}> in the early 15th century.\footnote{It has not yet been possible to assess the difference between \textit{that} and \textit{thet}.} Between 1400 and 1435 the spelling with <\textit{th}> gradually disappears. The archaic spelling is rare (<20\%) in the three texts of group C and additionally in the 'Leppa Wilkerran' (50\%, n = 4) and the 'Leowerdera Bota' (18\%, n = 49); These last two mentioned texts constitute group B. The rest of the sections of \textit{Unia} constitute group A.

The forms of the pronoun of the 3rd pers. sg. masc., Old Frisian \textit{him, hine} are preferably written <\textit{hem}> (<\textit{hene}> only appears in \textit{Unia}) in the charters after about 1420. The spelling with <e> is common in both the groups B and C.

The spelling of the dative plural ending of nouns, Old Frisian -\textit{um}, shows a gradual decline from <\textit{um}> to predominantly <\textit{em}> and <\textit{im}> in later periods. As long as the ending -\textit{um} is used in the charters, until late in the 15th century, the spelling <\textit{um}> still appears occasionally. In \textit{Unia} group A, the average for the use of <\textit{um}> is 83\% against 61\% in group B and C. However, there are substantial individual differences, for example in the B-text 'Leowerdera Bota', 77\% (n = 29) of the dative plural forms take <\textit{um}>, while this is only 38\% (n = 13) in the A-text of the 'Wilkert thes nija landes'.
Group A as a whole keeps pace with the charter from 1329. This means that its language type at least represents the language of (parts of) Fryslân from the 14th century. In the following paragraphs some more details are given. The linguistic character of the texts in group B and C were thoroughly reshaped in the first decades of the 15th century. For the texts in group B, the period between 1410 and 1430 is not unlikely. The texts in group C were probably first (re)written after 1430. Note that the linguistic character of these texts can reflect aspects of older versions. In the previous section 1.3.6, it was shown that archaic features which were still optional at the time of copying / reshaping a text, were more likely to be retained than linguistic elements which were completely outdated. The high level of the dative plural ending <um> in B and C could be the result of copying from older sources with abundant presence of this archaic form. The archaic <um> could be retained in the copy because <um> was still a common option in the first half of the 15th century.

Group A is not a homogeneous group. The number of attestations per text of suitable examples for chronological discrimination is often very low. A relative order of age could however be established for six longer texts from group A:

<table>
<thead>
<tr>
<th>relative ranking</th>
<th>title</th>
<th>Gerbenzon-number</th>
</tr>
</thead>
<tbody>
<tr>
<td>A-1</td>
<td>Older ‘Skeltenaricht’</td>
<td>855</td>
</tr>
<tr>
<td>A-2</td>
<td>The Twenty Four Land Laws</td>
<td>630</td>
</tr>
<tr>
<td>A-2</td>
<td>Synodal Law</td>
<td>857</td>
</tr>
<tr>
<td>A-2</td>
<td>The Seventeen Statutes</td>
<td>627</td>
</tr>
<tr>
<td>A-3</td>
<td>Foerdgung this richten (Processus Judictii)</td>
<td>647</td>
</tr>
<tr>
<td>A-3</td>
<td>Autentica Richten</td>
<td>876</td>
</tr>
</tbody>
</table>

Table 1.14: Relative dating of some of the older texts in the codex Unia (group A)

The two linguistic criteria used to define the relative ranking are:

- The use of <ande> alongside <and> ‘and’;
- The use of the full form <other> instead of <o(e)r> ‘other’.

In the text of the Older ‘Skeltenaricht’, the longer form of the conjunction is used in 11% of the tokens (n = 209). In group A-2, <ande> still appears, but only ≤ 5% of the tokens (n = 252). In group A-3, <ande> is fully absent. Detailed analysis of the forms of Old Frisian other reveal that the transition from /o:ðe/ř/ > /øe/ was
a gradual process. At the oldest stage, the word is always written <other(-)>), both with and without case ending, so: <other, othera, othere>, etc. The reduction to /other/ first took place in inflected forms, for example ôthera, ôtherum, ôthere, ôtherne, resulting in <ora>, <orum> etc. The long form was most persistent in the root form <other>. The texts from group A-1 and A-2 have only <other>, both in forms with and without a subsequent case ending. In the Seventeen Statutes, inflected forms are missing. The root appears only as <other>. In group A-3, <other> appears in 65% of the inflected forms and 86% of the root form.

The charter from 1329, OFO I-1, has only <and> and <orum> (2x) and <orne>. This implies that the texts from group A-1/2 are probably older than 1329. Geographical differences are probably not relevant for this comparison. The spelling of the word land ‘land’ as <land> and not <lond> (cf. following paragraph) suggests that the texts from group A-1/2 are from the western part of Friesland, just as OFO I-1. The text of the Older ‘Skeltenariucht’ is (of the longer texts that provide extensive examples) by far the most archaic one. This for example, contains verbal forms without syncope, including <(une)deled> ‘(un)divided’ against <deld> in Processus Judicii, or: <kumith>, <havith> ‘(he) comes, has’ (also synocopated forms appear), against only <comt> and <hat> in Processus Judicii. In the Older ‘Skeltenariucht’ (A-1) unsyncopeated forms are significantly better represented than in the texts of group A-2. In the Older ‘Skeltenariucht’ words such as hand ‘hand’ and land ‘land’ are only spelled with <a>, just as in OFO I-1, stipulating a western provenance.

In seven texts of group A, including the two texts from group A-3 in table 1.14, the spelling <lond> appears for land ‘land’, in four texts in 100% of the tokens. The Compensation Tariff of Franekeradeel and Wouweradeel (BFW) and the Compensation Tariff of Wymbritseradeel (BWB) also contain occasional instances of <hond> instead of the more common spelling <hand> ‘hand’. The spellings <lond> and <hond> appear in charters from the North-Eastern region (Leeuwmeradeel included) before 1452 only. Before 1452 the level of <o>-spelling remained rather constant. Charter OFO I-1 contains only <hand> and <land>. This suggests that the contrast between <and> and <ond> in these words were a fairly stable dialectal contrast in Friesland for more than one century at least. The presence of the <o>-forms in parts of Unia implies that those sections (including group A-3 from table 1.14) were linguistically shaped in the north-east.

The texts in group A-3 show a high level of double consonant spelling in the words weso ‘to be’ and iska ‘case (pl)’, for example <wassa, sakka>. This is a Middle Dutch spelling practice, that was applied since about 1400 (cf. § 1.3.3). This implies that these texts can be identified as texts from the north-east of Friesland, from about 1400. Johnston (2001, 582) dates ‘Processus Judicii’ in the late 14th century and
‘Autentica Rinct’ about 1400. The north-east appears to be a relatively conservative part of the language area in chapter two, for example in the retention of unstressed /a/ and the relatively late replacement of the feminine plural ending -a by the modern -en. Compare the following archaic linguistic features in the charters and in Unia group A-3:

- *And* ‘and’ (instead of *end*) that survived in the north-east until ± 1420, about 15 years longer than in the other parts of Fryslân according to the charters;
- The spellings <hond> and <lond>, exclusively in charters from the north-east until ± 1450.

The linguistically conservative character of the north-east, where the texts in group A-3 must be located, may be responsible for their archaic character and hence their assignment to group A of the Unia texts, despite their relatively young age. The relative positioning of the linguistic character of group A-3 in the graphs 2.1 (the doubling of historical single consonants following a short vowel, as in *wessa* ‘to be’), graph 2.7 (the decline of the spelling <a> in the masculine plural ending -an) and graph 2.16 (apocope of unstressed /a/) suggest that the texts in group A-3 postdate the year 1400 (± 1405-1410).

Section summary:

- The language of the majority of texts in Unia (referred to as group A) are from the 14th century and the first years of the 15th century;
- The Older ‘Skeltenaricht’ (group A-1) and some more sections (group A-2) are likely to be linguistically defined in the western part of Fryslân and are at least as old as OFO I-1, so ± 1329;
- ‘Processus Judicis’ and ‘Autentica Rinct’ and some more minor sections (group A-3) originate from the north-east and are from ± 1405-1410;
- The Older ‘Skeltenaricht’ is the oldest text in Unia, ± 1300.
1.4 The Power of Algorithms

§ 1.2.5 defines language as a “deterministic dynamic system, governed by self-organisation. Such systems can exhibit chaotic behaviour”. This is a reductionistic approach, different from the theory advocated by Chomsky e.a. which assumes humans have a specific inborn language ability. The following paragraphs give a working definition of reductionism, deterministic dynamic systems and self-organisation (cf. Ball 2004 for further illustrations of these concepts in non-physical contexts). This thesis does not assume to present a fully fledged model of language in a strictly defined theory. Rather this study is meant as a contribution to the establishment of such a theory. In § 5.1 and 5.2, this approach is applied to illustrate that it can work and that it provides elegant explanations for linguistic phenomena.

Reductionism

Reductionism means: Trying to understand a phenomenon by reducing it to its constituent elements. Dennett (2006, 75-78) brings up a contrast between ‘greedy’ reductionism and ‘good’ reductionism. ‘Greedy’ reductionists try to reduce everything to the lowest level immediately. ‘Good’ reductionists try to reduce features to one level lower, acknowledging that the sum can be more than the total of its component elements. Within this framework, language is the result of interaction between the following constituent elements:

- Similar elements are for example mentioned by Bye (2004a, 2): “In recent years, a complementary paradigm has been developing [in theoretical linguistics], guided by the idea that cross-linguistic regularities are emergent, reflecting universal extra-grammatical constraints on domains such as articulation, perception and memory formation.”

There seems to be quite an overlap with recent positions taken by Noam Chomsky e.a., who formulate it thus: “[...] we offered one potential cut through F[aculty of] L[anguage] B[road], explicitly distinguishing the sensory-motor (SM: phonetics/phonology) and conceptual-intentional (CI: semantics/pragmatics) systems from the computational components of language.” (Fitch, Hauser & Chomsky 2003, 182), where their SM-systems matches my field of ‘acoustics’, the CI-system matches ‘meaning’, while I seek the foundations for the working of their “computational components” in a more broadly defined ‘memory formation’.

This last assumption of the author of this thesis may be covered by a hypothesis formulated in the same article (idem, 206): “If it turned out that the capacity for recursion [= their main computational component of language] resulted from a phase transition in the pattern of neural connectivity that results automatically from increases in neocortex to sub-cortical tissue ratio, interacting with standard mammalian brain development, this would certainly be an interesting result.”

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Meaning / semantics: The outside world and the human mental perception of it;

Articulation and acoustics: The entire field of biology and physics connected with the production and transmission of sounds;

The bio-chemical working of the mind resulting in human-specific ways of perceiving, storing and retrieving information. Linking language features directly to bio-chemical processes might be a case of ‘greedy’ reductionism; linking language features to general cognitive and psychological phenomena is the aim of a ‘good’ reductionistic approach.

‘Grammar’ is the total of structures emerging from the interaction of the aforementioned elements by self-organisation.

Deterministic Dynamic Systems

The constituent elements of many dynamic systems are subject to physical, chemical or biological laws or constraints. The field of acoustics is a good example of this. The interaction of all components, each behaving according to its own ‘laws’, produces dynamic systems with a high level of complexity. The atmosphere, including both daily weather and long-term climate change, is a familiar example of a dynamic system.

Physical laws are universal and eternal. The current state of the system is determined by history and the previously mentioned physical laws. Knowing the starting configuration and applying the ‘laws’ consistently, the outcome can be computed, assuming there is sufficient computation capacity. Making a weather forecast is in fact an effort to use the deterministic quality of the atmosphere.

There are several problems in this approach:

• The system contains so many elements that it is not feasible to determine the exact starting position of all of them;
• Even if the first problem could be tackled, the number of interactions and computations is so large that no man nor computer could handle them.

The concept of a deterministic dynamic system theoretically implies a high predictability. In the long run, it may result in a highly unpredictable system. Therefore, these systems are sometimes called chaos systems.\(^{35}\) Determinism is the central idea behind the models in § 5.1 and § 5.2.

\(^{35}\) Note that chaos systems are a well defined concept in mathematics, cf. Verhulst (2003, 24 ff.). This thesis does not use the chaos concept, nor does it go further into this here.
Self-Organisation
Patterns that result from self-organisation emerge as a consequence of repetitive and recursive actions. They are not the result of any intention and therefore lack any teleological explanation. Even when some of the revealing patterns seem to reinforce themselves by positive feedback, they do not represent any independent power. Whatever the degree of (temporal) stability of a structure, it is not the result of any teleological self-maintenance of the structure, but of the underlying repetitive actions. Any change in the environment can lead to a change or even collapse of the structure.\textsuperscript{36} The modelling of language change in Frisian in § 5.2 builds upon the idea of self-organisation.

Modelling by algorithms
The working of a dynamic system can be modelled with algorithms. An algorithm is recursive and repetitive. One or more elements interact with each other according to a predefined behaviour, and the result of this interaction is the input for the next step: $a(x_0) \rightarrow x_1, a(x_1) \rightarrow x_2, \text{etc.}$

In dynamic systems, sudden changes may take place. This is an important outcome of algorithmic processes. Their results are not necessarily linear. That is the power of a good algorithm. No actor changes plans or has on its own neither the force nor the intention to provoke a change, and still things are changing and sometimes even abruptly.

Another aspect of systems driven by an algorithm is that they may reach a (temporary) equilibrium state, where every new round returns the same result. But many systems have an engine. For instance, the sun is constantly adding new energy to the atmosphere. Many systems with some kind of energy input do not reach a final steady state, but are balancing at a non-equilibrium steady state all the time (Ball 2004, 294 ff). The growth of new generations in a mentally and physically ongoing changing society is an 'energy engine' for the dynamic system of language.

Wider perspective
Structuralistic linguistics is trying to discover the rules / features / constraints / parameters or whatever they are called. They are responsible for observed linguistic patterns and structures and reflect the human language blueprint, the presumed

\textsuperscript{36}It is precisely this approach of linguistic structures which provides the explanation for an observation made by the author in Versloot (1994, 93), a lexical-semantic study in a very strict structuralistic framework. The, at the time surprising, outcome of the study was that the behaviour of the structures is totally passive. There is no resistance whatsoever against loanwords which form a complete semantical mismatch with the existing lexical-semantic structures in the receiving languages.

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inborn language ability. In a deterministic dynamic system, governed by self-organisation, the structures and patterns are secondary. They are the result of the way agents which want to communicate interact on a physical and biological substratum. To make a comparison with evolutionary biology, creationists look for the intention, the reason of an ‘intelligent designer’ to create an ant or a whale. Evolutionary biology shows that the interaction of spontaneously mutating genetic material with the environment, for instance the ongoing process of natural selection, can result in both an ant and a whale by the same forces. In a similar way the differences between languages are not the result of different rule orders / constraint rankings / parameter settings, etc. but different outcomes of the same deterministic dynamics, exhibiting chaotic properties. The Tower of Babel was not an accident. A complex, dynamic system such as human language, with its stochastic variation of individuals in production and perception, will always end up like that as the result of chaos theory.

This research has not systematically traced all the efforts that contribute to the theoretical concept outlined, but it may be worth mentioning some recent publications to create a wider perspective for this approach. Tracing the references in recent publications in this field, reveals that some of the aforementioned concepts were already formulated in the first half of the last century. This approach is gaining significantly from recent developments in computer techniques and the building of larger language corpora over the last few decades.

Zuraw (2003) and Ke (2004) provide interesting examples of algorithmic self-organisation in the emergence and dissemination of language change, resulting from the interaction of stochastic language variation and individual behaviour in social networks. Bart de Boer (2005) illustrates in his thesis The Origin of Vowel Systems (note the implicit reference in the title) how a system of contrasting vowels (phonemes) can emerge from random sounds by self-organisation. Oudeyer (2005) extends this direction of research. An interesting publication is also the thesis by Zach Solan (2006) called Unsupervised Learning of Natural Languages. Here a model is presented that creates syntactical and morphological grammars by the use of general pattern recognition algorithms. The concept of determinism is used in Pagel et al. (2007), showing how languages gradually renew their lexicon, with evolution rates controlled by the frequency of concepts.
2. Description of processes

Chapter two describes the reduction of unstressed Old Frisian vowels and other processes connected with this development. Detailed reconstructions in chapter two are needed:

- To provide evidence for the hypothesis in chapter four that Middle Frisian had phonologically contrasting tone contours, similar to the modern North Germanic languages Norwegian and Swedish;
- To formulate, calibrate and test the models of language change in chapter five.

The following processes are investigated:

- Degemination: § 2.2
- Open Syllable Lengthening: § 2.3
- Vowel Reduction: § 2.4
- Vowel Balance: § 2.5
- Vowel Harmony: § 2.6

Open Syllable Lengthening is one of the oldest processes and affects the root syllable quantity which, in turn, affects the process of Vowel Reduction. The same holds for the degemination of long consonants, a process contemporaneous with Vowel Reduction. Vowel Balance is revealed as a sub-pattern during the vowel reduction process where the syllable quantity structure is the leading force. Vowel Harmony relates to full vowels in unstressed syllables, but was partly lexicalised during the 15th century. Both Vowel Balance and Vowel Harmony reveal a great deal about the phonetics of both root and subsequent unstressed syllables in late mediaeval Frisian. All these processes are studied with material taken from the charters, in line with the interpretation outlined in § 1.3.

The processes regularly interfere, necessitating cross-references between paragraphs. For the feature of Vowel Balance it was necessary to choose a different order, as this plays a role in almost every paragraph. Vowel Balance as a general phonetic and phonological feature, as well as its appearance in Proto-Germanic, is discussed at the beginning of this chapter in section § 2.1. The Vowel Balance effect during the 15th century Vowel Reduction process is discussed later, in § 2.5. The treatment of degemination in § 2.2 helps reduce the need for back and cross-references.
2.1 Vowel Balance as a phonetic and phonological tendency in Germanic

Vowel Balance is a phonetic tendency in Germanic where unstressed syllables that follow a long or heavy syllable are somehow more reduced than when they follow a short or light syllable. The word somehow is important in this context. The basic engine of Vowel Balance is a purely physiological feature. Lung pressure gradually falls during the act of speech. Producing intensity stress demands a boost of expiration. In the course of this act lung pressure falls, leaving less speech energy for subsequent sounds, until a new cycle of lung pressure build-up and expiration is started. Phonologically long syllables take more time than phonologically short ones. Long syllables therefore leave less speech energy for the following syllable. From this gradual quantitative difference it follows that the second syllable of a word with an initial long syllable is more vulnerable to reduction, be it qualitative (for example a more centralised realisation, for instance, [i] > [e]), or quantitative (apocope), than when the initial syllable is short.

The purely phonetic effect is for example observable in modern Dutch (Jongman & Sereno 1991, 296). The ending /ən/ in the long-rooted plural form takken [ta:kən] ‘tasks’ is on average 18% shorter than the same ending in the short-rooted takken [takən] ‘branches’. But speakers of Dutch do not perceive this difference to be an allophonic or allomorphic contrast.

An example of the qualitative impact of Vowel Balance is found in Old Swedish (Hofmann 1979, 74). In Old Swedish, the phonetic contrast between vowels following a long root and those following a short root became so profound that writers used it in their spelling. This marks the transition from a phonetic effect towards a phonological, or at least allophonic contrast:

<table>
<thead>
<tr>
<th></th>
<th>Modern Icelandic, no Vowel Balance</th>
<th>Old Swedish, with Vowel Balance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Short root</td>
<td></td>
<td></td>
</tr>
<tr>
<td>nom. sg.</td>
<td>faðir</td>
<td>faþir</td>
</tr>
<tr>
<td>acc. sg.</td>
<td>fóður</td>
<td>faþur</td>
</tr>
<tr>
<td>Long root</td>
<td></td>
<td></td>
</tr>
<tr>
<td>nom. sg.</td>
<td>móðir</td>
<td>môþer</td>
</tr>
<tr>
<td>acc. sg.</td>
<td>móður</td>
<td>môþor</td>
</tr>
</tbody>
</table>

Table 2.1: Phonologised Vowel Balance in Old Swedish; after a long root, the vowels /i/ and /u/ of the unstressed syllable are reduced to /e/ and /ø/ in Old Swedish.

A stronger reduction of unstressed syllables following a long root could also lead to the complete disappearance of the unstressed vowel. Proto-Germanic i- and u-
roots tend to lose their ending in all Old West Germanic languages after a long root, but keep it after a short one:

<table>
<thead>
<tr>
<th>Root Type</th>
<th>Old English</th>
<th>Old Frisian</th>
<th>Old Saxon</th>
<th>Old High German</th>
</tr>
</thead>
<tbody>
<tr>
<td>i-root, long</td>
<td>giest 'guest'</td>
<td>jest</td>
<td>gast</td>
<td>gast</td>
</tr>
<tr>
<td>i-root, short</td>
<td>wine 'friend'</td>
<td>wine</td>
<td>wini</td>
<td>wini</td>
</tr>
<tr>
<td>u-root, long</td>
<td>hond 'hand'</td>
<td>hond / hand</td>
<td>hand</td>
<td>hant</td>
</tr>
<tr>
<td>u-root, short</td>
<td>sunu 'son'</td>
<td>sunu / sone</td>
<td>sunu</td>
<td>fridu 'peace'</td>
</tr>
</tbody>
</table>

Table 2.2: Vowel Balance effects in the retention of final vowels in Old West Germanic languages.

Traces of Vowel Balance are also visible in the structure of uncompounded words in Modern Frisian. About 32% of uncompounded Modern Frisian lemmas end in an unstressed word-final /ø/, for example, sjippe 'soap'. In the sub-group of words with a long root vowel, only 23% end in /ø/, against 37% of the words with a short root vowel. This difference is statistically significant, thanks to the high number of lemmas in the selection.

The previously mentioned examples illustrate that Vowel Balance has been a common phonetic phenomenon in many Germanic languages. Phonologised Vowel Balance effects are absent in Modern West Germanic standard languages. For instance, these languages have no allophones or allomorphs guided by (historical) Vowel Balance. New Norwegian for example, has two different infinitive endings (-a and -e), based on historical root quantity.

The appearance of Vowel Balance based contrasts in unstressed syllables in a given language variant can be used to reveal qualitative aspects of the preceding syllables.

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37 The same unification of Vowel Balance and apocope under the heading of one root quantity driven prosodic effect, is found in Smith 2007 (410).

38 These figures are based on a rough count using a morphologically annotated corpus of about 55,000 words (cf. Frisian Language Database: www.fr.knaw.nl/tdb). The word 'rough' implies that spelling modes have been taken as an indicator of vowel length. The contrast is restricted to vowel length. Other counts of dialectal material from the FAND database (1980/95) indicate that it is vowel length that matters most in Modern Frisian, rather than the syllable length, where syllable final consonants are included. However, this is a preliminary observation.
Section summary:

- As a phonetic phenomenon, Vowel Balance is ubiquitous in Germanic languages;
- In some varieties of Germanic it has achieved phonological status;
- Vowel Balance phenomena in unstressed syllables are indirect indicators of quantity in preceding root syllables.
2.2 Degemination
2.2.1 The Germanic context
In Proto-Germanic, there was a phonological contrast between short and long consonants, see graph 2.0 for a spectral diagram of a short and a long [t]. This feature has not survived in modern languages such as English, Standard High German, Dutch and Frisian.

Graph 2.0: Spectral diagrams of consonant length of [ita] (left) and [εta] (right). The continuous, white line marks the intensity contour, the dotted line marks the tone contour. The difference in consonantal length (a low in the intensity contour) is clearly observable. The diagrams are reconstructed realisations of Old Frisian ita ‘to eat’ and setta ‘to set’ by the author, using the program Praat, applying active second-language competence in Icelandic. Note the spontaneous Vowel Balance effect in the duration of the unstressed [a].

Phonetically long consonants are still found in southern High German dialects (König 2001, 149) and in North Germanic languages, except for Danish. In most cases, the feature of phonetically long consonants is integrated in the quantity structure of the word (cf. § 2.3.1). In Modern Icelandic for example, vowel quantity is redundant and controlled by consonantal length from a synchronic point of view. Only in Swiss dialects, do (semi-) minimal pairs with geminate and non-geminate consonants still exist. For example, from Wallisian (the High German dialects spoken in the Swiss canton of Valais/Wallis) erlame /ɛr-la-mɛ/ ‘to lame‘ and lammer /la-mɛr/ ‘lambs’.
2.2.2 The Frisian context

In Old Frisian, geminate consonants existed just as they did in other Old West Germanic languages. Boutkan (1996, 40) discusses the problem of geminate consonants in word-final position. In that position, gemination is not reflected in the spelling of Old Frisian. For example, <mon> instead of *<monn> for reconstructed /mɔn:/ ‘man’. Boutkan deduces the existence of word-final geminate consonants in Riutstringen Old Frisian from indirect evidence. An indicator of the existence of word-final geminate consonants in late mediaeval West Frisian is the lengthening of short vowels that precede geminate consonants in Old Frisian. This tendency can be particularly observed in northern West Frisian dialects, for example, Modern Frisian rôt /rɔt/ ‘rat’ < Old Frisian rôt /rɔt/ (Spenter 1968, 16).

Current Frisian dialects do not have geminate consonants in uncomounded words. Geminate consonants still existed in the dialect of Wangerooge, where they were noticed by Siebs (1901, 1383, section on Wangeroogic ɪ). Siebs mentions this phenomenon only briefly and misses its phonological relevance. More precise phonetic observations were made by Otto Bremer (in a copy of Ehrentraut 1849, stored in the Landesarchiv in Kiel, Cb 122, nr 82:1). The page refers to the page in the aforementioned book. The bold form is the lemma where Bremer made his note:

- p. 365, fät: fät, Pl. fytu (silbengrenze in dem ɪ)
  ‘barrel’ ‘.... plural .... syllable boundary inside the ɪ’

- p. 390, schipper: sxip-pr (deutlich geminiert)
  ‘boatman’ ‘.... clearly geminated’

Versloot (1996) reconstructs the distribution of the geminates in the dialect of Wangerooge in the early 19th century, based on notes made by Ehrentraut between 1837 and 1841. An important innovation in the dialect of Wangerooge was that new geminate consonants arose in bisyllabic Old Frisian words with a short root

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9 Schiermonnikoog dialect (= north-east) poot [poot] with lengthening. The Hindeloopen dialect poot [poot] has a curious palatalisation. This palatalisation occurs also in other instances where northern dialects exhibit lengthening: Hindeloopen rôt, jölle, Standard Modern Frisian röl, jöl. It is assumed that this is an alternative (indirect) reflex of former long consonants in the far south-west.

10 In a compound such as West Frisian brämnettel ‘nettle’ a long [ɛː] may be realised, but even there, it is not compulsory.
vowel. This made the distribution of the geminate consonants in Wangeroogic completely predictable, following on from the quantity of the root vowel. No minimal pairs in Wangeroogic are discriminated by consonant length only. Versloot suggests that the dialect of Harlingerland (extinct since the 18th century) contained a distribution of geminate consonants similar to that in Wangeroogic.

2.2.3 The West Frisian charters

The development of unstressed vowels following a long root syllable differs from the development of unstressed vowels which follow a short root syllable (§ 2.4). This is a manifestation of Vowel Balance (§ 2.1). When geminate consonants appear at the border of two syllables, the first half is commonly considered to be part of the rhyme, whereas the second half belongs to the onset of the next syllable:

/VC:V/ → /VC-CV/.

A single consonant is syllabified to the onset of the second syllable, creating a short(er) root syllable:

/VCV/ → /V-CV/.

Evidence from Vowel Balance effects

Root quantity affects, for example, the reduction of subsequent unstressed vowels (Vowel Balance). This can provide information on root and subsequently consonant length. Map 2.14 in § 2.5.2 shows the manifestation of Vowel Balance in the north-eastern half of Fryslân until about 1460: Retention of <a> following short root syllables, but reduction to <e> following long root syllables. The early reduction of an unstressed /a/ in a word such as habbath ‘have (ind. pres. pl.)’ before 1430 implies that the consonant must still have been long at that time. This provides a datum post quem of ± 1430 for the process of degemination in West Frisian.

A negative clue is provided by the reduction of word-final -a after 1470. Historical geminate consonants no longer contribute to root quantity at that time (graph 2.19). This makes ± 1470 a datum ante quem for the degemination.

Evidence from consonant spelling

Another way to detect consonant degemination is the spelling of intervocalic consonants. In Old Frisian texts, such as the Riustringen texts and Unia group A-1

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41 Cf. § 2.3.1 for similar developments in some North Germanic dialects.
A.P. Versloot: Mechanisms of Language Change

and A-2, phonetic single consonants are (mainly) written with a single consonant sign, irrespective of the quantity of the preceding vowel, matching Latin spelling practices:

- Old Frisian <wesa> ‘to be’ = [vɛza];
- Old Frisian <Fresena> ‘Frisians’ (gen. pl.) = [fɛːza].

Geminate consonants are written with a double consonant graph:

- Old Frisian <lesa> ‘to read’ = [lɛza];
- Old Frisian <lessa> ‘less’ = [lɛsə].

A similar situation is found in Old Dutch and Old Saxon. Open Syllable Lengthening was generally applied in Middle Dutch and Middle Low Saxon. In the spelling of those languages, the first <V> in the graphematic sequence <VCV> represented a long vowel, while the first <V> in <VCCV> was a short vowel. When long consonants disappeared from Middle Dutch and Middle Low Saxon, double consonant spelling turned into a marking of vowel length. A single consonant signals that the preceding vowel is long, while a double consonant signals a short preceding vowel. This is still the general rule in Modern Dutch spelling. For languages where Open Syllable Lengthening had been generally applied, the spelling did not change from this re-interpretation.

Before the quantity shift of vowels and consonants:

- <V(VC)CV> -> [V:CV]
- <VCV> -> [VCV]
- <VCCV> -> [VC:V]

after the quantity shift:

- <V(VC)CV> -> [V:CV]
- <VCCV> -> [VCV]

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42 Note the phonetic contrast in voiced single consonant versus geminated unvoiced consonant.
An example from Middle Dutch, with regular lengthening in open syllable:

Single vowel and single consonant spelling <VCV>:

- **Early-Middle Dutch:** short vowel and short consonant [VCV]:
  - <gebeden> - [bedən] ‘prayed’

- **Late-Middle Dutch:** long vowel and short consonant [V:CV]
  - <gebeden> - [bedən]

Single vowel and double consonant spelling <VCV>:

- **Early-Middle Dutch:** short vowel and long consonant [VC:V]:
  - <bedden> - [bədən] ‘beds’

- **Late-Middle Dutch:** short vowel, short consonant [VCV]
  - <bedden> - [bedən]

Open Syllable Lengthening was far less prevalent in West Frisian than it was in Dutch and Low Saxon. In West Frisian, there were several [VCV]-yllabes left with historically motivated spelling <VCV>, such as *wesa* ‘to be’. Writers of Frisian were familiar with the graphematic sequence <VCV> as a marker of [V:CV] from Middle Dutch and Middle Low Saxon. Therefore, they developed a habit of spelling with double consonants in those cases. For example, *wessa* instead of the older *wesa*. The application of this new ‘spelling rule’ was even more probable when in Frisian <CC> no longer represented [Cː]. An increase of <CC>-spelling can signal the loss of phonological geminate consonants. This phenomenon was already discussed by Hofmann (1969). Hofmann concluded that degemination did not take place in West Frisian before 1400 (idem, 72).

The following examples have been taken from the charter text corpus and *Unia*:

Old Frisian *seke* ‘case’, *bitalad* ‘paid’, *wesa* ‘to be’ and *makad* ‘made’. In Old Frisian, they are spelled with <VCV>, but in Middle Frisian they are written <secke>, <bitallet>, <wessa> and <macket>. The proportion of historical tokens with only one consonant is shown in graph 2.1. After 1460, the spelling type <VCV> almost disappeared. The charters reveal no geographical variation in the development.

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41 It is remarkable that the number of <Il> spellings in *bitala(ne)* is significantly lower than in *bitalad*. Following a single <Il> one often finds the spelling *<pe(n)>* or *<je(n)>*. This may be an indication that the sound following [Il] was a consonant [i], rather than a vowel [i]. Thus: *<bitalye(n)>* implies *[bitalja(n)]* while *<bitalle(n)>* reflects *[bitalə(n)]*. 

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In the original charters from the 14th century, tokens spelled with one, historically correct <C> dominate. This indicates that phonological degemination of long consonants did not start much before 1400. The data from Unia confirms this assumption. Most texts in Unia group A-1 and A-2 stick to the etymologically correct spelling of short consonants in words such as wes, seke and makad. In early 15th century texts 'Processus Judicii' and 'Thet Autentica richten', spelling with <CC> dominates. This data suggests that consonant degemination did not start in West Frisian before 1390, but then evolved very rapidly, to be completed before 1460.

Graph 2.1: Proportion of tokens with one intervocalic consonant in words with an historical short consonant. The graph is based on the words: seke 'case', bitlaid/-th 'paid/pay', wes 'to be' and makad/-th 'made/make'. 'token percentage (%)' means that the percentage <C> spelling was calculated over the total of the tokens from the four words. For 'lemma percentage (%)' the percentage with <C> was computed per word, and subsequently, the average of these four figures was taken. The dating of the charter data matches the middle of the time frames. For the Unia groups: A-1 = 1300, A-2 = 1350, A-3 = 1405 and C = 1440 (no data from group B for this graph).

There is one important restriction to this conclusion. What did Frisian writers do when they were writing their language with phonological geminate consonants using the spelling tradition of Middle Dutch? This question is difficult to answer. Middle Dutch spelling practices came into use shortly after 1400 and this was precisely the time when phonological degemination was likely to have taken place. Consider the following pronunciation and corresponding spellings, given the Middle Dutch spelling practice:
There is a theoretical way out of this problem. Spelling \[V:CV\] with \(<VCV>\), while spelling \[VCV\] with \(<VCV>\). But that system was not applied in the early 15th century. For example, \(<\text{dele}> = [\text{de:le}] \text{ 'part'} (\text{OFO I-9}, 1402)\); \(<\text{fane}> = [\text{fa:ne}] \text{ 'moor'} (\text{dat. sg.) (OFO I-34, 1421})\), although \(<VVCV>\) does regularly appear alongside \(<VCV>\).

---

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Summarising the evidence:

- The end of the Latin spelling tradition provides a datum post quem of about 1390. In the Latin spelling tradition, quality contrast of consonants are actually spelled out: /c/ = <C>, /c:/ = <CC>. The historical-phonological contrasts are spelled correctly in pre-1400 sources;
- Vowel Balance effects in an unstressed non-final /a/ suggest a degemination after 1430;
- An absence of Vowel Balance effects according to historical root quantity, including geminate consonants, in the reduction of word-final unstressed /a/ provide a datum ante quem for consonant degemination of 1470;
- Scarce evidence of the word *dam* suggests consonant degemination before ± 1450;
- The ambiguous indication of spelling practices suggests a start of the process of degemination after 1400, to be completed not later than 1460.

The accumulation of these indicators enables a dating of the degemination process in West Frisian between ± 1420 and 1460. This means that the process took place over little more than one generation.

The cause of the degemination may stem from a loss of functional loading in the quantity contrast. Take the following example:

<table>
<thead>
<tr>
<th>stage</th>
<th>‘sun’</th>
<th>‘son’</th>
<th>status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proto Old Frisian</td>
<td>[sunː]</td>
<td>[sunθ]</td>
<td>Gemination has phonological status</td>
</tr>
<tr>
<td>Old Frisian</td>
<td>[sunː]</td>
<td>[sənθ]</td>
<td>Single and geminated consonants show a complementary distribution: /VC:/ ~ /V:C/</td>
</tr>
<tr>
<td>Late-Old Frisian</td>
<td>[sonː]</td>
<td>[sən]</td>
<td>Due to /θ/-apocope and syncope, the number of contrasting contexts is strongly reduced.</td>
</tr>
<tr>
<td>Middle-Frisian</td>
<td>[sonθ]</td>
<td>[sən]</td>
<td>Vowel length is the only contrasting qualitative feature</td>
</tr>
</tbody>
</table>

Table 2.4: Geminated consonants and their phonological status.

Not every unstressed vowel was subject to syncope or apocope. There were instances of complementary distributions and incidental minimal pairs, but apparently not enough to maintain a phonetic contrast throughout the language.
Section summary:

• Old Frisian had a phonetic opposition between short and long consonants;

• Information about consonant length can be obtained from: Vowel Balance effects, spelling practices and compensatory vowel lengthening (Modern Frisian *rot < Old Frisian */rɔt/);

• The combined evidence suggests a rapid loss of long consonants between ± 1420 and 1460.
2.3 Open Syllable Lengthening

2.3.1 The Germanic context

Open Syllable Lengthening is a development where a Proto-Germanic short root vowel is lengthened when in syllable final position. For example, Proto-Germanic *sa-gô, with a short /a/, becoming English saw [sɔː], Dutch zaag [zaː], West Frisian seage [sɪə], Icelandic sög [sœː] and High German Säge [zeːɡ] (< *se-gô), all with long root vowels. A tendency towards some form of Open Syllable Lengthening is widespread in all Germanic languages.

Dutch and Low Saxon

The phenomenon is most widespread and generally applied in Dutch and Low Saxon: Modern Dutch week ‘week’ < Old Dutch wîka, meten ‘to measure’ < metan, water ‘water’ < water, zoon ‘son’ < sunn, deur ‘door’ < dur, West-Germanic /i/ and

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Here and in subsequent cases, High German pronunciation reflects common North German practices, for example, an initial [z] instead of a South German [s] or [R] for /t/ instead of a South German [t] (König 2001, 244-245).
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/e/ coalesce in /e/, and /o/ and /u/ in /o:/, and /a:/ in /a:/. Compare High German sicher ‘sure’ and Nüpf ‘nut’ preserving the original vowel qualities /i/ and /u/, against Modern Dutch zeker, noot, with lowered qualities /ɛ:/ and /o:/ (Modern Low Saxon seker, Nöt). Lengthening took place in Dutch prior to the 13th century (Pijnenburg 1997, 84).

English
In the course of the Middle English and early-Modern English period, Open Syllable Lengthening could be overruled by a metrical rule, asking for two short vowels in many disyllabic words ending in a consonant or trisyllabic words (Brunner 1970, 18; Ekwall 1975, 13). So Modern English sake [sɛ:ɪk] < Old English sacu, but hammer [ha:mə] < Old English hamor. This metrical constraint not only prohibited or reversed the lengthening, but also caused shortening of originally long vowels, as in brother [briðə] < Old English bróðor. The lengthening of /a/, /ɛ/ and /o/ took place around 1300. The lengthening of /i/ and /u/ did not take place before the late 13th and 14th centuries and in a more limited geographical region only.

High German
In High German (König 2001, 153) many words which were subjected to lengthening in other languages, avoid this because of the High German Consonant Shift. The consonant shift produced a number of new geminate consonants, closing the preceding syllable. Compare Dutch water [vɔtər] < /vaːtər/, High German Wäser [vəsɛ] < /vas-sɛr/, Dutch gereden [ˈɣɛrdɛdə] < -/ri-dan/ and High German geritten [ɡerɪtə] < -/rit-tan/. The oldest indications of Open Syllable Lengthening in High German are from the 12th century.

Standard High German has a large number of lengthened vowels in monosyllabic closed syllables due to levelling. In the Middle High German paradigm, the vowel was in open or closed syllable alternatively, depending on the case, for example in the singular of tac ‘day’: nom./acc. tac, gen. ta-ges, dat. ta-ge. In Dutch, the singular form kept the short vowel from the nominative and accusative (dag but: eerdaag < eerdaage). The lengthened vowel appears in the plural dagen. In Modern High German, the lengthened vowel has been generalised throughout the paradigm: nom./dat./acc. sg. Tag [ta:k]. The spread of this phenomenon through German dialects is gradual. In the Bavarian and East-Franconian dialects, monosyllabic words with a short vowel whether they be followed by a single or double consonant, are always lengthened: kopf ‘head’, dach ‘roof’, in Standard High German with short vowel: Kopf, Dach.

In the far south-western dialects (Swiss-German), there is no lengthening of short vowels at all. Here, the Proto-Germanic syllable types of short and long syllables
The name ‘Scandinavia’ is used in the narrow geographical sense of the Scandinavian Peninsula only, comprising of Norway and Sweden. Both Denmark and Finland and even Iceland and the Faroe Islands are sometimes included in ‘Scandinavia’. Note that Finnish and Sami, spoken in Norway and Sweden, are not Germanic languages, while Denmark is not on the Scandinavian Peninsula. The narrow interpretation is very practical in the context of this study, because relevant phenomena, such as pitch accent, Vowel Harmony and Vowel Balance are limited to varieties of Norwegian and Swedish.
Archaic syllable structures and stress patterns in Wallisian dialects

With the sole exception of Swiss German, all Germanic languages seem to ‘do’ something with originally short root syllables. High German dialects of Wallis preserve the archaic settings in this respect. There is a connection in phonetics between stress and duration. They attract each other. Wipf (1910, 19) writes about intensity stress in the Wallisian dialect of Visperterminen at that time:

“In isoliert gesprochenen Wörtern wie fatter Vater; bogo Bogen; bimill Himmel; bette beten; gibætto gebetet, besteht zwischen der Stärke der letzten Silbe und der Hauptsilbe ziemlich genau dasselbe Verhältnis wie in musterdeutschem ‘Schönheit’; [...].”

Wipf emphasises that the stress contrast between root and unstressed syllables is much less than in Standard High German or any other Swiss German dialect. The musical accent is described as ‘strong’ (idem, 21) and not connected with intensity stress, as is the case with the rest of Swiss German and Standard High German. The tone contour is “völlig frei, d.h. sie ist ganz von der Stellung im Satze und dem musikalischen Satzakzent abhängig.” (idem, 22). The Wallisian dialects also exhibit several full vowels in unstressed syllables. This is one of the features that disappeared from many Germanic languages as a result of primary root stress. The issue of stress in syllable structure and phonological change is covered further in chapter four.
Section summary:

- Proto-Germanic short roots (= short vowel + single consonant) are subject to lengthening processes in almost all Germanic languages;

- Wallisian High German preserves the old syllable pattern and exhibits no fixed connection between intensity stress and tone contours.
2.3.2 The Frisian context

Open Syllable Lengthening is far less obvious in Frisian than it is in neighbouring Dutch, Low Saxon and Danish. General implementation of this tendency is only found in the dialect of Saterland and in the North Frisian dialects of the islands. The latter case is difficult to come to grips with from a modern point of view, because of an extensive shortening of older long vowels (including the lengthened short vowels in open syllables). Examples from the North Frisian dialect of Föhr show different developments of Old Frisian /ɪ/ in open or closed syllable:

<table>
<thead>
<tr>
<th>In open syllable</th>
<th>In closed syllable</th>
</tr>
</thead>
<tbody>
<tr>
<td>sled ‘sledge’</td>
<td>fisk ‘fish’</td>
</tr>
<tr>
<td>slide</td>
<td></td>
</tr>
</tbody>
</table>

Open Syllable Lengthening influenced by subsequent vowel quality

In North Frisian mainland dialects, short vowels in open syllables show different developments depending on the quality of the vowel in the subsequent unstressed syllable. Before an Old Frisian /a/ in unstressed syllable, short root vowels share the same fate as their closed syllable cognates (Versloot 2002a). As in the island dialects, the later quantity reshuffle obscures the perception of this development. Examples from the dialect of the Halligen:

In open syllable before Old Frisian /ɑ/:

<table>
<thead>
<tr>
<th>määl ‘meal’ &lt; Old Frisian mele</th>
</tr>
</thead>
<tbody>
<tr>
<td>mele</td>
</tr>
</tbody>
</table>

In closed syllable and before Old Frisian /a/:

<table>
<thead>
<tr>
<th>smeel ‘narrow’ &lt; Old Frisian smel</th>
</tr>
</thead>
<tbody>
<tr>
<td>smel</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>steele ‘to steal’ &lt; Old Frisian stela</th>
</tr>
</thead>
<tbody>
<tr>
<td>stela</td>
</tr>
</tbody>
</table>

A similar tendency can be observed in the (now extinct) East Frisian dialect of Harlingerland and the West Frisian dialect of Schiermonnikoog (idem, 67,68).

‘Scandinavian’ patterns in East Frisian dialects

The central Scandinavian tendency to lengthen intervocalic short consonants (instead of lengthening the vowel) is found in the (also extinct) dialect of Wangerooge. In this dialect, historical geminate consonants were retained and augmented by new geminate consonants, developing from short consonants after a short root vowel (Versloot 1996), cf. § 2.2.2.:

<table>
<thead>
<tr>
<th>timmer [timːɐ] ‘to timber’ &lt; Old Frisian tɪmmeria</th>
</tr>
</thead>
<tbody>
<tr>
<td>kumme [kʊmːɐ] ‘to come’ &lt; Old Frisian kɔmna</td>
</tr>
</tbody>
</table>

In Scandinavia, dialects with consonant gemination are intermingled with Level Stress dialects (map 2.1). A similar geographical pattern was found in East
Friesland. The ‘neighbour’ of the Wangerooge dialect, the dialect of Land Wursten (also extinct) shows an extreme form of Level Stress (Hofmann 1961 and recently in Smith & Van Leyden 2007). In this dialect, the Level Stress resulted in a complete accent shift from the root towards the ending in words with short vowels in open syllables: *kma* ‘to come’ < Old Frisian *koma*.

The lengthening of Old Frisian /i/ and /u/
For West Frisian, Hoekstra (2001a, 723-724) and Versloot (2001b, 769) point out the absence of lengthening in open syllables of the Old Frisian /ɛ/ and the lengthening of /a/ and /ɔ/. For Old Frisian /i/ and /u/ in open syllables, the situation is rather complex. Versloot (2001b, 770-771) assumed a lengthening of /i/ and /u/ and subsequently coalescence with Old Frisian /iː/ and /uː/. Hoekstra (2001a, 723) takes a more careful position. He signalises that both the historical /i/ and /iː/ (and similar for /u/ and /uː/) underwent a redistribution of their quantity according to the following consonant. So there are two scenarios:

- /i/ was lengthened in open syllables and merged with the old /iː/. This sound was later shortened in specific phonological contexts (the view in Versloot 2001b);
- /i/ remained short and kept its closed quality in open syllables and could later be lengthened in some phonological contexts; /iː/ was shortened precisely in those contexts where /i/ was not lengthened. This cascade of developments finally produced an identical quantity distribution (Hoekstra’s view 2001a).

In the next section new evidence will be presented for the first scenario.

A similar problematic situation is found in Wangerooge. Versloot 2001b (770), mentions that /i/ and /u/ were probably lengthened in open syllables. The reasons for this assumption are:

- The gemination of former single consonants in open syllables is absent after Old Frisian /i/ and /u/;
- The root vowels are written <ii> and <uu>, suggesting long vowels.

Phonetic transcriptions of late 19th century Wangerooge made by phonetician Otto Bremer (in his copy of Ehrentraut 1849, cf. § 2.2.2) reveal that there was a quantity opposition in Wangerooge between short /i/ and long /iː/. The Old Frisian long /iː/ could either be long or short in Wangerooge. The product of short /i/ had the same quality, but was apparently always short. The numbers refer to the page in the aforementioned book, the bold form is the lemma where
Bremer made his note:

p. 363, dîk: dîk [\ldots], dîk (mit kurzem i)  
‘dyke’ ‘... with short i’; < Old Frisian /dik/

p. 399, tîd: thîd  
‘time’ < Old Frisian /ti:d/

p. 392, sílich: si-lix (deutlich zwei kurze i)  
‘seal’ ‘... clearly two short i’s’; < Old Frisian */silich/

It is difficult to date Open Syllable Lengthening in Frisian. Thirteenth and 14th century Old Frisian sources from East Friesland show no traces of Open Syllable Lengthening or intervocalic consonant gemination.

Three aspects deserve special consideration in the study of the charters in the following section:

- There is no certainty about Open Syllable Lengthening of the Old Frisian /i/ and /u/;
- The Old Frisian /e/ is apparently not affected by Open Syllable Lengthening in Middle Frisian;
- Different developments can be expected before an Old Frisian /a/ or /a/.

Section summary:

- Open Syllable Lengthening is not as general in Frisian as neighbouring West and North Germanic languages;
- The (extinct) East Frisian dialects of Wangerooge and Land Wursten show ‘Scandinavian’ patterns (consonant lengthening or level-stress);
- In other dialects, including some West Frisian ones, Open Syllable Lengthening does not occur when the following unstressed syllable contains /a/ in Old Frisian.
2.3.3 The West Frisian charters
The main issues in the following section are:

- Open Syllable Lengthening in mediaeval West Frisian in words where the following syllable contains an /a/ or /u/ (§ 2.3.3.1);
- A limited application in instances where the root was followed by an unstressed syllable with /a/ (§ 2.3.3.2).

Evidence from the charters has induced an investigation of two more, related features. In the context before /a/, curious spellings appear with <VVCC>, for example, <leessa> for lesa ‘to read’. The vowel digraph indicates vowel length, but the double consonant is usually a mark for the shortness of the preceding vowels. This phenomenon will be analysed in detail in § 2.3.3.3.

It also became apparent that an Old Frisian /a/ does not only block Open Syllable Lengthening in many cases, it can even cause the shortening of Old Frisian long vowels. Although both the <VVCC>-syllables and the shortening are beyond actual Open Syllable Lengthening, they will also be treated, given all phenomena are concerned with root syllable quantity processes.

2.3.3.1 Old Frisian short root vowels, when not followed by an unstressed /a/
The following words have been checked in the corpus to trace the development of the Old Frisian /a/ and /ɔ/ in open syllables before a following /ɔ/ in the next
syllable: _dore_ ‘door’, _sone_ ‘son’, _bitale_ ‘payment’ and _fore_\(^{50}\) ‘for’. In § 1.3.3, the case of _fore_ was used in table 1.4 to illustrate the transition from the Latin spelling tradition, without explicit indication of root vowel length, towards the Dutch spelling tradition, with digraphs for long vowels.

**Evidence from the charters**

Explicitly marked vowel length appears in the following four examples in original charters for the first time:

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><em>fore</em></td>
<td><em>&lt;foer&gt;</em></td>
<td>1425</td>
</tr>
<tr>
<td><em>sone</em></td>
<td><em>&lt;zoen&gt;</em></td>
<td>1429 = oldest original attestation to the lemma</td>
</tr>
<tr>
<td><em>bitale</em></td>
<td><em>&lt;bitael&gt;</em></td>
<td>1431 = oldest original attestation to the lemma</td>
</tr>
<tr>
<td><em>dore</em></td>
<td><em>&lt;doer&gt;</em>(^{51})</td>
<td>1487 = oldest original attestation to the lemma</td>
</tr>
</tbody>
</table>

Except for _fore_, there are no tokens with single vowel spelling in these words, not even in copies. Open Syllable Lengthening in these words must be older than the apocope of /a/, providing a first datum ante quem of this process of ± 1420. The preposition _fore_ is uniquely written as _<for>_ in the period 1390 to 1425. Because the lengthening of the original short /a/ must have taken place in the open syllable context with following /a/, the late 14\(^{th}\)/ early 15\(^{th}\) century form of _<for>_ can only represent /foə/. This is in accordance with Latin spelling practices, which are generally applied in the oldest charters from the period. In _fore_, the Open Syllable Lengthening must therefore be older than 1390.

**Evidence from Unia**

In very early 15\(^{th}\) century texts in _Unia_ (group A-3) _<for>_ and _<foer>_ prevail, while in older texts it is _<fore>_ . No attestations to _bitale_ were found. However the lemmas _dore_ and _sone_ are found, spelled _<dora, dore, dorum, dorim>_ and _<sone>_ . Examples of the words _fôt_ ‘foot’ and _grât_ ‘great’ show that the spelling of digraphs for long vowels in open syllables are not applied in _Unia_ group A, therefore not before 1400:

---

\(^{50}\) The lemma entry _foara_, _fora_, _fora(e), foram_ in Holthausen/Hofmann is not correct. The Old Frisian form is _fore_. This should be the first keyword. The spelling of _foara_ is found only once in the charters (OFO IV-112,1496) and is a hyper-correct spelling of _fore_. The form _foara_ deserves its own entry. It is an example of adverbial flexion, always following the preposition _to_ to _foara_ (cf. Modern Frisian _foar_ ‘for’ and _tofor_ ‘before’).

\(^{51}\) The _<e>_ is rendered with an abbreviation in the text. The text edition transcribes _<dore>_ , but this would be a unique instance. The other eight attestations to the singular are all _<doer>_ . Vries (personal contact) confirmed that the solution _<doer>_ could be equally valid for this case.
Because the text has not yet been lemmatised, it would be too time consuming to evaluate every word ending in <en>. Dative plural forms in <en> have been identified as part of the analysis of the masculine nom./acc. plural ending, Old Frisian -an (§ 2.4.3.2). There, it could be seen that dative plural forms in <en> are quite rare before 1400 (< 5%).

Table 2.5: Spelling vowel length with monographs or digraphs (tendencies).

<table>
<thead>
<tr>
<th>date</th>
<th>Unia-group</th>
<th>text</th>
<th>closed syllable</th>
<th>open syllable</th>
</tr>
</thead>
<tbody>
<tr>
<td>± 1300</td>
<td>A-1</td>
<td>Older ‘Skeltenariicht’</td>
<td>&lt;grat&gt; /grǝt/</td>
<td>&lt;fota&gt; /foːta/</td>
</tr>
<tr>
<td>± 1410</td>
<td>A-3</td>
<td>‘Authentica Rücht’</td>
<td>&lt;graet&gt; /grǝt/</td>
<td>&lt;grate&gt; /grǝtǝt/</td>
</tr>
<tr>
<td>15th c.</td>
<td>B/C</td>
<td>Lowerdena Bota</td>
<td>&lt;foet&gt; /foːt/</td>
<td>&lt;foetem&gt; /foːtem/</td>
</tr>
</tbody>
</table>

So for instance, the spelling <sone> in Unia group A-1 may represent both /sǝnə/ and /sǝnə/.

Indirect evidence from Vowel Balance in Unia
The effect of Vowel Balance offers an opportunity to define the length of the root vowel (cf. § 2.1). In the archaic parts of Unia, the dative plural ending is written <um> in 83% of the tokens, but <em> and <im> also appear (cf. graph. 1.10). Instances of a complete reduction to <en> are not considered here. Due to Vowel Balance, reduction of /um/ to /ım/, spelled <em> or <im>, will take place primarily when the root is long. Spelling <em> and <im> can therefore be used as indirect evidence of root vowel length. If words that are vulnerable to Open Syllable Lengthening indeed exhibit <em> and <im> significantly more often than words with an expected short root, the conclusion is justified that Open Syllable Lengthening has indeed taken place in those words.

Some texts contain <um> only and are therefore unsuitable for this test. When no variation appears, forms cannot be used to obtain indirect indications about the quantity of the root. The following subgroups have been identified:

(a) Words with an etymological short root, that still exhibit short vowels in the 15th century, for example, degum, sekum ‘days, cases’;
(b) Words with an etymological short root, that exhibit long vowels in the 15th century, for example dorum, farum ‘doors, travellers’;
(c) Words with an etymological short root of which it is uncertain if they had a long vowel in the 15th century. For example, wikum, lithum ‘weeks, limbs’.

These cases are particularly interesting, because they can provide information about the lengthening of /i/ in open syllables;

52 Because the text has not yet been lemmatised, it would be too time consuming to evaluate every word ending in <en>. Dative plural forms in <en> have been identified as part of the analysis of the masculine nom./acc. plural ending, Old Frisian -an (§ 2.4.3.2). There, it could be seen that dative plural forms in <en> are quite rare before 1400 (< 5%).
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(d) Words with an etymological long root, for example, *jērum, wordum* ‘years, words’;
(e) Words with a root consisting of two or more syllables, for example, *fingērum, wēpuum* (base form *wēpen*) ‘fingers, weapons’.

Below is a distribution of the endings in texts from *Unia* group A (14th century) which contain variations between <um> and <em/im> according to defined subgroups:

<table>
<thead>
<tr>
<th>ending</th>
<th>(a) short root, no context for lengthening</th>
<th>(b) short root, context for lengthening</th>
<th>(c) short root, uncertain</th>
<th>(d) long root</th>
<th>(e) bi-and trisyllabic</th>
<th>total percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;um&gt;</td>
<td>21</td>
<td>7</td>
<td>7</td>
<td>171</td>
<td>76</td>
<td>282</td>
</tr>
<tr>
<td>&lt;em/im&gt;</td>
<td>1</td>
<td>3</td>
<td>4</td>
<td>58</td>
<td>6</td>
<td>72</td>
</tr>
<tr>
<td>total</td>
<td>22</td>
<td>10</td>
<td>11</td>
<td>229</td>
<td>82</td>
<td>354</td>
</tr>
</tbody>
</table>

Table 2.6: Distribution of the dative plural endings <um> and <em/im> according to word structure.

The differences mentioned in the rest of this paragraph are all statistically significant (see appendix 1):

- The reduced endings <em/im> are over-represented in the long roots (d);
- The reduced endings <em/im> are under-represented in words with an historical short root that do not fulfil the demands for Open Syllable Lengthening (a), for example, *sekum, degum*;
- Words that are expected to show Open Syllable Lengthening such as *dorum* and *farum* (b) behave the same as words with a long root (d) and differ from the words in group (a);
- Words such as *wikum* and *lithum* (c) behave in the same way as other words with Open Syllable Lengthening (b) and words with an historical long root (d).

This is a firm indication that originally short vowels were lengthened in open syllables during early times. Not only short /a/ and /a/, but also /i/. Therefore words such as *dore, bitte* and also *wike* already had long root vowels in the 14th century.

Further differentiation within *Unia* group A is problematic, because of the low number of relevant examples. A separate assessment of data from two archaic *Unia* texts, the *Older Skeltemarich* and the *Eight Dooms*, reveals exactly the same skewness as in table 2.4, albeit that the numbers are too low to constitute a valid statistical proof. Taking this evidence seriously, the conclusion should be that
Open Syllable Lengthening of /a/, /o/, but also /i/ and probably /u/, dates from the beginning of the 14th century. The effect of Vowel Balance remained active in the reduction of -um in the charters from 1379 to 1430 (test in appendix 1).

The paradigm of 'ship'
Additional information about Open Syllable Lengthening, especially the root vowel /i/ can be obtained from the paradigm of the noun skip 'ship'.

The Old Frisian paradigm of 'ship' is shown below (genitive not considered here):

<table>
<thead>
<tr>
<th>skip 'ship'</th>
<th>sg.</th>
<th>pl.</th>
</tr>
</thead>
<tbody>
<tr>
<td>nom./acc.</td>
<td>skip</td>
<td>skip</td>
</tr>
<tr>
<td>dat.</td>
<td>skipe</td>
<td>skipum</td>
</tr>
</tbody>
</table>

Table 2.7: Old Frisian paradigm of skip 'ship'.

Following the evidence from the Vowel Balance in the dative plural ending in Unia, Open Syllable Lengthening in the word skip could be expected when it is followed by an unstressed /u/ or /ø/. This is basically everywhere apart from the nominative and accusative singular. In closed syllable, /i/ was lowered to /I/. The evidence from dore, zon, and bitale shows that the final -e is dropped after a long root vowel (cf. § 2.4.3.9). Hence: dat. sg. and nom./acc. pl. /skipø/ > /skipø/ > /skip/ (cf. fore: /forø/ > /forø/ > /for/). With the vowel reduction in the dative plural, the following forms of the paradigm of 'ship' could be expected. The attested forms in the charters before 1460 are rendered in the other half of the table:

<table>
<thead>
<tr>
<th>skip 'ship'</th>
<th>expected</th>
<th>attested until 1460</th>
</tr>
</thead>
<tbody>
<tr>
<td>nom./acc.</td>
<td>/skip/</td>
<td>&lt;scip&gt; = /skip/</td>
</tr>
<tr>
<td>dat.</td>
<td>/skip/</td>
<td>&lt;schype&gt; = /skipø/</td>
</tr>
</tbody>
</table>

Table 2.8: Middle Frisian paradigm of skip 'ship'; the dominant attested forms are given.

The attested forms before 1460 reveal a direct correlation between an expected /I/ and the written <i> in closed syllable on the one hand, and an expected /i/ and written <ii/> on the other. All relevant cases show Open Syllable Lengthening.
The plural has regular apocope of the final /ð/ following a long root, producing /skiːp/. The dative singular shows an additional morphological ending -e (cf. § 2.4.3.9).

The example of ‘ship’ illustrates:

• The application of Open Syllable Lengthening to Old Frisian /i/;
• That lengthening took place before both the Old Frisian /ð/ and the Old Frisian dative plural ending -um.

*Incidental lengthening of Old Frisian /ɛ/*

Words containing an Old Frisian /ɛ/ usually show no signs of lengthening in Modern Frisian. Compare: Modern Frisian water ‘water’, lekken ‘blanket’ and brekke ‘to break’, all with a short /ɛ/, with Dutch water, laken, broken with /aː/ and /ɛː/. The absence of Open Syllable Lengthening in words such as degum and sekum was confirmed by the Vowel Balance data in Unia (previous section). In the Middle Frisian data, digraph spelling occasionally occurs for Old Frisian short /ɛ/ in open syllables in several words, cf. § 2.3.3.3. The short-rooted seke ‘case’ for example, exhibits the spelling <seeck(e)> in 13% of the singular tokens. The first attestation

Map 2.2: Lengthening of /ɛ/ in Old Frisian seke ‘case’.

-107-
is from 1441. This matches the period of apocope of word-final -e after short-rooted words such as seke (cf. § 2.4.3.8). The first time the word seke appears without the ending <e> is a case of vowel lengthening: OFO 1-83, 1441 (Tytsjerksteradiel): <seeck>. This lengthening tendency does not really gain momentum and is not dominant in any specific region. Its distribution is concentrated in the centre of the province (map 2.2).

After the apocope of final -e in most of the dialects, a final vowel in seke became a secondary feature of the south-west (cf. § 2.4.3.8, map 2.12.). This resulted in the following geographical distribution of secondary (!) forms:

<table>
<thead>
<tr>
<th>region</th>
<th>primary form</th>
<th>secondary form</th>
</tr>
</thead>
<tbody>
<tr>
<td>South-west</td>
<td>&lt;seck&gt;</td>
<td>&lt;secke&gt;</td>
</tr>
<tr>
<td>Centre</td>
<td>&lt;seck&gt;</td>
<td>&lt;seeck&gt;</td>
</tr>
<tr>
<td>North-east</td>
<td>&lt;seck&gt;</td>
<td></td>
</tr>
</tbody>
</table>

Table 2.9: Primary and secondary forms of the noun seke 'case' in the period 1480-1550

After 1465, the root <seeck> is always found without a final vowel. The details from the period 1440-1465 reveal that the drop of the final vowel is not always instantly combined with a lengthening of the root, but the two processes are closely connected in time. It looks like a metrically motivated preference for a long foot consisting of either two short syllables, as in <seeck>, or one long syllable <seeck>. The Open Syllable Lengthening in, for example, sone is definitely older than 1350, but in sone, the apocope of the final /e/ is from ± 1390 (cf. § 2.4.3.9). This implies that the lengthening of /e/ has to be separated from the regular Open Syllable Lengthening. The lengthening of /e/ in open syllables never became a prominent feature in Middle or Modern Frisian.
Section summary:

• Open Syllable Lengthening of Old Frisian /i/ (and /u/?), /a/ and /o/ is revealed by indirect evidence from Vowel Balance effects on the dative plural ending -um in Unia;

• The lengthening is confirmed by the spelling in the 15th century charters;

• The lengthening started as early as the beginning of the 14th century;

• The lengthening of the Middle Frisian /ɛ/ in the middle of the 15th century was closely connected in time to the apocope of the final /θ/ and remained a limited phenomenon.
2.3.3.2 Old Frisian /a/ and /ø/ before /a/: regional diversity

Open Syllable Lengthening is less prevalent in words where the vowel of the second syllable is an /a/ in Old Frisian. The contrast between the development before an unstressed /a/ or /ø/ is well illustrated by plural forms of the word doere 'door', in the singular always <doer> from Old Frisian doer:

nom./acc. pl. dore: The plural appears as <dorra> (OFO II-30, 1450 copy). At a later stage, the old plural ending -a is replaced by the modern -en: <dorren> for example, in OFO I-307, 1481. The root remains short.33

gen. pl. dorena: In the genitive plural form dorena, there is an /a/ in the final syllable, but the syllable directly following the /a/ has /ø/. This allows Open Syllable Lengthening, followed by the syncope of the word internal /ø/. The results are forms spelled: <doerana/doerena> in OFO II, 85 (1478, copy). The reconstructed stages are: /dorena/ > /dorena/ > /dorena/.

Another striking pair is formed by the noun bitale 'payment' and the past participle of the verb bital: bitaled. Old Frisian bitale has always Open Syllable Lengthening with subsequent early apocope of /ø/ after the long root: /bital/ (cf. 2.3.3.1). The past participle bitaled hardly ever appears with signs of vowel lengthening. Spelling with <ae> appears in less than 5% of the tokens. Cases of spelling with an <ae> are concentrated in the south-west (map 2.3). More information on this lengthening and the specific spelling with <aell> in particular is given in § 2.3.3.3.

Map 2.3. reveals that in spite of the general trend not to lengthen Old Frisian short vowels before an unstressed /a/, exceptions are found. Compare the case of seeke, which has an 'unexpected' lengthening of the Old Frisian /ø/. This regionally-limited lengthening before /a/ can be documented further for the nouns nama 'name' and boda 'messenger'. The first one has a short vowel in the modern language, namme, the other a long vowel, boade.

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33 In OFO II-85 (1478 copy) the form <doeren> appears for the first time, being newly derived from the singular /dœren/. This becomes plausible from the fact that both <dorra> and <dorren> exist, but only <doeren> and not <*doera>.
Map 2.3: Lengthening of Old Frisian /a/ in *bitad/*bitia.

Map 2.4: Open Syllable Lengthening in words ending in unstressed *-a* Old Frisian *nama* and *boda*. The trend surface is based on the cases with explicit spelling of vowel length *<ae>,<oe>* (black portions in the pie charts) and instances where the shortness is marked with double consonant spelling *<mm>,<dd>* (white portions in the pie charts). The area with vowel lengthening is grey, the percentages of the trend surface represent the portion of short forms.
Three spelling practices can be distinguished for these two words:

- `<naem-, boed->` indicate vowel lengthening;
- `<namm-, bodd->` indicate short root vowels;
- Tokens like `<nama>` or `<boden>` are ambiguous.

The trend surface in map 2.4 is based on cases with explicit marking of vowel quantity, either with `<ae>`, `<oe>` for long vowels or with a double consonant spelling `<mm>` or `<dd>` to mark short vowels. Lengthened forms cover a larger area than in the map of *bitalia*. Short vowels remain dominant in Leeuwarden and further to the north-east. Percentages of the trend surface indicate that even in the south-west, the tendency of lengthening does not exceed 50%. Both in map 2.3 and 2.4, the lengthening is a tendency and not a general rule.54

Lengthening before an unstressed `/a/` differs from the lengthening before an `/e/`, both in geographical extension and in dating. Open Syllable Lengthening before the unstressed `/a/` dates back as early as the 14th century.

Evidence of lengthened forms in *nama*, *boda* and *bitalad/bitalia* are found after 1450 (cf. the indicated time frames in the headers of the maps 2.3 and 2.4). So, the lengthening in open syllables when followed by an historical Old Frisian `/a/`, was a relatively recent feature, compared to the vowel lengthening before `/e/`. The same holds for the lengthening of `/e/` in *seke*.

The masculine plural ending `-an`

In the word *bitalad*, the `/a/` is not word-final, but protected by a final consonant. Also the classical Old Frisian ending of the masculine plural `-an` has a protected `/a/`. It is difficult to find convincing examples that can support or dismiss the hypothesis that the protected `/a/` in the latter ending blocks the Open Syllable Lengthening. The potential corpus is limited to masculine nouns. Words such as `<hossen>` (17th century) `socks` or `<dorren>` `doors` are old feminine nouns where the Old Frisian ending `-a` was replaced by `-er` at a time when the Old Frisian `/a/` in a protected position had already been reduced to `/e/`. Many words with a short root, a potential group for Open Syllable Lengthening, belong to the n-stems and as a result have an ending with word-final `-a` in the singular, for example, *boga* `bow`. The spelling `<bogghen>`, appearing once in the charters, may have its short root vowel levelled from the singular. In words with an Old Frisian singular in `-e`, the lengthened vowel of the singular can be levelled to the plural. An example of

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54 In both maps, the region *Gaasterlân* has only long vowels. The figures from the *Gaasterlân*-region differ significantly from other regions in Fryslân.
this was the previously mentioned spelling of &lt;doeren&gt;.

There are two possible scenarios. One is a blocking of the Open Syllable Lengthening before word-final -a, but not before the plural ending -an. The other is the blocking of the lengthening in both cases:

<table>
<thead>
<tr>
<th>lemma</th>
<th>singular</th>
<th>phonologically expected plural</th>
<th>plural with vowel levelling from the singular</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;son&gt; 'son'</td>
<td>/sɔːn/</td>
<td>/sɔːnan/</td>
<td>/sɔːnan/</td>
</tr>
<tr>
<td>knapa 'boy'</td>
<td>/knapa/</td>
<td>/knapan/</td>
<td>/knapan/</td>
</tr>
</tbody>
</table>

Scenario I: No Open Syllable Lengthening for either word-final -a, or -an

| &lt;son&gt; 'son' | /sɔːn/ | /sɔːnan/ | /sɔːnan/ |
| knapa 'boy' | /knapa/ | /knapan/ | /knapan/ |

Scenario II: No Open Syllable Lengthening for word-final -a, but for -an

The plural forms /sɔːnan/ and /knapan/ are possible in both scenarios. If there are attestations to /sɔːman/ but not to /knapan/, scenario I is the most likely. If there are attestations to /knapan/ and no attestations to /sɔːnan/, scenario II is the most likely. In the following paragraphs, the words &lt;son&gt; and knapa, boga, nama, boda (all representing the same syllable structure) are evaluated.

&lt;sonan / senan 'sons'

The word 'son' alternates between back and front root vowels (cf. § 1.3.5). In the singular, &lt;soen&gt; and its variations outnumber &lt;zin&gt; and its variations 62% to 38%. Forms such as &lt;sinnen&gt; /&lt;zennen&gt; constitute the majority of the plural tokens (71%). There are 14 instances of &lt;o&gt; in the plural, two of them &lt;zonen&gt; /sɔːnan/ . The others probably represent /sɔːnan/.

Hoekstra (2007) discusses the curious spontaneous fronting of /u/ > /e/ (> /i/), as in Modern Frisian slon 'sun', wenje 'to live' and simmer 'summer' from Old Frisian sunne, wunia and sumer. The fronted vowel in &lt;son&gt; (from older sun) may belong to the same development. As this feature is limited to historically short vowels, this scenario would be justification for the retention of the short vowel in
the plural form plural: /sɔnə/ ~ /sunə/65 > /sɔnə/ ~ /sunə/ > /sɔnə/ ~ /sɔnə/ > /sɔnə/ ~ /sɔnə/. Summarising the evidence for *one*, the form /sɔnə/ is attested, supporting scenario 1 with no lengthening in the plural. The widespread fronting in the plural is another, indirect indication of a short root vowel in the plural.

knapan ‘boys’
The word knapa ‘son, boy’ appears in the charters in the singular and as first element of the compound knapakind ‘boy-child, son’: <knappa>. There are two examples in the plural form: <knapan> in OFO IV-12, 1451, a copy of a copy(!).

Unia provides several examples from the early 15th century from the text ‘Processus Judicii’ with a singular <knapa> (one time) and <knappa> (four times), probably all representing /knapa/ with a short root vowel66. In the plural there is <knappan> (nom. pl.) once. An interesting case is the genitive plural form <knapene>, possibly representing /knapənə/ < Old Frisian knapena with a lengthened vowel (cf. the gen. pl. form <doerna> earlier in this section). These Unia forms would comply with an expected phonologically defined paradigm, where both word-final /a/ and protected /a/ in the plural ending -an block Open Syllable Lengthening: singular knapa /knapa/, nom./acc. pl. knapan /knapan/, gen. pl. knapena /knapənə/, dat. pl. *knapum /knapum/.

bogan ‘bows’
The plural of boga is found as <bogghen> in the accusative in OFO II-100 (1481 original) and as <boeghen> in the dative in OFO II-201 (1501 original). This fits expected phonological forms: nom. acc. pl. /bɔpən/ < bogan without lengthening and /bɔpən/ < bogum with lengthening. The year 1501 is rather late, but not impossible, for a separate dative form, cf. <deggum> ‘days’ in OFO IV-129, original from 1502.

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65 With ‘Seesaw’ Vowel Harmony, cf. § 2.6.2.

66 Note it is assumed that <apa> renders /apa/, but <ape> /æpə/. When a vowel was mostly short before an /a/, there was less of a need to write a double /pp/ for /apa/, because at that time /pp/ would represent /p/. Evidence of this assumption is provided by the forms of the infinitive / gerund and past participle of the verbs kera ‘to choose’ and swera ‘to swear’. In the gerund, Old Frisian kera/ne/sweran, the /e/ is mostly written with one <e> (Middle Frisian <keren / sweren>), while in the past participle, Old Frisian ker/n / swer, it is mostly written <rr> (Middle Frisian <keren / sweren>) after 1450. The historical geminate consonants had already disappeared at that time. All evidence from later developments suggests that the root vowel was short /e/. Writers apparently felt less need to mark the shortness of the root vowel with a <rr> when the following vowel was the ‘heavy’ underlying /a/.
nāman 'names'
The six instances of <naemen> (four originals and two copies) as a plural form of nama 'name' all originate, bar one, from the west or south-west, where lengthening before -a(n) is possible (cf. map 2.4). There is one case from the north-east (OFO II-205, 1510 original from Dantumadiel), which happens to be a context for a dative plural.

bodan 'messengers'
Most attestations to the plural of boda are written <bodden>. The three remaining tokens from original documents are: <boden> and <bodena> both gen. pl. and <boden> acc. pl., all from the late 15th century. No instance of *<boeden> has been found.57

The evidence of sone and knapa (with old attestations from Unio) points towards scenario I. The evidence for boga and nama could still fit there as well, while the evidence for boda remains ambiguous. All in all, the most likely scenario is number I: that the masculine plural ending -an indeed prohibited Open Syllable Lengthening.

Section summary:

• Both word-final /a/ (for example in Old Frisian dorg 'doors') and protected Old Frisian /a/ (for example in Old Frisian bitalad 'paid') generally prevented Open Syllable Lengthening;

• Exceptions are found in the south-western half of Fryslân, not before 1450 (while Open Syllable Lengthening before an Old Frisian /ə/ is from the early 14th century).

57 In originals only once <boeda> as a singular from Bodward located in the south-west.
2.3.3.3 <VVCC>-spelling

The tokens of *bitia* 'to pay' reveal a curious peculiarity in the spelling (cf. map 2.3). In 13 tokens the vowel digraph <ae> is followed by consonant digraph <ll>. A double vowel <VV> usually expresses a long vowel, while a double consonant <CC> marks the shortness of the preceding vowel (cf. § 2.2.3). The combination of both is a contradiction. The question is: What special sound pattern is represented by this spelling, if any? This can only be answered after a thorough analysis of the <VVCC> spelling, by identification of the historical and synchronic phonological contexts in which the spelling pattern appears.

From the combination of <VV> = ‘long’ + <CC> = ‘short’, the working hypothesis is formulated that the sequence <VVCC> reflects a half-long vowel. This is sufficient for the rest of this section, where the analysis of the contexts is the primary issue. Final conclusions are drawn in chapter four.

The corpus was checked for words with the spelling pattern <VVCCV>, for example, in *bitaellet* or *weesse*, Old Frisian *wees* 'to be'. The following combinations were filtered from the text: <a,e,i,o,u,y+e> + <dd|gg|ll|mm|nn|pp|rr|ss|sz|tt|zz>. Irrelevant tokens were removed from the selection, for example, *tyennende* Old Frisian *thianande* 'serving', which can be understood as /tiennande/, with a consonant /j/ + short vowel, marked by the following <nn>. Also, place names and proper names were removed, and only material from the original charters included.

There are four types of words with a <VVCC>-spelling pattern:

1. Words with /a/ or /o/ in open syllables, for example: Old Frisian *foa* 'before' <foerra>, Old Frisian *bitalad* 'paid' <bytaellet>;
2. Words with an historical long vowel, for example: Old Frisian *kaepad* 'bought' <kaappet>;
3. Words with a short /e/ in open syllables, for example: Old Frisian *leesa* 'to read' <leessa>;
4. Words with an historical short vowel in closed syllable, for example: Old Frisian *threda* 'third' <treedda>.

A total of 193 tokens from 56 lemmas were counted and statistically tested for typical patterns in a regional spread and phonological context.

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58 The spelling <ck> is a double consonant spelling from a modern point of view, but at that time it was not distinctive, and regularly appears following any long vowel or in word-final position.
In this selection, only actual instances of <VVCC> spelling are counted. In other sections, all relevant examples of a lemma are counted, for example, the verb *bitalia* ‘to pay’. In this case, only absolute numbers of <VVCC> tokens are known and not contrasting spelling variants. Therefore, a token count was not an option, because an absolute number of tokens is meaningless when the number of contrasting tokens is unknown.\(^{59}\) The alternative is a charter count: What percentage of the charters (from a given period/region) exhibit at least one instance of a <VVCC> spelling? Graph 1.9 illustrates that the consequences are very limited in practice. To obtain additional information, one high frequent relevant lemma per type was checked completely, enabling a token count. Before dealing with the individual types, two observations can be made for all types discussed:

**Vowel quality of the following syllable**

Significantly, <VVCC>-syllables are often followed by an Old Frisian /a/. For all the <VVCC>-tokens, the historical Old Frisian vowel of the following syllable was reconstructed. The percentage of historical /a/ or /ia/ - the reason to include /ia/ becomes clear from the discussion of type 1 - is compared with the percentage of /a/ and /ia/ in 150 tokens selected at random from the archaic Old Frisian texts of the *Older ‘Skeltenariucht’*. In the Old Frisian sample, /a/ or /ia/ appear in 45% of the tokens. Among the tokens in the <VVCC> sample, this percentage is 74%. The /a/ context is also significantly over-represented for each type individually.

**Dating**

The oldest example in the <VVCC> set is from 1418 and belongs to type 4. All the other examples are ≥1436. There is a weak progressive trend. See graph 2.3. Application of the same <VVCC> search in *Unio* retrieved only one relevant example, <treedde> ‘third’, in the early 15\(^{th}\) century north-eastern text ‘*Antentica Rienct’*. This word belongs to type 4, just as the oldest token from the charters. The <VVCC> phenomenon belongs to 15\(^{th}\) century Middle Frisian.

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\(^{59}\) For example: In table 2.11, there are more tokens with <aell> in the noun *hitalinga* (6) than in the infinitive and gerund (2). It is only when it is known that the ‘g’ are 6 out of 76, while the ‘z’ are 2 out of 11 instances, that the real importance of these absolute numbers becomes apparent.
Type 1: example <bitaellet>

Type 1 is relatively frequent with 61 tokens. Words in this group contain Old Frisian /a/ or /a/ as a root vowel, for example, fora 'before', buria 'declare an agreement', fola 'many' and bitalia 'to pay'. The root vowels /a/ and /a/ usually show Open Syllable Lengthening before the /a/ (§ 2.3.3.1). In the south-west this is also found to a limited extent before /a/ (§ 2.3.3.2). Type 1 shows, in its geographical distribution, a descending slope from south-west to north-east. For the South-West region, a relative over-representation is statistically significant.

The word bitalia and the noun bitalinge 'payment', derived from the verb, are typical examples of this type and are well represented in the charter corpus: 30% of the tokens of this type belong to these two lemmas. The sequence <ael(l)>, appearing in this verb and noun, have been studied in detail. Querying the entire charter corpus shows that the spelling of <ael> + vowel is an anomaly. Compare the following figures:
Table 2.11: Skewed distribution of the sequence <aell>.

Table 2.11 shows that the spelling sequence <aell> is not random. There is a clear preference for the verb bitalia and the derived noun bitalinge, but among them, there is a special preference for paradigm forms of the verb such as bitalath and bitalad. The table shows that the context before Old Frisian /a/ in the following unstressed syllable, is the ‘natural’ environment of the half-long vowel. Through levelling, it can appear in related forms.

**Type 2: <kaeppet>**

Type 2 is concerned with lemmas with a long vowel, such as Middle Frisian karpia ‘to buy’ and goena ‘gulden (valuta)’ < Old Frisian goldena. This type has no statistically significant geographical core at the level of the regions. In the charters from the city of Harlingen it is over-represented. The overall percentage for type 2 is 5%, for Harlingen it is 29%.

One of the most frequent lemmas in this group is the verb (for)kâpia ‘to buy / to sell’. This verb was investigated as a whole, enabling a proper comparison with other spelling variants and token counts. This revealed that not only forms such as <kaeppit> exist, but also <cappet>. The latter token combines a single vowel sign with a double consonant sign, a reliable marker of a short vowel: [kapç]. This is remarkable for a word with an Old Frisian /a/. The spelling with <pp> in the lemma (for)kâpia is over-represented in Wûnseradiel, which is next to Harlingen, a place already mentioned in this context.

Evidence of kâpia reveals a significant contrast between the east and the west of Fryslân. In the east, the spelling <aep> is dominant among the tokens with <pp>. The sequence <ae> was probably pronounced [æ:] in the late Middle-Ages.

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60 Including both originals and copies from the entire charter corpus.

61 Most of the contrasts in table 2.11 are statistically significant.
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It is therefore interesting to observe that Leeuwarden has an attestation to <keppet>, probably representing [kɛpɛt], a short variant of <kaeppit>. The tokens from the west of Fryslân have <c/kappet>: [kapɔt]. A complete shortening of an Old Frisian long vowel as in <kappet> is for example, also found in Old Frisian bîran ‘neighbour(hood) (plural)’. This word appears as <burren> in two charters from Wûnsieradiel. This suggests a complete shortening of Old Frisian long vowels in the west of Fryslân, especially Wûnsieradiel, in specific words.

There is a slight tendency to shorten Old Frisian long root vowels when followed by an unstressed /a/. In the west, especially in the region of Wûnsieradiel, this could lead to a complete shortening (for example, <kappet> and <burren>) while in the east, the vowel remained half-long (<kaeppit>) with only occasional shortening to [ɛ]. A short [a] is the product of shortening of [aː], while [ɛ] comes from [ɛː]. The realisation [ɛː] for Old Frisian /aː/ is more recent than [aː], so the shortening in the west is probably older than that of the north-east.

Type 3: <weessa>
Type 3 contains words with Old Frisian /ɛ/ in open syllables, for example, in wesa ‘to be’, lesa ‘to read’, but also in wenia/-ath ‘to live’. Discussion in § 2.3.3.1 indicated that vowel lengthening is rare in this context. It should be noted that this lengthening is not the same as in modern Modern Frisian: wêze, lêze or dialectal weinje. The latter instances of lengthening are from the 18th century (Hockstra 2001a, 724).

62 The form kœje [kɛpɛ] is mentioned as a variant of kaœje [kæpɛθ] in the north-eastern modern dialect of Schiermonnikoog.

63 This is not 100% certain. The transition from [aː] > [ɛː] could also have been earlier in the north-east than the south-west. There are three known phenomena which make this option possible:
1) In placenames, Old Frisian /gæst/, denoting a location with sandy soil, became Modern Frisian [gast] with [aː] < [ɛ] in the north and east of Fryslân, for example, Westroyaat. In the south-west, this element regularly appears as [gast]: Gaast, Tyerkgast.
2) An Old Frisian /aː/, that was lengthened in open syllable, often joins the development of Old Frisian /aː/ > Modern Frisian [aː] in the west and south, while it is kept separated from /aː/ in the rest of Fryslân. Coalescence of the vowels is more likely when Old Frisian /aː/ was still very close to [aː] at the moment of lengthening of /aː/. Forms like <deagen> with [aː], modern standard language <dagen> [dæɣɛn], and <tæl> with [ɛː], modern standard language <taal> [taːl], appear in writings from the early-Modern Frisian period from the south-western half of Fryslân.
3) The archaic dialect of Schiermonnikoog in the north-east regularly has an [aː] or [ɛ] < Old Frisian /aː/. The archaic dialect of Hindhopen in the south-west also regularly has an [aː] or [aː] < Old Frisian /aː/.
Of all four types, this one is most closely attached to the context of an Old Frisian /a/ in the following syllable (88% of the tokens). This is confirmed by the information on the verb *wesa* 'to be', a prototype example of this type. Twelve out of the 13 examples with a long vowel (four <VVC> and nine <VVCC>, including copies) are infinitives or gerund forms, Old Frisian *wesan*(*en*). There is only one past participle <weisen>, Old Frisian *wesen*; the six tokens from original charters with <VVCC> are infinitives and gerund forms only.

The combined evidence from the verb *wesa* and the <VVCC> sample set provides a rather solid indication that the product of this half-lengthening was [e], written <ae> in the south, but [e], written <ee> (sometimes [e], written <ei>) in the north.

The conclusion for type 3 is that lengthening of Old Frisian /ε/ in open syllables was taking place to some extent, with a clear preference for the phonological context of a following Old Frisian /a/. This is remarkable, because it is normally the context for unstressed /a/ which indicates Open Syllable Lengthening, while /a/ rather blocks the lengthening. The example of *wesa* shows that when lengthened, the spelling of <VVCC> is preferred to the spelling of <VVC>, underlining the special nature of this lengthening. The quality of the lengthened vowel was slightly more open in the south than in the north.

Type 4: <treeddə>

This type contains words with an historical short vowel before a geminate consonant. There are few tokens in this group. Statistically significant observations on geographical regions are not possible. The evidence from the most frequent lemma in this type, Old Frisian *thredda* 'third', does not provide a clearer picture. Considering the phonological pattern of short vowel plus long consonant in Old Frisian in these words, the expression of lengthening might be a demonstration of the compensatory lengthening for degeminated consonants (§ 2.2.3).
Section summary:

- The phenomenon of half-long vowels was little more than a weak tendency in the overall picture;
- The south-west has a preference for half-long vowels from Old Frisian /a/ and /o/ in open syllables, when followed by an Old Frisian /a/ (type 1);
- The north-east shows half-long vowels as the result of shortening Old Frisian long vowels before an unstressed Old Frisian /a/ (type 2);
- In all four types, there is an over-representation of the context before the Old Frisian unstressed /a/, for example, weis, thredda.
2.3.4 The reverse process: shortening before an /a/

A study of the process of Open Syllable Lengthening reveals the shortening of historical long vowels before /a/ in the following syllable in the <VVCC> type 2: <kaeppt>, <cappet> (Old Frisian kâpat h/kâpad). The material studied contains two more examples of shortening of an Old Frisian long sound before a following unstressed /a/, in the Old Frisian words fût ‘foot’ and mônandei ‘Monday’.

2.3.4.1 Old Frisian fôta

The first example is Old Frisian fût ‘foot’. The Old Frisian paradigm in Unia is:

<table>
<thead>
<tr>
<th></th>
<th>singular</th>
<th>plural</th>
</tr>
</thead>
<tbody>
<tr>
<td>nom.</td>
<td>foet</td>
<td>*foten / fet</td>
</tr>
<tr>
<td>gen.</td>
<td>-</td>
<td>fota</td>
</tr>
<tr>
<td>dat.</td>
<td>fote</td>
<td>fotum (-em)</td>
</tr>
<tr>
<td>acc.</td>
<td>foet</td>
<td>foten / *fet</td>
</tr>
</tbody>
</table>

Table 2.12: Paradigm of Old Frisian fût in the archaic parts of Unia (group A).

The archaic plural form <fet> (cf. Modern English feet) is found once, the form <foten> three times. The newer nom./acc. plural is not found with a full ending -an in Unia, but there are attestations to <fo(e)tan> in Jut. The genitive plural is relatively frequent because of its use as a partitive genitive, for example, thria and sextich fota bred ‘63 feet wide’. Additionally a derivated adjective with the suffix -ad (Munske 2001b, 643) is found in Unia, for example, fiowerfotad a scette ‘four-legged cattle’. In a reduced form, this suffix may appear in da Berfetha brewen (OFO I-222, 1472) and da Barfotte brewen ‘the barefoot(ed) brethren’ (OFO I-336, 1484), both from Leeuwarden. In the nom./acc. plural fôtan, the gen. pl. fôta and in the suffixed form fôtade, the root was followed by an unstressed /a/ in Old Frisian. In the 16 attestations to the three forms in original charters, a clear difference is apparent between the charters from the North-East and Leeuwarden regions and the charters from the other regions (map 2.5).

Unambiguous vowel length indication in <foten> is predominant in the west. Unambiguous spelling of a short vowel in <fo(t)e> is only found in the (north-)east. The form <foten> is also the form in the Bogerman proverbs, dialectally allocated to Dongeradeel at the beginning of the 16th century and in the
modern Schiermonnikoog dialect. Apparently, the Old Frisian long /o:/ could be shortened in the context before an unstressed /a/.

Modern Schiermonnikoog has singular - plural pairs such as (Visser & Dyk 2002):

\[\text{fúet} [\text{fy}o\text{t}] \sim \text{fotten} [\text{fo}t\text{o}n] \text{‘foot’} \sim \text{Middle Frisian /fo:xt/} \sim \text{/fot\text{o}n/}\]
\[\text{prim} [\text{pri}:\text{m}] \sim \text{primmen [prim\text{m}en] ‘needle’} \sim \text{Middle Frisian /pre:m/} \sim \text{/pre:m\text{en}/}\]
\[\text{bait} [\text{bait}] \sim \text{betten [bet\text{t}en] ‘boot’} \sim \text{Middle Frisian /bet\text{t}/} \sim \text{/bet\text{t}en/}\]

These modern dialectal forms provide further evidence for occasional shortening of originally long vowels before the plural ending -\text{an} in the north-east.

Map 2.5: Vowel length in the word \text{'fôt’ ‘foot’} in forms derived from Old Frisian \text{fôta/fôtan/fôtad}. The archaic plural \text{fôt} survived only in the north-east.

\[<\text{fott}>\text{ is also a modern form in the dialect of Terschelling, but there it is phonetically [fô\text{t}an], where the [o:] is pronounced while the tongue rapidly moves to the palatum (Versloot, 2002b). This form originates from an older /fy\text{t}an/ \sim /fu\text{t}an/, matching the development in Standard Modern Frisian \text{footen} \sim \text{fotten}. The transition of /\text{u:/} \sim /\text{w}/ is also a kind of shortening and dates back to the 18\text{th} century.\]

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2.3.4.2 Mônandei ‘Monday’

The word for ‘Monday’ is a compound of the words for ‘moon’ and ‘day’. ‘Moon’ is Old Frisian múna, a masculine n-root. It ends in -a in the entire singular. In the compound, the Proto-Germanic final -n of múna has been preserved: mônandei. There are no attestations to the noun múna ‘moon’ in Unia, but the word for ‘Monday’ is found: <monandei>. In the charters, ‘moon’ is possibly attested in the compound <moenstånd> ‘duration of one moon/month’ (OFO I-155). The word for ‘Monday’ frequently appears in the charters. A third word from this root is the word for ‘month’, Old Frisian mûnath. There are attestations to it both in Unia and in the charters. In the charters it also appears without a final dental sound as <mûn(n)a/-e>. The seven attestations in original charters between 1498 and 1537 do not present a clear picture of the temporal or geographical variations of this /t/ apocope. As late as 1537 (OFO IV-263, Leeuwarden), the form <mûnnet> is found. Even when the copies are included, no further light is shed on this question. In Modern Frisian, the words for ‘moon’ and ‘month’ have merged into one form: moanne [mwanə].

The development of the unstressed /a/ in both mônandei and mûnath is discussed in § 2.4.3.5. In this context, it is the quantity of the root vowel, indicated by the following <n> or <nn> which deserves attention. The following combinations are found in the charters:

<table>
<thead>
<tr>
<th></th>
<th>en</th>
<th>a</th>
<th>e</th>
</tr>
</thead>
<tbody>
<tr>
<td>mon</td>
<td>19</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>monn</td>
<td>11</td>
<td>5</td>
<td>5</td>
</tr>
</tbody>
</table>

Table 2.13: Spelling of the first element in the word ‘Monday’; mon + en represents <monendey>, monn + a is <munnadey>, etc.

In a copy of a charter from 1413 (OFO II-213) the form <monansdeis> is attested with <a> in the unstressed syllable. In the rest of the data, the historical /an/ is always rendered with <en>, suggesting a reduction from /an/ > /an/ in unstressed syllables already in the early 15th century (cf. § 2.4.3.2). The transition from <a> to <e> in mônadei, where it is not followed by a tautosyllabic consonant, can be dated at ± 1500. Therefore during the 15th century there were three

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65 There are also attestations to the forms man(n)endei and mën(n)endei in the charters. According to Århammar (1986) these forms are loans from Middle Dutch maanendach. They are rare in Leeuwarden and the North-East region. In the rest of Fryslân they make up about 50% of the attestations to ‘Monday’. The forms do not increase in respect to mônandei over time. The variant mûnandei is almost exclusively south-eastern and does not appear after 1490. Some two-thirds of the tokens in this group have a short vowel. The number of forms with a long vowel is gradually increasing, albeit a weak tendency. The total history of ‘Monday’ - including the developments in early-Modern Frisian - deserves closer analysis.
competing forms: /môndê/, /môndei/ and /mônde/. Contrasts in the distribution depicted in table 2.13 are statistically significant. When a final /a/ is retained, the root is mostly short. When followed by an <en>, the root is generally long. There are similar variations in the word ‘month’: <mone(d)>, <monna/-et>. Map 2.6 shows the geographical distribution of the vowel quantity. The combination of long vowel with suffix <en> is dominant in the west. The combination of short root vowel and suffix <a> is typical for the central region around Leeuwarden. In the north-east the form <monnen> is dominant. The charters from Leeuwarden exhibit a ‘western’ flavour. This is mainly due to the city clerk Hemma Odda zin. He is the author of 10 of the 14

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66 A remarkable aspect is that the graphematical and phonological patterns in the original charters are largely confirmed by the data from the copies, and yet the geographical pattern in map 2.6 is completely blurred when the copies are included.
A.P. Versloot: Mechanisms of Language Change

original charters from Leeuwarden with <monen->. 67

Just as in the word fôt, there is a strong correlation between the retention of unstressed /a/ and the shortening of the root vowel in 'Monday' and 'month': <a> and late-Middle Frisian <e> from Old Frisian /a/ nearly always take a short root: <monnadey>, <monnedey>. Both the historical data and the geographical pattern suggest that the form <monnadey> was an innovation, replacing the archaic allomorph mônan- by the regular form for 'moon': môna. The north-eastern instances of <monnendey> probably reflect a direct continuation from the Old Frisian form <monandei> as found in Unio: /mônan/ > /mônan/ > /môna/. The absence of shortening in the south-west suggests a development: /mônan/ > /mônan/. This matches the geographical picture for fôt. This implies that either the reduction of a protected unstressed /a/ > /ã/ was much earlier in the south-west than in the north-east or that the phonological impact of an historical unstressed /a/ was different in the two regions, (or perhaps a combination of both, cf. § 4.5.2).

Section summary:
- Old Frisian fôta(n) 'feet' and môna(n)dei 'Monday' show shortening of the root vowel in contexts before unstressed /a/ in the north-east.

67 Hemma Odda zin writes <monendey(s)> 34 times and <monnendey(s)> only twice, including copies by his hand; he never uses the spelling <monna(-e)dey>, which is quite common in the central region of Leeuwarden and surroundings. Other identified authors from Leeuwarden have a preference for <monna/-e> and <monnen>: Albertus Petri, minister in Lekkum, later in Wirdum writes <monnadeys> once, maester Otta, city clerk of Leeuwarden writes <monnedey(s)> three times and Marten Albert zoen, clerk of Leeuwarderadeel, writes <monnendeys> twice. Vries (1993, 190) suggests that the student 'Henricus Odonis de Bolzerardia', matriculated at the university of Leuven in 1471, was actually Hemma Odda zin. According to his spelling of the word 'Monday' Hemma's provenance from Bolward fits nicely.
2.3.5 Conclusion

The process of Open Syllable Lengthening appears to be a gradual one, both in phonological impact and in time:

- The oldest stage of Open Syllable Lengthening is the lengthening of /a/, /ø/ and probably /i/ and /u/, when the following unstressed syllable was not an /a/. This lengthening took place at the beginning of the 14th century or even earlier;

- Lengthening of /e/ was only a marginal feature at the time of the apocope of the final /a/, in the middle of the 15th century;

- Lengthening of /e/, /a/ and /ø/ in open syllables, when followed by unstressed /a/, remained limited to the south-west of Friesland and even there, not everywhere and not always. It took place in the 15th century. The product of lengthening before an unstressed /a/ was a half-long vowel, often spelled <VVCC>;

- In the north-east and Wûnseradiel/Harlingen there is occasional (half-)shortening of long vowels before unstressed /a/: kâpad: <kaeppit>, mòna- <monn->, fota <fotten>. 
2.4 Reduction of unstressed vowels

The reduction of Old Frisian unstressed vowels is at the core of this study. The mechanisms that control this reduction process are subject to deterministic modelling in chapter five. It is the remarkable behaviour of the unstressed Old Frisian /a/, especially its dominant presence in the phonological system even at a

Map 2.7: Size of the vowel inventory of unstressed syllables in modern Germanic languages.

The number ranges from only one (/a/) in many West Germanic languages, to five in Wallisian dialects (for North Germanic: Haugen 1984, 333; for Wallis: König 2001, 161; additions from few other dialect monographs). This map shows the situation at the level of the spoken dialects. The Faroese and Swedish standard languages have three different vowels (resp. <i ~ a ~ u>; <e ~ a ~ o>). Literary documents from Gotland use <i, e, a, å, o, u> in unstressed syllables. The New Norwegian standard allows for <i> and <o> in some cases, along with more widespread <e> and <a>. In the Upper Bavarian dialect of the XIII-communities (near Verona; Cappelletti & Schweizer 1942), /e/ and /u/ are the most frequently used sounds, /i/ and /o/ are more rare.
time when it was predominantly written <c> (≈ [ə]), that induced the formulation of the hypothesis about a tonal system in late mediaeval Frisian, which is covered in chapter four.

2.4.1 The Germanic context
The vowel inventory of the Proto-Germanic unstressed syllables included both long and short vowels, monophthongs and diphthongs. As a characteristic - apart from all kinds of individual changes throughout time - this was still valid for Gothic, Runic North Germanic and Old High German. Old Saxon had four different qualities in unstressed syllables, but no length opposition, just as early-Old English. Classical Old English and Old Nordic had only three short unstressed vowels. The reduction process has evolved into a situation with only /ə/ in many modern Germanic languages and dialects.\footnote{This assertion is limited to etymologically Germanic words, preferably monomorphematic ones, and does not hold for every unstressed affix in several languages, as in Modern Frisian hantsje 'little hand', meitsje 'to make', regionally pronounced as [hntsits] and [mitsis], Modern Dutch meitsje 'gift', occasionally pronounced as [maisis] or English daddy [dædi].}

Contrasting vowel qualities in unstressed syllables are found in the North Germanic languages and in Upper High German dialects. Note that most written forms of North Germanic standard languages and literary expressions of North Germanic dialects regularly use more different vowel qualities than spoken varieties. Diphthongs and quantity contrasts in unstressed syllables have disappeared from all modern varieties of the Germanic languages.

Wallisian dialects have the vowels /i, e\footnote{In Wipf (1910, 9), this sound is spelled <c>. To speakers of languages with a preference for /a/ in unstressed syllables, it may sound like a fronted 'schwa'. The sound is definitely more closed than, for example, the Frisian [e]. The phoneme /a/ does not exist in the aforementioned Wallisian dialect (idem, 11).}, a, o, u/ in unstressed syllables. They are the result of Old High German long vowels. Old High German short vowels have often been subjected to apocope or syncope (Wipf 1910, 47-61). Not every ‘unstressed’ position is the same in these dialects. In word-final position, the entire range of /i, e, a, o, u/ may be found, but when followed by a consonant, only /i, e, o, u/ appear. In several contexts, there are even more limited vowel sets: before a final /n/ there is only /u/ and /e/, before a final /r/, only /e/ (idem, 60). In originally trisyllabic words, Old High German’s unstressed penultimate vowels are mostly subject to syncope (idem, 47, 61ff.). A similar pattern of increasing vowel reduction from the final position inwards is observed in Riustringen Old Frisian (Boutkan 1996, 33). The size of the vowel inventory in unstressed syllables in
different positions in Wallisian German, matches the intensity stress (Wipf 1910, 19):

“Der stärkste Nebenton liegt in drei- und mehrsilbigen Wörtern meistens auf der letzten Silbe.”

In the analysis of unstressed vowels in late mediaeval Frisian it seems useful to distinguish between word-final and non-word-final positions.

Section summary:

• Reduction of Proto-Germanic unstressed vowels to /ə/ or even deletion (apocope, syncope) is a general tendency in all Germanic languages;

• The variants of Germanic with a relatively limited reduction are found at the geographical fringes;

• The level of reduction is gradually increasing from word-final position towards the word-interior.

78 “In three or more syllabic words, the most prominent secondary stress is positioned on the final syllable”.

-131-
2.4.2 The Frisian context

The exact phonological interpretation of unstressed vowels in Old Frisian is subject to differing opinions. These are discussed in more detail in § 3.1. In writing, vowels <i, e, a, u> appear frequently in Old Frisian. In the language of Riustringen the <o> also appears frequently.\(^1\) Anticipating the outcome of § 3.1, it is the author’s understanding that Old Frisian had three different vowels in unstressed syllables: /a~a~u/, with /u/ merely appearing in the dative plural ending -um. It is presumed that Riustringen Old Frisian had five different vowels, with complementary distributions of /i~u/ and /e~o/ (Versloot 2005, 271).

In Old East Frisian and also in the oldest parts of Unia, the historical /a/ is almost uniquely rendered with an <a>, for example, in the plural endings -an and -ar (Versloot, 2005 with further references; Sjölin 1970, 159-160).

All existing varieties of Modern Frisian have only an /a/ in unstressed syllables (with the same limitations as mentioned for all modern Germanic languages in the previous section). The North Frisian dialect of Föhr and Amrum has an /a/ and an /i/, the former being pronounced as [ø] or [ʌ] or even [ə]. The /i/ originates from the Old Frisian ending -ia in most cases. A similar phenomenon exists in some (former) southern mainland North Frisian dialects.

Modern Weser Frisian descendants of Riustringen Old Frisian (the now extinct dialects of Land Wursten and Wangerooge) had a more extended set of vowels in unstressed syllables. The dialect of Harlingerland represents a transition towards western East Frisian dialects. The dialect of Wangerooge retained the Old Frisian /i/ and /u/, while /a/ was reduced to /a/, but only following an Old Frisian short root. Otherwise every final vowel disappeared (example in table 2.14). The Vowel Harmony that saw the alternation of /i~e/ and /u~o/ in Riustringen Old Frisian left no such remnants in Wangeroogic (Versloot 2001a, 426).

The situation in the Land Wursten dialect was complicated by the accent shift. In words with a short root in Old Frisian, the stress shifted from the root towards the final syllable in the Wursten dialect (Hofmann 1961; Smith & Van Leyden 2007).

\(^1\) None were found in Unia, and in the charters no more than five types with <o> in unstressed syllables of non-compounded words (so apart from instances like <fridom> ‘freedom’ = fe+t+dom); OFO-IV,12 (1451, copy) <wirdom> ‘Wirdum (place name)’, with in the same sentence <wirdum>; OFO I-175 (1465) <munekom> dat. pl. of ‘monk’; the other examples are all from OFO II-76 (1473, old copy): <otherom> dat. pl. of ‘other’; <hinxtdijeron> dat. pl. of ‘horse’; four times <wetteron> dat. pl. of ‘water’. Note the reduction of the dative plural ending from -um to -om to -on. A parallel copy of the last charter writes <hynxedeyren> and <wettberen> in three of the four instances of <wetteron>.
Newly stressed vowels were not reduced but lengthened. For example, *Snuh* [snu:] 'son' < *sunu*. Original root vowels became unstressed and were reduced, as any other 'normal' unstressed vowel, first to /ə/, for example, *nesie* [nǝ'ɕi:] 'nose' < Old Frisian *nosi*. This schwa could either be dropped, if the syllable structure allowed for it as in *Snuh*, or the schwa was colored according to the new stressed vowel, for example, *mickie* [mik'ki:] 'to make' < /mɔ'ki:/ < Old Frisian *makia*. In words with long roots, all unstressed vowels were reduced to /ə/ and could be subject to apocope, for example, *Wursten dialect* øge'eye', øhr'ear' < Old Frisian øge, øre.72 In the dialect of Harlingerland, there are a few unclear indications of a remaining unstressed /i/, for example, *hovvy 'church' < Old Frisian *hovi 'churchyard' and makki 'to make' < Old Frisian *makia*.

In Insular North Frisian, all final vowels are regularly dropped. In Mainland North Frisian dialects and in West Frisian, it is predominantly the quality of the Old Frisian ending that determines the development. In Weser Frisian dialects, the root quantity is the controlling factor in the development of the unstressed syllables. The dialect of Harlingerland exhibits a mixture of both factors. Table 2.14 gives a somewhat idealistic picture of the developments:

<table>
<thead>
<tr>
<th>Old Frisian examples</th>
<th>long root -e:</th>
<th>long root -a:</th>
<th>short root -e, Riistr.: i/-a,</th>
<th>short root -a:</th>
</tr>
</thead>
<tbody>
<tr>
<td>bâne 'bean', âre 'ear'</td>
<td>rooge 'oat', knekke 'neck'</td>
<td>müal, sâan meal, soon</td>
<td>hae 'hare'</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mainland North Frisian/West Frisian - 20th c.</th>
<th>ø</th>
<th>ø</th>
<th>ø</th>
<th>ø</th>
</tr>
</thead>
<tbody>
<tr>
<td>buun, nur bean, ear</td>
<td>e</td>
<td>rooge, nekke</td>
<td>müal, sâan</td>
<td>hae 'hare'</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Harlingerland - 17th c.</th>
<th>ø</th>
<th>ø</th>
<th>ø</th>
<th>ø</th>
</tr>
</thead>
<tbody>
<tr>
<td>bohne, abr ør</td>
<td>e</td>
<td>rooge, nekk</td>
<td>mill, zahn</td>
<td>hae 'hare'</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Wangeroogeic - 19th c.</th>
<th>ø</th>
<th>ø</th>
<th>ø</th>
<th>ø</th>
</tr>
</thead>
<tbody>
<tr>
<td>boon, oor raag, nekk</td>
<td>i /-u</td>
<td>milli, sunnu</td>
<td>hae 'hare'</td>
<td></td>
</tr>
</tbody>
</table>

Table 2.14: Vowel reduction and root structure in the modern Frisian varieties. Examples for North Frisian dialects from the Halligen dialect.

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72 In 16th century Wangeroogeic, apocope of word-final /ə/ after long roots had become the rule (Versloot 2001a, 426). Analysing the East Frisian dialects of the Harlingerland, Wangerooge and Land Wursten suggests that the apocope was on its way in the 17th and early 18th century. This is contemporaneous with the apocope of final /ə/ in the adjacent Low Saxon dialects; the earliest recordings of apocope in Low Saxon are from the second half of the 16th century (König 2001, 159).
The development in West Frisian has been subject to more detailed investigation. Therefore, the Fryske Akademy language database, accessible at www.fa.knaw.nl/tdb and the FAND-database (1980/95) were used. There appears to be a set of factors that contribute to the retention or apocope of final vowels. Typical examples are given.

1) Old Frisian vowel quality was complicated by the flexion of words. Strong feminine and a few masculine words ended in -e in the entire singular. For example, seke l. ‘case’ and breke m. ‘break’. Apocope is expected there. Weak masculine nouns ended in -a in the entire singular, for example, nama ‘name’. These words are expected to show a final -e in Modern Frisian. Weak feminine nouns ended in -e in the nominative and accusative singular, but in -a in the genitive and dative, for example, strêta / strêta ‘street’. The word strête appears 41 times in the charters, all of these in the context of locations (in der strêto, etc.). Because the oblique form strêta was far more frequent, the oblique form formed the input for the modern form when the case system was abandoned in the late 15th century: Middle Frisian strêta developed into Modern Frisian: strjette with final /a/.

A statistically significantly high proportion of Old Frisian weak masculine nouns retains the final vowel Old Frisian -a as /a/ in Modern Frisian: Middle Frisian nama > Modern Frisian namme. For Old Frisian strong feminine nouns, the trend towards apocope is statistically significant, for example, Middle Frisian dêde ‘deed’ > Modern Frisian died. But weak feminine nouns with a mixed pattern, reflecting the mixed Old Frisian paradigm, with alternating -e and -a, do not differ significantly from the average figures. For example, Middle Frisian bregge, oblique cases bregge > Modern Frisian both brêge and brich (dialectal form).

2) § 2.1 states that vowel quantity in the modern form of words contributes to the word structure. A final -e is statistically significantly favoured by a short root vowel. After a long root vowel there is a preference not to have the final -e. This implies that words such as ploeg [pla:ɡ] ‘plough’ or boste [bu.ɔt] ‘penalty’ with a long root vowel [u] / [u.'] and final -e appear 40% less frequently than might be expected if the distribution of the final -e was random. Words like protte [prɔt] ‘a lot’ and wolte [volt] ‘wool’ have a short root vowel [o] and final -e. They are favoured by Vowel Balance.
These type of words tend to have a final -e almost twice as often as could be expected from a random distribution of the final -e.

3) The quality of the final consonant also has some influence. Words with a root ending in /b/, /d/ or /g/ in Old and Middle Frisian have a tendency to keep the final vowel, apparently to avoid word-final voiced consonants. Words that end with -be, such as ebbe ‘low tide’, appear three times more often, while words that end with -de, such as terde ‘earth’, appear 1.5 times more often than would be expected from a random distribution of the final -e.

4) The dialects show a general north-south trend in the level of apocope, irrespective of the former quality of the vowel. In Old Frisian, apocope is more intensive in the north (map 2.8, left). For example, in Schiermonnikoog and Terschelling there is wyk ‘week’ and blom ‘flower’. In mainland dialects there is wike, bloem, Hindeloopen in the south(-west) has wyke, bloem < Old Frisian wike, blêma.

5) The dialects behave differently in relation to the historical quality of the vowel. A diverging development of the Old Frisian final -e and -a is quite significant in the north and north-west, but less so in the south, and is practically absent in a region in the east (map 2.8, right). In Rottevalle (a village in that specific region) there is the example of buke ‘beech’ and duaze ‘box’, while other mainland dialects refer to bûk and duaze < Old Frisian bûke and duasse.

To summarise, the following phonological factors have been identified:

- Old Frisian vowel quality: /a/ or /a/;
- Modern Frisian root syllable quantity;
- Voice feature of the root final consonant.

74 This is an interesting case, because at the time that apocope was at stake, Frisian still had a final voiced /b/, /d/ or /g/. However, the apocope was apparently blocked when the result would be a new word with a final voiced consonant. This relationship can not easily be established for the phonemes /s/ ~ /s/ and /f/ ~ /v/, because Old Frisian only had /s/ and /f/. The sounds [z] and [v] were allophonic realisations in an intervocalic position. The word ending /z/ and /v/ did not exist in Old Frisian.
These interfered with the following pragmatic factors:

- Frequency-based preference for context-dependent word-final -a or -e in Middle Frisian;
- Dialectal variation in the sensitivity towards the aforementioned phonological factors.

All these factors have been interacting with each other from the very beginning of the reduction process. The factors are not entirely independent of each other. There is an historical relationship between the length of the syllables in the modern language and the syllable structure of the Old Frisian words, but the correspondence is not one-to-one. The distribution of the different syllable types over the morphological classes of inflection were not random in Old Frisian. Inflectional groups had morphologically defined case endings (for example, either -a, -e or ø in the nominative singular). There were also dominant syllable structures for class and gender, etc. The interactions did not take place at only one moment in time, but constitute an ongoing process, as can be seen from the correlation between modern syllable structure and the presence of a final vowel. An interesting topic for future research would be determining the exact weighting proportion of all these factors in a diachronic perspective.
Most of the aforementioned factors are dealt with in § 2.4.3, chapter 3 and chapter 4, in the context of Old and Middle Frisian.

Section summary:

• Compared with many other Germanic languages, the reduction of unstressed syllables shows many different facets and many different routings in Frisian;

• Vowel Reduction shows high dialectal variation;

• Vowel Reduction depends on phonological criteria, there are: quality of the unstressed vowel itself, quantity of the preceding root syllable, voice features of neighbouring consonants.
2.4.3. The West Frisian charters

This section deals with the reduction of vowels in unstressed syllables in West Frisian between 1300 and 1550. It covers the transition from Old Frisian (a language form with both /a/ and /ɔ/ in unstressed syllables) to early-Modern Frisian, a language characterised by an /ɔ/ as the default vowel in unstressed syllables as well as frequent apocope and syncope of historical unstressed vowels. The developments are traced from the spelling in the charters and from the codex Unia.

Previous sections show how Vowel Balance and the position of the unstressed syllable in the word affected the development of unstressed vowels. As a result, examples are categorised according to those with a word-final or non-word-final position and the quantity of the root syllable. This produces the following combinations:

<table>
<thead>
<tr>
<th>Old Frisian /a/</th>
<th>protected</th>
<th>word-final</th>
</tr>
</thead>
<tbody>
<tr>
<td>short root syllable</td>
<td>§ 2.4.3.1</td>
<td>§ 2.4.3.4</td>
</tr>
<tr>
<td>long root syllable</td>
<td>§ 2.4.3.2</td>
<td>§ 2.4.3.5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Old Frisian /ɔ/</th>
<th>protected</th>
<th>word-final</th>
</tr>
</thead>
<tbody>
<tr>
<td>short root syllable</td>
<td>§ 2.4.3.7</td>
<td>§ 2.4.3.8</td>
</tr>
<tr>
<td>long root syllable</td>
<td>§ 2.4.3.7</td>
<td>§ 2.4.3.9</td>
</tr>
</tbody>
</table>

Each sub-section begins with a preview of the evidence from Unia, combined with data from the early 14th century charter, OFO I. This is followed by detailed information from the charters, where the developments can be traced over time frames of ± 30 years. This section is basically descriptive. The phonological interpretation and implications of the observed patterns are dealt with in chapter three.

2.4.3.1 Old Frisian /a/ following a short root, followed by a consonant

The Old Frisian /a/ in an unstressed position, followed by a consonant is almost entirely restricted to inflectional morphemes, such as -ath, -ad and -an(e). Words like mónandeit ‘Monday’, mónath ‘month’, sunnandeit ‘Sunday’ and abbat ‘abbot’ (all with a long root, cf. § 2.4.3.2) are typologically exceptional in Old Frisian.

According to the syllable structure, a difference could be expected between a non-word-final unstressed /a/ in open syllables, (for example, in bitalane ‘to pay
As syllable boundaries are non-existent in phonetic measurements, this is a logical conclusion, assuming that phonology relies on phonetics (and not the other way round).

Historically the ending of the past participle is with a /d/. Final devoicing was not common in Frisian until the 19th and 20th centuries. However, the ending of the past participle of verbs such as *bilitia*, *kâpia* bitalad and *kâpad* exhibit a <t> or <th> in some 90% of the tokens. The Old Frisian ‘standard’ form is spelled with a -d, but in citations, a <t> prevails. The dental element has disappeared from the paradigm in Modern Frisian, except for Terschelling, where it is written as <t>. It is presumed that the final devoicing took place in Middle Frisian when the /d/ followed an unstressed syllable. At the end of stressed syllables, as in *goed* ‘good’ or *burd* ‘beard’ the /d/ remained voiced until the 19th century.

The evidence from *Unia* and OFO I-I
In positions where historically an /a/ is expected in unstressed syllables following a short root, tokens from *Unia* group A-1 (Older ‘Skeltenariicht’), A-2 (early 14th century) and A-3 (early 15th century) show only an <a>, for example, <makade> ‘made’ (past tense sg.) in A-1 or <bitalad> ‘paid’ (past part.) in A-3 (18 examples). Also, in OFO I-1 (1329), there is only an <a>: <stadan> ‘places’, <barad> ‘declare an agreement’ (past tense, 3rd pers. pl.) (11 examples). Therefore, in 14th century West Frisian, /a/ was intact in this position.

Old Frisian ‘biltath’, ‘biltad’ and ‘biltiane’
The verb *biltia* ‘to pay’ is found frequently in the corpus and is therefore suitable for tracing its development. The following forms are relevant in this context:

- Gerund form *biltiane*;
- 3rd person singular and the entire plural of the present tense: *biltalath*;
- Past tense singular and plural *bitalade(n)*;
- Past participle: *bitalad*.

---

75 As syllable boundaries are non-existent in phonetic measurements, this is a logical conclusion, assuming that phonology relies on phonetics (and not the other way round).

76 Historically the ending of the past participle is with a /d/. Final devoicing was not common in Frisian until the 19th and 20th centuries. However, the ending of the past participle of verbs such as *biltia*, *kâpia* *biltalad* and *kâpad* exhibit a <t> or <th> in some 90% of the tokens. The Old Frisian ‘standard’ form is spelled with a -d, but in citations, a <t> prevails. The dental element has disappeared from the paradigm in Modern Frisian, except for Terschelling, where it is written as <t>. It is presumed that the final devoicing took place in Middle Frisian when the /d/ followed an unstressed syllable. At the end of stressed syllables, as in *goed* ‘good’ or *burd* ‘beard’ the /d/ remained voiced until the 19th century.
The bulk of the attestations are past participles. The data from *bitalad* (etc.) shows a clear shift through time (graph 2.4). Before 1430, the <a> is dominant, but after 1460 the <a> becomes very rare. The oldest spelling with an <i> is from 1449: *<bytellit>*. About 30% of the of tokens have an ending written with an <i>. In the tokens from *Leeuwarden*, this figure is 60%, so the spelling with an <i> is over-represented. In texts with identified authors, two-thirds of the tokens with an <i> are from the hand of Hemma Odda zin. His share of the Frisian charters at the end of the 15th century explains the large proportion of <i>s in the time frame 1490-1510. This is an example of the token count validity being distorted by skewed attestations (cf. § 1.3.7.10).

The oldest attestation to a gerund, OFO I-2 (1386), shows the full form *<bytaliane>*. The full ending <-ian> is found once more in 1439, but after that only <-ian> and <-ien> appear.

The quantitative trend in graph 2.4 also has a geographical component. The <a> does not disappear from the spelling at the same time everywhere. Between 1406 and 1470, 33% of the tokens contain the letter <a>. In seven municipalities, this figure is less than 15% while in four it is more than 50%. Almost all the 'lows' are in the south, while the 'highs' are concentrated in the north (map. 2.9).

Graph 2.4: The rendering of Old Frisian /a/ in *bitalad/bitalath/bitaliane*. 
The more archaic Old East Frisian dialects have -ar or -a. The form -an is an innovation in the west that was already used in Unia, so before about 1300, cf. Versloot (2004, 294 ff., 301).

**Plurals of masculine nouns in -an**

The Old West Frisian plural form for masculine nouns is -an. In the modern language, the ending is -an [an]. Nowadays it is often [n], where syllabification can take place. While the development of /a/ in verbal endings is different for words with a long or a short root (cf. 2.4.3.2 and 2.5.2), there seems to be no difference in the distribution of <an> and <en> in terms of root quantity. The few instances of plurals in <an> in the charters are often words with a long root. For example, with a long root <dadan> 'dead ones', <deylan> 'parts' and <sibban> 'relatives' and with a short root <stadan> 'cities/locations' and <wegghan> 'ways'. This matches the fact that long-rooted nouns are more frequent in the language as a whole. The development of the plural ending -an is discussed in § 2.4.3.2.

---

Map 2.9: Geographical variations in the reduction of protected /a/, following a short root. See § 1.3.7.4 for further explanation on the construction of this map.
A phonologically similar variation of -ath-~a appears in habbath ‘(we/you/they) have’: wi habbath versus habba wi (cf. Hoekstra, 2001c).
The different timings in the reduction of the unstressed /a/ in these three phonological contexts is shown in graph 2.5. In a protected position, the /a/ has become an <e> since the oldest attestation in an original charter: <monnendey>, OFO II-35 (1453). This matches the developments in the protected positions, discussed earlier in this section. Both the word and morpheme final /a/ were retained until the late 15th century. In the late 15th century, a small difference in timing emerges. The oldest attestation to an <e> in morpheme final position is in the original charter from 1497: <monnedey> (OFO I-428). The first instance of <monne> is from 1527 (OFO II-334). So, a morpheme final vowel in what probably was a transparent compound, behaved almost like a word-final vowel.

Instances of a syllable final, but not morpheme final /a/ are rare, for example, <monaden> /mɔː-nɑː-dɔn/ ‘months’ (OFO II-161 from 1488, copy) and <moneden> /mɔː-nɑː-dɔn/ ‘months’ (OFO III-27 from 1498. Similar examples of abbate are missing (§ 2.4.3.2); the verb bitalia provides only two examples: <bi/etelleden> /ba-tɛlɛ-dɔn/ in original charters from 1472 and 1489. These scarce examples suggest that the reduction of the syllable final, but morpheme internal /a/ keeps pace with the reduction of the protected /a/.

2.4.3.2 Old Frisian /a/ following a long root, followed by a consonant
For words with a long root, the frequently-used verb habba /hab-ba/ ‘to have’ serves as the first example, with the Old Frisian /a/ in a protected position in the plural form of the present tense, habbath, and the gerund habbane. The nominative and accusative plural ending of the masculine nouns -an deserves separate treatment. The protected /a/ appears in two more examples. In the word sonnadei ‘Sunday’ the /a/ is followed by a tautosyllabic consonant. In the word abbate ‘abbot’ the /a/ is word-interior but syllable final in Old Frisian, but not in Middle Frisian <abbet>.

Habbath /habbane:
The verb habbath appears as <habba> in inverted forms in the 1st and 2nd person plural indicative present tense. For example, habba wi ‘... have we ...’ (OFO I-4, 1390). This inversion is discussed in Hoekstra (2001c). The form <habba> is dealt with in § 2.4.3.5. This section looks at the alternation of <a>~<e>~<i> in instances where the <t(h)> was retained.

79 The overall contrast between the positions (word final / morpheme final / protected) is statistically significant. For several sub-contrasts, Fisher’s Exact Test was used, because of the low numbers, returning p-values of 10.7% and 6.7% (details of the tests are included in the appendix 1).
The evidence from Unia and OFO I-1

The word forms are spelled with <a> in ± 80% of the tokens in all the Unia subgroups A-1, A-2, A-3 (41 examples) and in OFO I-1 (9 examples). The Unia groups B and C return a statistically significant lower score.

The charters

In the above mentioned paradigm forms of the long-rooted verb habba, the spelling <a> disappears earlier than in bitalia. After 1430, spelling with an <a> is incidental. For bitalia, this is after 1470. The first spelling with an <i> appears in 1423 (OFO IV-8): <habbith>. The authors from Leeuwarden are again well represented, but remarkably Herman Odda zin prefers -et and uses -it in only 4% of the tokens. In the gerund, there is <hebbyn> once (OFO II-256, 1511). The number of tokens with an <a> is too small to show any significant geographical distribution. Combined evidence from Unia and the charters implies that a protected /a/ following a long root may have appeared as an [a] since the early 14th century. The proportion [o] : [a] was about 1 : 4. This situation remained stable during the 14th century. Between 1380 and 1430, the vowel became predominately an [a].

Graph 2.6: The rendering of the Old Frisian /a/ in habbath/ habbane.
Masculine plural in -an.
Because neither Unia nor the charter corpus are yet fully lemmatised, it is not easy to get a full picture of the changes with respect to the plural endings of masculine nouns. There are several complicating factors:

- The transition takes place before 1440, when the number of charters are limited. The development cannot be traced by looking for one or two frequent lemmas;
- The plural ending -an is not in the expected archaic form for all masculine words, especially in some highly-frequent words, such as lud ‘people’, fit ‘feet’ or man ‘men’;
- The ending <en> can be the result of a reduction in both the dative plural ending -um (> -em > -en) and the masculine plural nominative/accusative (-an). Several instances of -en in the oldest charters are dative plural forms;
- Also, from the early 15th century, feminine nouns may already end in -en, albeit occasionally.

To overcome these problems, three search strategies were applied:

- A search query on “tha/da(e)/twen(e)/t(h)ria ...-an/-en/-in”, to find plural forms preceded by the plural article tha/da(e) or the numerals 'two' and 'three'. The result of this search of the charters reveals 911 tokens in original charters, 21 of which prior to 1440. From Unia, 76 examples were found. In these selections the dative plural forms have been excluded in the charters up till 1440.
- Scanning the charters for words ending in <an> and selecting the real plural forms from that set results in 27 tokens in original charters, including 16 from the period up to 1440.

The queries result in four data sets, two from Unia and two from the charters. The sets are labelled in graph 2.7:

- **U-tha-an** = result set from the query “tha/da(e)/twen(e)/t(h)ria ...-an/-en/-in” on Unia
- **U-4 words** = result set from the query on the plurals of dei, del, ëth and riechter
- **Ch-tha-an** = result set from the query “tha/da(e)/twen(e)/t(h)ria ...-an/-en/-in” on the charters
- **Ch-an-tokens** = the identified plurals in <an> in the charters, counted with charter count (§ 1.3.7.10)
The following chronological correspondences were applied:

\[
\begin{align*}
&\text{Unia group A-1 } \pm 1300 \\
&\text{Unia group A-2 } \pm 1350 \\
&\text{Unia group A-3 } \pm 1405 \\
&\text{Unia group B } \pm 1420 \\
&\text{Unia group C } \pm 1440 \\
&\text{Charters } 1379 - 1400 \quad \pm 1385 \\
&\text{Charters } 1400 - 1440 \quad \pm 1420 \\
&\text{Charters } 1440 - 1460 \quad \pm 1450 \\
&\text{Charters } 1460 - 1490 \quad \pm 1475
\end{align*}
\]

Graph 2.7: The decline of <an> as an ending in masculine plural nouns.
Probably as a consequence of heterogeneous data sets and a lack of completeness, the resulting graph exhibits some deviation. However, despite a large deviation of data from Unia group B and C, the general trend is clear and undisputable.\textsuperscript{80}

Similar to the long-rooted verb habba, the level of spelling with an \(<a>\) in -an is not 100\% in the very early years of the 14\textsuperscript{th} century. This differs from the Old Frisian /a/ following a short root, as in bitalad, which is always written with an \(<a>\) in the examples studied from Unia and the oldest charters. OFO I-1 (1329) has two attestations to masculine plurals: <stadan> 'places' and <dadan> 'the dead ones', both spelled with an \(<a>\). The transition from <an> to <en> started in the second half of the 14\textsuperscript{th} century, and ended around 1450.

In Unia group A, there is a significant Vowel Balance effect, so a stronger reduction of -an to <en> after long roots is prevalent. This effect is not observed in the charters, nor in Unia group B and C (15\textsuperscript{th} century). The charters do not show any significant geographical distribution of this feature.

\textit{Old Frisian} sunnandei \textit{Sunday}\textsuperscript{81}

The word for 'Sunday' poses a very interesting case. The oldest form as found in Old East Frisian is sunnandei, a compound of sunne 'sun' and dei 'day'. The lemma sunne appears in the allomorphic shape sunnan-, preserving the Proto-Germanic final -\(\text{n}\) (as in mënaänderi, \S 2.3.4.2). In Unia, the archaic form of the word is found only without geminate <\textit{nn}>: <sunandeis> (2x) from group A-2 (early and mid-14\textsuperscript{th} century) and <sonandeis> (group C, 15\textsuperscript{th} century). In Jus, there are four attestations to the word 'Sunday', two <sonandeis(j)\textit{s}> with a <\textit{nn}>, and two <sonandeis>, with just one <\textit{n}>. The base lemma 'sun' is always written with <\textit{nn}>, both in Unia (12 examples) and in Jus (19 examples). The relevance of the spelling with one or two <\textit{n}> is discussed later in this section. The more modern form <\textit{snande}> is found in the Unia group A-3 from the very early 15\textsuperscript{th} century.

\textsuperscript{80} Statistically the high values for U-tha-an and Ch-tha-an for ‘1420’ do not differ significantly from the computed average. The original texts in Unia group B and C are older. The texts were linguistically reshaped in the early 15\textsuperscript{th} century (\S 1.3.8). The ending -\textit{an} was still an option in the early 15\textsuperscript{th} century. The outcome of \S 1.3.6 was that archaic, but still current features were more likely to persist in the copy than the completely outdated features. Therefore the (excessively) high level of the <an> spelling for the masculine plural could fit this picture. The reason for the difference with graph 2.1, where the figures for group C are not (excessively) high, might be that maintaining the spelling of <an> did not cause any distortion in the spelling or the grammar. Maintaining the archaic spelling such as <makad> instead of <mackad> could lead to misreading [makad] instead of [makad].

\textsuperscript{81} Basically the same reconstruction, albeit with fewer details, is found in Miedema (1971, 41).
The language material from the charters comprises of six types. Including 15 tokens from copies, there are 51 tokens, which is quite good. However, due to high temporal and geographical variations, not all details can be covered completely:

sonnandei There is an archaic form of the word <sonnandeys> (OFO I, 11) from 1405, an original charter located in Franekeradeel. In a charter from 1412 (OFO II-9, copy from Leeuwarden), the form <sonen-dei> is found.

sennendei The word ‘sun’ was subject to a spontaneous fronting: sunne > senna (Hoekstra 2007, 44). This process had already started in the oldest sections of Unia. In the Older ‘Skeltenaricht’ there were four examples of <sunna/e>, one of <senna> and one <sinnne>.

82 The replacement of sun- in the first element of ‘Sunday’ followed the simplex with some delay. Both Unia and Jus have as the simplex both sunne/sonne and sennne/sinne but only son-/sun- as the first element in ‘Sunday’.

83 In the charters, the form <sennendeijs> is found once in a charter from 1466 (OFO II-66, a copy made in 1582). The charter deals with market rights in the village of Joure. Although located in the South-East region, this village is actually on the border of the South-Eastern and South-Western regions. It is therefore no surprise to find descendants of sennendei in (early-)Modern Frisian dialects in the far south-west: Hindeloopen: sennedeijs/ sendei (1679), sende (modern)

Graph 2.8: The alternation of <sculta> and <scelta> in the three oldest sub-sections of Unia.

82 Steller (1926, 10) discusses the variation in the name of the ‘sheriff’, appearing both as <scelta> and <sculta> in the text of the Older ‘Skeltenaricht’. Steller assumes that the form <sculta> is a loanword, cf. Dutch schout < scholte, cf. the patronymicum Scholten from the Low Saxon speaking regions of the Netherlands. Steller therefore generally replaces <sculta> with <skelta> in his edition. The chronological rendering of facts clearly shows a different story: <scelta> is the older form, <sculta> the more recent one, matching the <sunne> ~ <sinnne> pattern.

83 In Standard Modern Frisian, ‘sun’ is sinnne, but in the south-west, including the dialect of Hindeloopen, the form sinnne is used. The data allow for an interpretation of sinnne > sennne in Fryslân before 1450, and sennne > sinnne in the south-west in the second half of the 15th century (cf. § 2.6.3, map 2.15). This reconstruction remains tentative, due to a limited amount of information.
The sequence /nVn/ is very rare in Frisian, especially with a short vowel. In Modern West Frisian only *knyn [knin] ‘rabbit’ was found, which is a loanword.
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- *snande* is attested between 1406-1463 and is prominent in the north-east;
- *snainde* is attested between 1450-1488 and is prominent in central Fryslân;
- *snein* is attested between 1459-1532 and is prominent in the west and south.

If *snein* developed directly from *snendei*, then its base form may have been *sonandei*, with a reduced vowel [a]. This would separate the accent shift from the realisation of the unstressed vowel as [a].

If *snein* developed from *snainde* < *snande* < *sonandei*, there would be a direct link between the unstressed [a] in *sonandei* and the accent shift. To gain more insight, the data is split both into time frames and regions:

<table>
<thead>
<tr>
<th>region</th>
<th>-1420</th>
<th>1420-1470</th>
<th>1470-</th>
</tr>
</thead>
<tbody>
<tr>
<td>NE</td>
<td>snande</td>
<td>snande</td>
<td>snein</td>
</tr>
<tr>
<td>MM</td>
<td>sonnandei</td>
<td>snande</td>
<td>snein</td>
</tr>
<tr>
<td>NW</td>
<td>sonnandei</td>
<td>snande</td>
<td>snein</td>
</tr>
<tr>
<td>SE</td>
<td>-</td>
<td>snainde</td>
<td>snein</td>
</tr>
<tr>
<td>MW</td>
<td>-</td>
<td>sneinde</td>
<td>snein</td>
</tr>
<tr>
<td>SW</td>
<td>-</td>
<td>sennendei</td>
<td>snein</td>
</tr>
</tbody>
</table>

Table 2.15: The geographical and temporal spread of the forms of ‘Sunday’.

Plain text = one attestation or two from the same charter. Underlined = more than 2 attestations. Both originals and copies are used. The copies confirm the picture from the originals and provide additional data for three cells in the table.

---

55 The transition from [ˈsonan̩] > [se'næː] is not excluded; there is at least one example of the transition of /o/ to a fronted mid-high vowel in Modern Frisian /ɛː/: *gruwelich* [grauˈveːlæx] ‘terrible’ < */ˈgruwelɪx/ (cf. Modern Dutch *gruwelijk*).
Table 2.15 suggests the following sequence of events:

\[
\begin{align*}
\text{sonnendei} & \quad \rightarrow \quad \text{sennendei} & \quad \rightarrow & \quad \text{modern (Hindeloopen) sende} \\
\text{sonnande} & \quad \rightarrow \quad \text{snande} & \quad \rightarrow & \quad \text{snainde} \quad \rightarrow \quad \text{modern standard language sain} \\
& & & \quad \rightarrow \quad \text{snau} \quad \text{(charter Dongeradeel; modern Schiermonnikoog dialect)}
\end{align*}
\]

The combination of a single attestation (in a copy) of \(<\text{sennendeijs}>\) from the village of \textit{Joure} and post-medieval information from the archaic south-western dialects of \textit{Hindeloopen} and \textit{Molkwerum}, suggest that accent shift was absent in the South-West region and some parts of the adjacent Mid-West and South-East regions. Later appearances of the word \textit{snein} in the south-west are a result of dialectal borrowing/spread since the late-15th century.

Table 2.15 suggests that accent shift always went from \textit{sonandei} to \textit{snande(i)}. For the South-East and Mid-West regions, this is neither confirmed nor contested. The years of attestation to the variations of 'Sunday' suggest that the accent shift took place in the late 14th century. Taking only original charters, there is one attestation to an archaic form, \(<\text{sonnandeys}>\) from 1405. The oldest token with an accent shift in an original charter is from 1406: \(<\text{snandis}>\). Including the copies, 1412 is the last attestation to an archaic form and 1390 the first appearance of the form with the accent shift, \(<\text{snande}>\). The same form with the accent shift is also found in \textit{Unia} group A-3 from the early 15th century. This implies that the accent shift took place between ± 1380 and 1420.

The given spelling of the word for 'Sunday' with only one \(<\text{n}>\) in \textit{Unia} and \textit{Jus} could mark the first stage of the accent shift. Geminate consonants only appeared in the rhyme of stressed syllables in Old Frisian. When the accent shifted towards the second syllable, the realisation of the geminated [n:] became obsolete, a fact reflected in the spelling.

The modern dialectal form \textit{snôn} from Terschelling is a direct descendant of \textit{snande}, cf. Terschelling \textit{lon} 'land' \_<\text{Old Frisian} \textit{land}. In the far north-east, a velar glide was inserted: \textit{snande > snau}, as found in \textit{Dongeradeel} (1504) (not rendered in table 2.15) and in the modern Schiermonnikoog dialect, cf. modern Schiermonnikoog dialect \textit{laun} 'land' \_<\text{Old Frisian} \textit{land}.

In the rest of Friesland, \textit{snande} developed a palatal glide: \textit{snande > snainde}. The phonetically normal case is that a velar vowel triggers the insertion of a velar glide, whereas front vowels trigger the insertion of a palatal glide. The intermediate vowel /a/ can go with both glides, depending on the phonetic details of its
realisation. A realisation towards [æ] results in *snainde*, while a rather backward [ʊ], produces *snaun*.

The vowel [ai] later developed into [ei]. In every region where both *snainde* and *snein* are found, the former is always the older one (albeit only by four years in the Mid-West region). The transition from [ai] to [ei] is confirmed by the word *ein(dom) ‘own(ership).* 67 The new *snein* replaced the local form *sennedei* in the south-west, while in the north-east, *snein* replaced the retained *snaand* or the newer *snaun*, all after 1470.

<table>
<thead>
<tr>
<th>dialect</th>
<th>accent shift</th>
<th>second syllable</th>
<th>glide sound</th>
<th>form / example</th>
</tr>
</thead>
<tbody>
<tr>
<td>NE / Schiermonnikoog</td>
<td>yes</td>
<td>[a]</td>
<td>[u]</td>
<td>16th cent. and Schm. <em>snaun</em></td>
</tr>
<tr>
<td>North / Terschelling</td>
<td>yes</td>
<td>[a]</td>
<td>ə</td>
<td>15th cent. <em>snaand</em>, Ters. <em>snôn</em></td>
</tr>
<tr>
<td>Centre</td>
<td>yes</td>
<td>[a]</td>
<td>[i]</td>
<td>15th cent. <em>snainde</em>, mod. <em>snein</em></td>
</tr>
<tr>
<td>SW / Hindeloopen, Molkwerum</td>
<td>no</td>
<td>[o]</td>
<td>-</td>
<td>Hind. <em>sennedei &gt; sende</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Molkw. <em>zindei</em></td>
</tr>
</tbody>
</table>

Table 2.16: Geographical stages in the development of unstressed /a/ in Old Frisian *sunnande* ‘Sunday’.

Combining information from the charters and the modern dialects, the main conclusion is that in the centre and north of Fryslân there is a co-occurrence of [a] as the vowel of the second syllable and accent shift. In the south-west, there is a reduction to [ʊ] and no accent shift. This is confirmed by evidence from *Jus*, in the south-west of Fryslân, with only *<son(n)en>* in the first part of the lemma

---

66 In the modern dialect of Schiermonnikoog, the vowel /a/ is generally pronounced [a], while the mainland dialects have [a]. This contrast may have ancient roots. Compare also Hindeloopen dialect /ai/ < /a/ in *sain* ‘song’ < *sang*, with Icelandic *langir* [laŋgir] ‘long’ with /au/ < /a/.

67 The very oldest forms, from the Older *Skeltenariucht* (Unia group A-1), are *<ein>* (two examples), matching the vowel in Old East Frisian sources. *<Ain>* then becomes dominant in the rest of Unia (92%, 37 examples) and also in *Jus* (95%, 74 examples). The (back) development of *<ein>* starts in the southern half of Fryslân before 1430. It is not before 1510 that the form *<ein>* really takes over, to become the only form in early-Modern Frisian, with the sole exception of the far north-east: *Begemar Proverbe* *<aun>* , modern Schiermonnikoog dialect *oost*. 
Contrast is statistically significant according to Fisher’s Exact Test, with a p-value of 1.8%.

Noticeably, the word is only found with an <e> or <i> in the second syllable and no final vowel in Old East Frisian sources R1 and F (not attested in B, E1); nom./acc. sg. R1 <abbit>, F <abbet, abbit>.

H has <ebbete>: with final vowel and no <a> in the second syllable.

‘as we then asked mr. Reijner, the abbot in (the monastery of) Jerusalem’
Table 2.17: Development of Old Frisian *abbate.
The geographical contrast in the nom./dat./acc. sg. is statistically significant.

When the second unstressed vowel is protected by a consonant (for example, gen. sg. *abbatii) or even a complete syllable (gen. pl. *abhatena), the second syllable is subjected to the syncope: /ab-ba-ta-na/ > /ab-ba-te-na/. However when the second unstressed syllable is not protected, as in *abbate, the developments diverge. In the north-east, the original /a/ is retained as an <e>, probably an [ø], while the final /ø/ is dropped. In the rest of the language area, the second syllable is subjected to syncope and the final syllable is retained. This development is the ‘normal’ procedure, cf. § 2.4.1. The full implication of these patterns is discussed in § 3.4.

In this section on the reduction of non-word-final /a/ in *abbate, it is important to note that:

- The penultimate /a/ is reduced at an early stage. This is consistent with tendencies previously described for non-final unstressed syllables in polysyllabic words in Wallisian High German and in Riestringen Old Frisian in § 2.4.1;
- In the ongoing process of reduction, the <e> that develops from the preceding /a/ in the unstressed syllable is retained in the north-east, the same region where the unstressed /a/ was preserved for a long time, for example bitalia and isonnandui;
- In the south and west, regions with an early reduction of an unstressed /a/, the second syllable of *abbate is subject to syncope in the entire paradigm.
2.4.3.3 Summary: the development of Old Frisian /a/ in protected position

Examples in this section show that the unstressed /a/ in a protected position was hardly rendered with <a> already in the beginning of the 15th century. The difference between the long-rooted example of habbath / habbane and the short-rooted bitalad / bitaliane is evident. In the former, the year 1430/40 marks the end of spelling an <a>. In the latter, it lasts until 1460/70 when the <e> and <i> take over. This is the result of Vowel Balance (cf. § 2.5.2). The reduction of the masculine plural ending -an shows Vowel Balance effects in the 14th century, but not in the 15th.

For short-rooted words, a geographical trend could be observed between the south-west and the north-east. In short-rooted words, <a> was still relatively common in the north-east up until 1470. The long-rooted examples of sunnande and abbate reveal the same south-west / north-east trend.

An Old Frisian /a/ in a penultimate unstressed syllable, as in abbate, was subject to early reduction, earlier than in the final syllable. At the same time, this reduced historical /a/ showed somewhat more endurance in the north-east than in the west and south of Fryslân. The /a/ in sunnande attracted primary stress. In this word, the /a/ was reduced to /ə/ in the south-west at an early stage and moved away from this development.

The spelling <i> of the historical /a/ appears at a time when reduction of [a] to [ə] is already happening. The <i> is a variant of the reduced vowel and not of the [a]. The phonological relation between <e> and <i> is discussed in § 3.6.

Section summary:

- The protected unstressed /a/ was reduced to an [ə] in the first half of the 15th century;
- Particularly in verbal endings such as /aþ/ and /an(ə)/, reduction is earlier when the preceding root is long (<1430), compared to when the root is short (<1470);
- In word-interior position, as in abbate ‘abbot’ and sunnande ‘Sunday’, the /a/ was more resistant to reduction in the north-east than in the south-west.
2.4.3.4 Old Frisian word-final /a/ following a short root

Infinitives: \(wesa\) ‘to be’, \(bitalia\) ‘to pay’

In the infinitive of the Old Frisian verb \(wesa\) ‘to be’, the spelling with a final \(<a>\) appears to be very resistant to reduction. Only after 1510 does the spelling with an \(<e>\) increase substantially (cf. graph 2.9). The same trend, but with a slightly lower level of \(<a>\) tokens, is found in the infinitive of \(bitalia\). Here, the year 1470 is the turning point. Between 1490 and 1510, the proportion of \(<a>\) had already fallen to 46% (graph 2.10). Despite the differences between \(wesa\) and \(bitalia\), the comparison with the reduction of \(<a>\) in protected position in the gerund forms \(wesan(e)\) and \(bitalian(e)\) shows that /a/ in word-final position behaved distinctly differently. The reduction of /a/ in word-final position follows the reduction in protected position with a delay of at least half a century.

Plural of Old Frisian: \(seke\) ‘saak’ and Old Frisian: \(dore\) ‘doar’

The frequent noun \(seke\) ‘case’ combines several of the developments addressed in this study. In the period 1400 to 1500 the transition from Old Frisian grammar, with four grammatical cases, towards the modern paradigm, with the sole distinction of singular and plural, can be observed:

<table>
<thead>
<tr>
<th>Nom.</th>
<th>sg Old Frisian</th>
<th>pl Old Frisian</th>
<th>sg Middle Frisian</th>
<th>pl Middle Frisian</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gen.</td>
<td>seke</td>
<td>saka/seka</td>
<td>seke</td>
<td>seeken</td>
</tr>
<tr>
<td>Dat.</td>
<td>seke</td>
<td>seken</td>
<td>seek(e)</td>
<td>seeken</td>
</tr>
<tr>
<td>Acc.</td>
<td>seke</td>
<td>saka/seka</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 2.18: The Old Frisian and Middle Frisian paradigm of the noun \(seke\) ‘case’ in the 14th and 15th century.
Graph 2.9: The spelling of Old Frisian -a in the infinitive wesa ‘to be’.

Graph 2.10: The spelling of Old Frisian -a in protected and word-final position, following a short root is illustrated by the infinitives and gerunds of ‘to be’ and ‘to pay’: wesa / wesan(e), bitalia / bitalian(e).
The Old Frisian forms are frequently used in the first half of the 15th century. Note the variants with <a> in the root of the nominative and accusative plural. More information on this variation is given in § 2.6.3. The transition towards the modern situation takes place roughly between 1460 and 1490. The apocope in the singular is discussed in § 2.4.3.8. Before 1460, the ending of the dative plural is regularly <im>, <em> or <um>. However after 1460 <um> is only found once more, in OFO II-79 (1479, Dongeradeel). By then, it is replaced by the ending -en. The genitive plural is rare. The last instance is from 1497. The ending of the nominative and accusative plural remains as -a until late the 15th century, cf. graph 2.11.

The replacement by -en is quite abrupt. While the infinitives in graph 2.10 show a gradual transition from <a> to <e>, the reflection of a gradual phonetic reduction from [a] > [ə], the plural marker of feminine nouns, shows a complete replacement of morphemes. The regular phonetic development to [ə] is only found in the modern dialect of Schiermonnikoog, where feminine nouns end in -e, the successor of Old Frisian word-final -a, for example, baan (sg.) - bane (pl.) ‘bean’, with few relics in the northern mainland dialects.

Between 1460 and 1490, the ending -en was used exclusively for the dative plural, while the nominative and accusative still ended in -a. The dative ending -en was the autonomous outcome of the reduction of the archaic -um. The -en in the nom./acc. pl. is probably the result of levelling from the masculine nouns, not from the dative. The details of the developments in the 15th century are shown in table 2.19.

Graph 2.11: Nominative and accusative plural of seke.

---

*In OFO I-428 (Leeuwarden, 1497) the phrase: “... om dar sekena ende deke wilde ...” (“for this sake and deed”). Note that the article is not in the genitive, a sign that the case system was by then almost lost.*
A.P. Versloot: *Mechanisms of Language Change*

<table>
<thead>
<tr>
<th></th>
<th>-1460</th>
<th>1460-1490</th>
<th>1490-</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nom./acc. Pl.</td>
<td>sacka (-e-)</td>
<td>secka</td>
<td>secken</td>
</tr>
<tr>
<td>Dat. Pl.</td>
<td>seckem</td>
<td>secken</td>
<td>secken</td>
</tr>
</tbody>
</table>

Table 2.19: The changing plural paradigm of *seka* in the 15th century, (without genitive).

The transition from *-a* to *-en* in the nominative and accusative plural shows a geographical variation (map 2.10). The introduction of *-en* in the nom./acc. plural completes the levelling of the plural endings. Once more, the innovation comes from the west and south and was later followed in the north-east. The difference
is approximately 30 years. After 1490, both the endings with full vowels, that could mark the grammatical cases (-a, -ena, -um), as well as the case system itself, have gone. About that time, there are several examples of historically incorrect case forms, for example, OFO II-94 (original from 1481): “[...] sted van Lienwerd in das seck twiska Snuytzer ende Bolswerdera [...]”\(^{92}\), instead of the historically correct form “inder seck”, which was used in the original charter OFO I-311 from the same year.

For comparison purposes, the feminine noun dore ‘door’, plural dora, with a similar syllable structure, was studied. Note that the vowel was not lengthened in the plural, due to the subsequent -a. There are only 21 tokens, most of them from copies, so the attestation status is far less favourable than for seke. The tokens fit nicely into the pattern of seke. In the dative plural, a form of <em> is found once (OFO II-30, 1450). The next dative plural form is <em>eren> (OFO II-38, 1455). Between 1450 and 1478, the nominative and accusative plural appear three times with the Old Frisian ending -a and short root vowel /e/: <em> (cf. the singular <em> /dɔr/ in § 2.3.3.1). In three attestations from 1478 to 1515, the spelling <em>eren is encountered, presumably with a long root vowel /dɔrən/. These forms confirm the morphological innovation. They show that they are recent constructions from a singular root with a long vowel, extended by the ending -en.

The token <em> (OFO I-307, original from Boarnsterhim, 1481) shows a

\(^{92}\) ‘... city of Leeuwarden in the case between the people of Sneek and Bolsward ...’
A.P. Versloot: Mechanisms of Language Change

According to this data, it could be assumed that *dooren* becomes the dominant form in the 16th century, but this is not the case. From 1609 to 1774 12 plural tokens of *door* are attested. The form *dorren* was found eight times between 1609 and 1774, and four tokens that indicated a long root vowel, such as *do(o)ren*, *doaren* and *dûaren*. It is not possible to determine a geographical distribution of these variants.

2.4.3.5 Old Frisian word-final /a/ following a long root: *kâpia*

The infinitive of the verb *kâpia* ‘to buy’ serves as an example of the Old Frisian /a/ following a long root. This example is extended with the word <kapa>/<kape>, a more recent variation of the past participle, the older form being *kâpad*. The first appearance of <kapa> is in OFO I-306 (1481 from Skarsterlân). In both meanings, the proportion of spelling an <a> remains relatively high until the late 15th century, cf. graph 2.12.

The data in § 2.4.3.1 and § 2.4.3.2 reveal a clear difference in reduction progress of the protected /a/, following either a long or a short root. The word-final <a> remains high at least until 1490, in both a word such as *wesa* ‘to be’ and in *kâp(i)ja* ‘to buy’. Note that both *wesa* and *kâpia* are not affected by either Open Syllable Lengthening or by degemination of long consonants. This makes them diachronically stable examples of words with a short or a long root. Comparison of graph 2.12 with graph 2.9 reveals a difference between *kâp(i)ja* and *wesa* after 1490. Note the following dates of attestation in the well-documented South-Eastern and North-Eastern regions:

<table>
<thead>
<tr>
<th></th>
<th>North-East</th>
<th>South-East</th>
</tr>
</thead>
<tbody>
<tr>
<td>last &lt;a&gt; in <em>kâp(i)ja</em></td>
<td>1470</td>
<td>1520</td>
</tr>
<tr>
<td>last &lt;a&gt; in <em>wesa</em></td>
<td>1506</td>
<td>1539</td>
</tr>
</tbody>
</table>

Table 2.20: Vowel Balance in the reduction of word-final /a/.

- Final <a> disappears earlier in long-rooted *kâp(i)ja* than in short-rooted *wesa*;
- Final <a> disappears earlier in the North-East than in the South-East.

This Vowel Balance effect is discussed further in § 2.5.2.

All instances of *kâp(i)ja* with word-final <a> after 1510 come from the south. A similar geographical pattern is found in the spelling of <habba>/<habbe>, the combination of an old plural root vowel and new morphological ending.93

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93 According to this data, it could be assumed that *dorren* becomes the dominant form in the 16th century, but this is not the case. From 1609 to 1774 12 plural tokens of *door* are attested. The form *dorren* was found eight times between 1609 and 1774, and four tokens that indicated a long root vowel, such as *dejypen*, *dorren* and *dionen*. It is not possible to determine a geographical distribution of these variants.
The infinitive and present plural form of the verb *habba* 'to have', cf. map 2.11. Note that *habba* had a long root before the degemination, but a short one after it, i.e. after ± 1460. A similar preference for the final *<a>* is found in short-rooted *wesa*, with only an *<e>* in the North-West and North-East regions after 1510, but occasionally an *<a>* in other, more southern regions. Until then, retention of the */a/* was a characteristic of the north-east (this is treated further in § 5.2.4).

### 2.4.3.6 Summary: Old Frisian */a/* in word-final position

The Middle Frisian unstressed final */a/* was either word-final from the very beginning of Old Frisian, as in *wesa, seka* and the infinitives *kâpa* and *habba*, or it was the result of an apocope of a word-final consonant, as in *<kapa>* from *kâpad* and *<habba>* from *habbat*. All instances behave in the same way. In all examples, with both an historical long or short root, spelling with an *<a>* dominates until about 1490. This is much later than in a protected position, where, even after a short root, the *<a>* disappears by ± 1470. Also, in word-final position, there is a Vowel Balance effect, causing a phase difference of approximately 20 years.
The examples of *wesa, habba* and *kapt[ja]* reveal the south as the most conservative region for the preservation of word-final *<a>*.

The final *-a* as a plural marker of feminine nouns was not reduced to *[ə]* (except in the dialect of *Schiermonnikoog*), but replaced by the ending *-en*, which came from masculine nouns.

**Section summary:**

- Word-final *<a>* remains unaltered until ± 1490;
- There is a Vowel Balance effect with later transition to *[ə]* after short roots;
- The transition from *[a]* > *[ə]* is later in the south than in the north.
2.4.3.7 Old Frisian /a/ in protected position

The sections 2.4.3.1 and 2.4.3.2 discuss the reduction process of the Old Frisian /a/ in an unstressed position. The reduction of /a/ implies a reduction to /ə/.

The general trend of vowel reduction in unstressed syllables in Germanic languages is from a full vowel inventory (as in Gothic and Old High German) towards a reduced vowel set (as in Old Frisian or Old Nordic), towards /ə/ and finally to 0. For example, Old High German machōn, Old Frisian makia, Modern Frisian maitsje [ma.itsjə] and Modern English to make [me.ɪk]. During the reduction process, qualitative reduction (for example, /a/ > /ə/) and quantitative reduction (cf. the qualitative and quantitative contrast between /oː/ and /a/ in machōn ~ makia) alternate. There is no principle opposition between both features, at least not in Germanic languages. Quality and quantity do not reduce independently, but in cooperation with each other. The reduction of the /ə/ > 0 is a logical step in this process.

The reduction of /ə/ can, however, have severe consequences for the syllable structure, which do not occur at other stages of vowel reduction. Dropping an /ə/ may lead to consonant clusters that are difficult to pronounce. This can influence the actual implementation of the reduction from /ə/ > 0. This is particularly relevant when /ə/ is in a word internal position (syncope of /ə/ > 0). When /ə/ is in word-final position, the reduction is called an apocope. The latter process generally causes fewer problems with pronunciation.

This touches the fuzzy concept of ‘wellformedness’. Wellformedness is a collective word for a complex of articulatory and auditory constraints on combinations of sounds. Some of these are absolute and universal (for example, an onset cluster, as far as we know, [ktp] does not exist in any language). Some are very general, but not absolute (for example, onset cluster [pt] that is allowed in Greek²⁹) and others are purely language specific (for example, voiced spirants [z] and [v] at the onset are prohibited in Frisian). This implies that wellformedness rules for one language at any given moment are a sub-selection of a universal ‘convenience’ phenomenon.

Apocope of the /ə/ in for example, Old Frisian dore, poses no problem. The new shape of the word /dɔːr/ does not violate the conditions for well-formed words in Frisian, neither in Old Frisian, nor in Modern Frisian. However, the past participle of ‘to be’, Old Frisian wesen never exhibits syncope of the /ə/ to *<wesn> in Middle Frisian, because the sequence /sn/ does not fulfil the criteria of a well-formed rhyne of a Middle Frisian syllable. In Modern Frisian, the

²⁹ From Greek it penetrates into other languages in loanwords, for example, περιμακων. In Wangeroogic Frisian, the coda cluster [kt] exists in an endogenous word: fisk ‘wing’ < *fi:tək (diminutive form), cf. High German Fittich.
sequence [ve:zn] (with syllabic [n]) exists.

This is not the place to investigate aspects of wellformedness in Old or Middle Frisian. This study works with two assumptions here:

1) The criteria of phonological ‘wellformedness’ for 15th century Frisian is, by and large, the same as for Modern Frisian words in the inherited Frisian part of the lexicon, excluding recent Dutch loanwords and internationalisms. This is a logical assumption, because the shape of inherited words in Modern Frisian is the direct product of wellformedness constraints in earlier stages of the language. A difference is the constraint on /r/ + /d, t, s, n, l/, implemented in the 18th century. So *bern /bern/ ‘child’ was a possible sequence in Frisian before 1700, but the modern pronunciation is [be:(n)]. Loanwords from the 20th century, such as sport ‘sport’, are pronounced with an [r]: [sport].

2) Syllabification of /n,m,r,l/ was not an issue in the 15th century. Reconsidering the example of *wesen (in the 15th century gerund and past participle, in the modern language as wêzen only gerund) *<wesn> *[we:zn] is not attested in the charters. In modern language [we:zn] is the most common pronunciation of wêzen, alongside [we:zn]. The ‘naïve’ Frisian authors between the 16th and 18th centuries hardly ever wrote a plural with only an <n> instead of an <en>. ‘Naïve’ authors of the Modern Low Saxon dialects, where syllabification is a compulsory phonological feature, do so regularly. In early-Modern Frisian, there are occasional tokens with <in>, for example, in <soonin> ‘sons’, modern spelling <soannen> (text 1686f in the Frisian Language Database).

The process of syncope of the Old Frisian /a/, being developed from Proto-Frisian /i/, /e/ and /u/, covers a period of more than two centuries. The process remains active over the entire time frame studied, from the archaic language type in Unia until the early 16th century. The following examples do not exhaustively cover all instances of syncope in Old and Middle Frisian, but are meant to provide examples for the study of conditions for /a/ syncope. Syncope is the result of prosodic habits and varies according to factors such as style and speech rate, even for a single speaker. The manifestation in writing, as used below, marks the stage where the author consciously considers the syncope form as the correct form, or at least a correct alternative and suitable for spelling out.
Syncope of /ə/ in verbal endings in Old Frisian (Unia)

Syncope of the Proto-Frisian /i/ in the ending of the 3rd pers. sg. pres. of strong verbs and weak verbs of the so-called first class, for example, *kumeth* ‘comes’ was already completed in the oldest charters. Examples with retained /ə/ are, for example, found in the archaic texts of the Older ‘Skeltenariucht’, Synodal Law, and Statutes of Old Frisian Law: <kumith, comet>. In other texts, only syncopated forms are found. Note that already in a text like the Older ‘Skeltenariucht’, syncope is more frequent in this context than the retention of /ə/. No relevant examples without syncope were traced in the charters. The only possible context in OFO I-1 (1329) has syncope: <kumith>.

This evidence implies that syncope in this verbal ending was quite old. It must have started before 1300 and was completed before 1380. The syncope in the abovementioned verbal ending was not concentrated in time. A side glance towards Old English shows temporal and dialectal variation in the syncope in this verbal ending. In Old English it was a gradual process, that started in the 8th century. In Old English, this syncope is frequent in some dialects and is absent in others (Campbell 1977, 299 ff., 322 ff.). In the frequently syncopating West-Saxon dialect, the vowel is often preserved after liquids and nasals: /r, l, m, n/. In the Riustringen Old Frisian dialect, the syncope is generally conducted (Boutkan 1996, 116). In the language of the codex F, 65% of the 43 tokens with vowel <et(h)> or <it(h)> are found after liquids and nasals (Sjölin 1970, 154 & 161).

Another query on the Unia data provides 17 examples of a 3rd pers. sg. ind. in <et/it(h)>, all of them in the Unia group A. A further subdivision into older texts and late 14th century texts reveals a remarkable contrast. All the old examples (Unia groups A-1 and A-2) follow a short root, for example: <binimith, hevith> ‘deprives, has’, and all of them end in a liquid, a nasal (cf. Old English, West-Saxon) or a /w/. As all the old examples without syncope have a short root, this is indirect evidence that after long roots, the syncope was already completed by then. Positive examples of the syncope of /ə/ following a long root are abundant in the Older ‘Skeltenariucht’, for example, <bifalt> (inf. *bifalla* ‘being submitted to’), <bifikit> (inf. *billiva* ‘to die’), <delt> (inf. *dêla* ‘to divide’).

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55 This is one of the few instances in which the language of Unia is more archaic than the Riustringen dialect.

56 This implies that in *kumeth*, for example, the root vowel was short. This contrasts with the conclusion about Open Syllable Lengthening (§ 2.3.3.1). The vowel of the infinitive and the present plural forms remained short before following /ə/: *kuma, kumath*. This short vowel quality is confirmed by the later spelling, such as <komma> (infinitive) and <komt> (3rd pers. sg. pres. tense).
There are five examples from *Unia* group A-3 with intermediate <e>, all with long roots; three of them end in obstruents, for example, <sprecket> ‘speaks’ and <jechter> ‘allows’. This seems a case of epenthesis to avoid long syllables with complex codas.

Syncope is more reluctantly implemented in the past participle of a weak verb such as dêla, taking a past participle in archaic Old Frisian in -ed (in contrast to the verbs in -ia, that take -ad). In the *Older Skeltenariucht* (*Unia* group A-1), the participle of the verb dêla regularly takes <ed>: <(une) deled> ‘(un) divided’ (2 examples). In the text ‘Processus Judicii’ from the early-15th century (*Unia* group A-3), there is only <deld> (3 examples) and in the text from the *Unia* group C ‘Statute of the Dean of Wirdum’ once <deeld>. This matches the evidence from the charters, with only past participle forms <deeld>; oldest charter OFO I-5 (1390, copy) and oldest original OFO II-15 (1427). Of all examples in *Unia* of past participle forms of verbs like dêla that keep the unstressed /e/ at the ending, the root of 16 out of 19 end in a liquid or a nasal, /w/ or /j/. The sample contains verbs with both long roots (for example, *berned* ‘burned’) and short roots (for example, *seged* ‘said’).

Therefore, syncope of an /a/ in the verbal endings of the 3rd person singular and the past participle was affected by:

- The length of the root: All older instances of <eth> appear in short roots;
- The quality of the preceding consonant: Nasals, liquids and semi-vowels, all voiced continuants, favour the retention of /e/;
- The voice of the following consonant: The /a/ disappears earlier from -eth than from -ed.

*Unia* provides some additional good examples of /a/-syncope. An example of an unstressed protected /a/ following an historically short root syllable is the past participle of swer ‘to swear’, originally Old Frisian sworen. It has been attested five times in the *Older Skeltenariucht* (*Unia* group A-1) and once in ‘Het is riecht’ (*Unia* group A-2). In § 2.3.3.1, the evidence from Vowel Balance points to a conclusion that Open Syllable Lengthening had taken place in Old Frisian by the beginning of the 14th century. Open Syllable Lengthening was generally applied to Old Frisian /e/. This means that <sworen> represented /sweræn/ and that the word was a candidate for syncope of the /e/ following a long root vowel. It is found with syncope as <sworn> in two old charters: OFO I-1 (1329) and OFO I-15 (1407), a copy that looks reliable in this case, because it does not have the more recent
This more recent form <sworen>\(^7\)) is an indicator of early Open Syllable Lengthening and an early syncope of a protected /ə/ following a long root. The conversion of <sworen> to <sworn> may date back to the early 14\(^{th}\) century.

**Syncope in word-interior position:**

<table>
<thead>
<tr>
<th></th>
<th>bōdel ‘property’</th>
<th>hāwēd ‘head’</th>
<th>finger ‘finger’</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(Older ‘Skeltenaricht’)</td>
<td>(Unia group A)</td>
<td>(several fine registers, Unia group A and B)</td>
</tr>
<tr>
<td>nom./acc. sg.</td>
<td>bodel</td>
<td>hawed</td>
<td>finger</td>
</tr>
<tr>
<td>gen. sg.</td>
<td>bodlis</td>
<td>haudis</td>
<td>-</td>
</tr>
<tr>
<td>dat. sg</td>
<td>bodel</td>
<td>hauđe</td>
<td>finger/fingere</td>
</tr>
<tr>
<td>gen. pl.</td>
<td>-</td>
<td>hauđa</td>
<td>fingra</td>
</tr>
</tbody>
</table>

Table 2.21: /ə/-syncope in Old Frisian noun paradigms.

**Brief discussion of the relevance of the examples:**

**bōdel:** The sequence of two consecutive /ə/-s in the genitive and dative singular is avoided by deleting the left one, cf. the case of *abbate* in § 2.4.3.2 with /ab-tə/ < /ab-bə-tə/.

**hāwēd:** The contracted form <hauđ> is frequently found in *Unia*, for example, in the Older ‘Skeltenaricht’, but always in either inflected forms or as the first element of a compound. In texts where the long form appears, it is almost always (9 out of 10 times) the uninflected nom./acc. sg.

**finger:** Syncope of the first /ə/ in the sequence <fingere> is not ‘compulsory’ (cf. <bōdel>). Preference is given to the form <finger> (four examples) in the dative singular, to avoid both the sequence /ə-ə/ and a heavy consonant cluster /ŋgr/. In the genitive plural form, dropping the ‘strong’ /a/ is not an option, and <fingra> seems to be the only solution (three examples). The genitive plural is once attested with a long ending -ena from the weak declensions, producing the form <fingerna>, with syncope of the second /ə/, avoiding both /ə-ə/ and /ŋgr/.

\(^7\) This more recent form *sworen*, appearing for the first time in 1450, is regularly spelled <sweren>, being /swerən/, with a short root vowel and no syncope. The syncope in *sweren* first appears in a charter from 1488 (OFO II-163, copy).
In word-interior position, the syncope in Old Frisian was older than in the protected position in a word-final syllable, as can be seen from the comparison *kumeth* - *bodle* < *bodele*, both from Unia group A-1.

**Syncope in Middle Frisian: the charters**

The syncope of the protected Old Frisian /a/ from the time frame covered by the charters, is illustrated with the following words: *wesen* ‘been’ (past. part.), *sekena* ‘cases’ (genitive plural), *êpena* ‘open’ (inflected form of the adjective), *sweren* ‘sworn’ (past participle of *swera*; cf. the syncope in the original Old Frisian form *sworen* in the language of Unia), *swergna* (inflected form of *sweren*), *dorena* ‘doors’ (gen. pl.) and *wegena* ‘ways’ (gen. pl.). Finally, also *abbet* ‘abbot’ (nom./acc. sg.) and *abbete/-s/-n* gen./dat. sg., nom./acc. pl. are included. The words were chosen to demonstrate a broad spectrum of phonological contexts, using words that are well attested in the charters. Section 2.4.3.2 shows that a reduction from *abbate* to *abbet* occurred relatively early, especially in the south-west. Therefore, for the time frame after 1400, the Old Frisian word *abbate* can be interpreted as /ab-bət/ and as such, is a possible candidate for syncope of the of /a/.

![Graph 2.13: Syncope of the Old Frisian /a/](image)

Graph 2.13 shows a wide range of developments. In the word for ‘abbot’, when followed by another unstressed syllable, as in *abbeten* (nom./acc. pl.), the first /a/ is always syncopated: *abten*. But in the nom./acc. sg. form *abbet* (north-east Fryslân) the syncope appears much later. It is a manifestation of the pattern that unstressed vowels are syncopated in the word-interior earlier than near the end (cf. similar patterns in the Wallisian dialects, mentioned in § 2.4.1 and in the case of Old Frisian *bodel~bodle* < *badele*). However, in the word *êpena*, syncope of the word-interior /a/ hardly takes place. The form <eepna> for *êpena* is attested only twice in the 250 tokens from the original charters. Here wellformedness (no sequence
[pn] allowed in Frisian) overrules the syncope tendency.

There are large differences between morphologically identical cases, as in: Ṇpena - swerena (inflected adjectival forms) or sekena - dorena (gen. pl.). Phonologically similar cases such as Ṇpena and dorena, both with a long vowel since the 14th century, or Ṇpena and sekena, both with a root ending in an unvoiced consonant, behave differently.

It is tempting to try to find all regulating factors for syncope and their exact interaction. Root quantity and surrounding consonant voice features have been identified, as have wellformedness constraints, such as the syllable final [rn] ~ *[sn]. So far, sufficient information has been gathered to be used in the modelling of vowel reduction in § 5.1, and in § 5.1.4 in particular.

Section summary:

- Syncope of /ə/ in unstressed syllables was a gradual process in Frisian, stretching from the 12th to the 16th century;
- Syncope of /ə/ could be delayed or even prohibited by factors such as a short root quantity, a position near the end of the word, voiced consonantal surrounding, or wellformedness constraints.
2.4.3.8 Old Frisian word-final /ə/ following a short root

Apocope of a word-final /ə/ does not pose a problem with wellformedness in Old Frisian.\footnote{Strictly speaking, this is a coincidence. There are definitely historical phonological reasons for it, but these are not the subject of this study. The key point here is that an apocope of /ə/ can always take place.} To find suitable examples of words with a short root ending in -e is difficult in Middle Frisian, because Open Syllable Lengthening turned most short-rooted words into long-rooted ones, especially those with an -e (to a far less extent those ending in -a, cf. § 2.3.3.1 and 2.3.3.2).

Another complicating factor is the transition of words into another inflectional class. The frequently used word *breke* ‘break’ for example, is a masculine noun in -e. Masculine nouns rarely end in -e. The word tends to lose its final -e much earlier than the feminine word *seke*, as most words in -e are feminine. The importance of the gender in this example emerges from the fact that, in both charters with frequent spelling of *breke* with a final <e> (OFO II-9, 1412 & OFO II-10, 1417 both copies), the word appears as a feminine word. For example, “*dio breke*” (nom. sg.), “*bi der breka*” (dat. sg.). In the latter case, the word has the ending <a> from the dative singular of the weak feminine nouns. As a masculine noun, the syllable structure of *breke* is adjusted earlier to that of other masculine nouns, i.e. without the final -e.

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{seke_singular.png}
\caption{Graph 2.14: Development of unstressed /ə/ in the word *seke* ‘case’.
}
\end{figure}
Singular of Old Frisian seke 'case'

The singular of the noun *seke* 'case' may serve as an example of the Old Frisian /a/ in word-final position following a short root that was not generally subject to Open Syllable Lengthening (however cf. map 2.2 in § 2.3.3.1). The word *seke* is a feminine ô-root and has the ending -e in all cases of the singular. Levelling from the weak feminine nouns, marked by the ending -a in the genitive and dative singular, is very limited, with less than 5%.

The word is well attested in the charters, with 300 tokens of the singular in original charters between 1379 and 1544. The first token with apocope is from 1441: <seeck> (OFO I-83, Tytsjerksteradiel). Prior to 1460, tokens with a final <e> still constitute 75% of the cases. After 1460 <e> vanishes, but stays at a more than marginal level. See graph 2.14.

The development has a distinct geographical component. Instances of <e> and sometimes <a> after 1470 are predominantly from the south and west of Frysln (map 2.12). Map 2.8 (‘Apocope in Modern West Frisian’) shows that, in the modern dialects, apocope is stronger in the north than it is in the south. In the modern dialect of Hindeloopen in the south-west, the level of apocope is particularly low, with only 38%. The word *seke* cannot be traced any further into modern times because

![Map 2.12: Geographical spread of retained final <e> (hypercorrectly sometimes <a>) in the singular of *seke* after 1480.](image-url)
the old form *seck(e)* was replaced by the Dutch loan form of *saak* in the 17th century.

2.4.3.9 Old Frisian word-final /a/ following a long root

Open Syllable Lengthening had taken place in the beginning of the 14th century (§ 2.3.5). Apocope of the word-final -e postdates this development. This implies that words with lengthening in open syllables, such as *dore* ‘door’, should be dealt with in this section.

Words ending in -e with a long root in early-Old Frisian, such as *âge* ‘eye’ are scarce. Many words with long roots dropped their final vowels in the Proto-Old Frisian period, cf. the i- and u-roots (§ 2.1, table 2.2). Also, in words such as *âge*, which kept a final -e in early-Old Frisian, this -e was dropped early. These words are rarely attested with a final <e> in the charter corpus, which makes it difficult to trace geographical differences.

Another complicating factor is the mixed paradigm in the singular, with -e in the nominative and accusative, but -a in the genitive and dative of the weak feminine nouns (cf. § 2.4.2). The forms in -a have contributed significantly to the retention of an /a/ in Modern Frisian. That makes them unsuitable examples for the study of a final -e. A typical example is the word *bregge* ‘bridge’, originally a strong feminine noun. It exhibits extensive levelling towards the group of weak feminine words, with frequent dative singular forms in <a>, turning into a final <e> after 1480. In Modern Frisian, the word is *brêge* /brizh*.

All this may be interesting from a morphological point of view, but it limits the opportunities to see what happened from a purely phonetical and phonological viewpoint. In the rest of this section, words with -e as part of the nominative singular are presented, as well as the cases of -e as a verbal ending (1’s pers. sg. pres. of babba) and the -e as marker of the dative singular of masculine and neuter words. The noun ‘ship’, originally a short root with Open Syllable Lengthening, provides an interesting illustration of the interaction between phonology and morphology in parts of the paradigm.

**Old Frisian fore ‘for’**

The case of fore ‘for’ is also discussed in § 1.3.3 and § 2.3.3.1. The word was subject to Open Syllable Lengthening. The final vowel was dropped soon after 1390 (graph 2.2). *Unia* shows <foe> in group A-2, but <fo(e)r> prevails in group A-3, to become the only option in group B and C. This matches the dating of ± 1390.

**Singular of Old Frisian dore ‘door’, sone ‘son’ and bitale ‘payment’**

The preposition fore is often unaccented in the sentence and that may be a reason for early apocope (cf. a similar case in Middle English, Brunner 1970, 32). This is
why some other words with Open Syllable Lengthening and word-final /ə/ have also been checked. The oldest original attestations to ‘son’ and ‘payment’ in the charters already exhibit apocope: 1429 <зоen>, 1431 <bitael>; there is no trace of a remaining /ə/. The oldest original attestations to ‘son’ and ‘payment’ in the charters already exhibit apocope: 1429 <зоen>, 1431 <bitael>; there is no trace of a remaining /ə/. The oldest original attestations to ‘son’ and ‘payment’ in the charters already exhibit apocope: 1429 <зоen>, 1431 <bitael>; there is no trace of a remaining /ə/.
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The oldest attestation to ‘dore’ in an original charter is in OFO II-153, 1487 <do:>, which has been transcribed as <dore> in the text edition. It may well represent <doer> (cf. § 2.3.3.1). Otherwise, there are no attestations to a retained final /ə/ in ‘dore’. Both ‘sone’ and ‘dore’ are regularly attested with the final vowel, both in Unia and in Jus, indicating that apocope of the final /ə/ did not take place before ± 1400, indeed somewhat later than in Jus.

Old Frisian âge ‘eye’
The Old Frisian word âge ‘eye’ is one of the few neuter weak nouns. It is rarely attested in the charters. As a singular, it is first attested in OFO I-267 from 1467: <æech>. In a text from Unia group A-2 (middle of the 14th century) the nominative singular is attested as <æech> and <æeg>. In a text from group A-3, the dative singular appears as <ægh>. This suggests the adoption of the general paradigm for strong neuter singular nouns: nom./acc. -ø, dat. -e. As an example of morphological levelling, it says little about the phonetic process of apocope. In Jus, the final -e is found 17 times in nominative and accusative singular. Jus provides no examples with apocope. As the language of Jus reflects the situation from the late 14th century, this would place the apocope in âge some time after 1380. The language of Jus can be sited in the south-west. The texts from Unia originate from the north. More specifically, the later texts in Unia originate from the north-east. The different appearances of âge in both codices may reflect a geographical contrast in the 14th century (note the retention of -e in the south-west in the word seke in the 15th century, map 2.12).

skippere ‘skipper’, klagere ‘complainer’
Words such as skippere ‘skipper’ and klagere ‘complainer’ were nomina agentis. These words had a word-final -e in Old Frisian: skippere and klagere. In the archaic language of Riustringen, they appear with a final <c>. The word skippere is not attested in either Unia or in Jus. In the charters it appears in 1506 for the first time. By that time, the final -e had already disappeared: <sc(h)ipper>.

The word klagere is attested in all three West Frisian sources, Unia, Jus and the charters. Unia contains six tokens of a nom. sg. of klagere. The four instances from group A are all <clagere>-. In two texts from C the word appears once as <clagere> and once as <clagher>. Jus has both forms with and without final <e> (nom./acc. and dat.).

In the dative singular, the form is <claghere> in a text from Unia group B. In the charters, a dative singular <claghere> is found in OFO II-29 (1450). After 1460,
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no dative singular forms with a final vowel are attested. The oldest attestation to a nominative singular in a charter is found in that same charter from 1450: <clagher>. In a copy from 1412, OFO II-9, the nom. sg. <klagher> is found. This implies that in the nominative singular, the final -e was lost at the beginning of the 15th century. In the dative singular, the final -e remained until the second half of the 15th century.

**abbate ‘abbot’**

The word *abbate* is discussed in § 2.4.3.2, in particular in table 2.17, and § 2.4.3.7. After the reduction of the unstressed /a/ > [ə], [ab:ət] > [ab:ət], the word developed a sequence of two /ə/-s. This sequence did not survive into the 15th century. In both cases, at least one /ə/ was preserved for reasons of wellformedness:

- When the penultimate vowel was retained, apocope of the word-final [ə] took place in the late 14th century: [ab:ət] > [ab:ət];
- When the penultimate vowel was subject to syncope, the apocope of the word-final [ə] took place after 1430: [ab:ət] > [apt] > [apt].

**dêde ‘deed’ and misdêde ‘crime’**

The word *dêde ‘deed’* was originally a strong feminine noun, with the -e in the entire singular paradigm. In *Unia*, the singular is found as <dede> 12 times in group A-1, A-2 and A-3. In the compound <ded ethum> ‘deed oaths’ (6 times) and in the sole phrase “mit reed and mit deed” (‘in word and deed’) it appears without a final<e>.

In the charters, it frequently appears in the compound *misdêde ‘crime’*. This is attested twice in 1392 (OFO II-3) in the nominative singular as <misdede>. An almost contemporaneous copy of that specific charter has <misdeed> once. In two charters from 1450 (OFO II-29 and OFO II-50) the word is found in the singular as <misdede> and <misdede>. In six tokens from 1472 to 1501 the word is written with a final <a> in nom./dat./acc. singular. This pattern suggests two tracks:

- The final /ə/ was gradually reduced during the course of the 15th century;
- The word *misdede* was levelled to the group of weak feminine nouns in the middle of the 15th century, giving rise to the ending -a in the singular paradigm.

The beginning of the apocope is not before 1400. The rendering of <e> until 1450 is quite late.
The special position of the dative ending of singular masculine and neuter nouns was also mentioned in the context of âge and klagere (earlier in this section).

The dative singular of the neuter noun hûs ‘house’ is well attested from 1379 onwards. The three oldest attestations are <huse>, but already in 1404 (OFO I-10), the first instance of a dative form without a final <e> is encountered: “by Eppamahuys”. Up until 1466, dative singulars with a final <e> are regularly attested, albeit in a (large) minority of cases. After 1470, the ending has almost entirely disappeared.

The word kâp ‘purchase, transaction’ is frequently attested in the idiomatic expression a fria kape/ in frie kaep ‘in a free transaction’ (to underline the voluntary character of a deal). Between 1439 and 1466, 11 out of 17 cases (65%) had a dative ending of <e>. In the period up to 1547 there are only nine out of 112 (8%), the last one from 1516.

There is some evidence that the -e was better preserved in the idiomatic expression a fria kape/ in frie kaep. Before 1470, there are no attestations to dative singular forms in the original charters outside this idiomatic context. In a copy of a charter from 1412 (OFO II-9), the dative form <kape> appears outside the aforementioned idiomatic expression. After 1470, the few instances of dative singular in <e> are always in idiomatic expressions, but this specific contrast is not statistically significant:

<table>
<thead>
<tr>
<th>1470 - 1547</th>
<th>idiom</th>
<th>non-idiom</th>
</tr>
</thead>
<tbody>
<tr>
<td>-ø</td>
<td>66</td>
<td>32</td>
</tr>
<tr>
<td>-e</td>
<td>8</td>
<td>0</td>
</tr>
</tbody>
</table>

Table 2.22: Writing a dative <e> in Old Frisian kâp, in the context of the idiomatic expression a fria kape/ in frie kaep and other contexts. The skewness is not significant. Original charters only.

In the word lôg ‘place, village’ (cf. Modern Frisian only in yn ‘e lytse loege sittë’106) there are 19 attestations in original charters between 1442 and 1512, almost entirely in the fixed expression in elkea lûske ‘in every place’. Before 1470 all tokens have a final

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This presentation is rather difficult. The oldest instance of a nom./acc. pl. is from 1450, without the final <c>. The oldest dat. sg. without <c> is from 1466 and the previous one with <c> from 1454. This means that the apocope both in the dat. sg. and in the plural could be from about 1450. If both dat. sg. and nom./acc. pl. were */ski:p/ in 1440 and the apocope in both paradigm forms were a coordinated development, a plural */skipen/ could be expected already in the middle of the 15th century. This was not the case, which supports the hypothesis.
Analogy with other dative singular forms prevented the final -e of the dative singular of *skip from disappear. The dative singular of masculine and neuter words generally retains the ending -e until about 1470, also after a long root. The spelling <schype> with root vowel <y> shows that this is the phonologically original dative form. Levelling would produce *<schippe>. After 1460, not only the dative ending -e disappears but also the vowel quality and quantity are levelled from the nominative and accusative singular. The dropping of the /a/ in the dative singular after 1460 is not a phonological process, but paradigmatic levelling. In the year after 1500, the plural form of *<schippen> is encountered, irrespective of grammatical case. It was a recent product from the singular /skip/ + plural ending /an/, restoring a regular paradigm.102

The example of 'ship' illustrates:

- The apocope of word-final /a/ when not blocked by morphological levelling, at least before 1450 (OFO II-30, copy; confirmed by two more copies from the same decade), producing the pl. <schijp>;
- Removal of the dative singular ending -e after 1460 due to morphological / paradigmatic reshuffling.

1st sg of habba: ic habbe 'I have'

The case of *ik habbe 'I have' is an example of word-final /a/ as a verbal ending. The word form is highly frequent in the charters. It is important to distinguish between the normal word order *ik habbe and the inverse order habbe ik. In the inverse construction, the unstressed /a/ of the ending coalesces with the initial vowel /i/. This sequence encourages apocope of the unstressed /a/. Indeed, apocope was more widespread in an inverse word order than in normal word order. Before 1430 there is 73% apocope in the inverse word order, compared to only 17% in the normal order. Between 1430 and 1460 the figures are 83% and 67%. After 1460,

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102 In the 17th century, the plural /skip/ was still used in south-west Fryslân. It is attested in Hindeloopen and in writings by Gysbert Japicx, who came from Bolsward. Japicx uses <schijp/schyp> four times and <schippen> once. The latter form is also attested in the Burmania proverbs, a text dialectally most likely to be from the north-west of Fryslân. In the 18th century, the irregular plural form vanishes. As a common singular Japicx uses <schip>, but in the idiomatic expression "t'schijp" ('to ship, embark', used twice) the old dative singular form is preserved (cf. Dutch scheepgaan < *schoep-gaan). In the compound Schippe kwaapje 'ship manoeuvre' Japicx uses the old genitive singular /skips/ < /skips/ (cf. Dutch scheep: < scheep) as the first element of compound words. All forms at www.ta.knaw.nl/tfd, lemma skip. Cf. in Modern West Frisian skipje 'embark' < Old Frisian skipia.
the word ending -e has almost completely disappeared in both contexts.

The combination of verb form + pronoun, known as *clitisation*, is not equivalent to the sole combination of any unstressed ending with any initial vowel. Apart from the combination habbe + ik, with a high level of apocope, there is no difference in the level of apocope between the order ik habbe + /N/ or ik habbe + /C/.

Map 2.13 illustrates the geographical opposition. The final <e> is better preserved in the north-east than in the west and south. The map on the right shows the inverted construction. It is much whiter, reflecting a higher level of apocope. Before 1460, in five out of 61 tokens (8%) the ending is written with an <a> instead of an <e>. After 1460 this becomes nine out of 32 (32%), four being from Boarnsterhim (cf. map 2.11, showing the retention of word-final <a> in the infinitive habba). Therefore, in the region where word-final [a] was generally retained as [a], the word-final /ə/ tended to be realised as [a] as well. This is discussed further in chapter 3.
In the law texts of Unia, verbal forms of the 1st pers. sg. present tense appear 32 times, 20 times with an inverted word order and 11 with a regular word order. All examples are from text group A. In regular word order, the final <e> is the rule while in inverse word order, the <e> is regularly missing. There are three exceptions. There are two instances of inverse word order with the final <e> (<wedde ic>, <lidze jc>) from the groups A-1 and A-2. There is one instance of regular order without the final <e> in <ic hab> from the early 15th century, group A-3. This produces a consistent diachronic picture (graph 2.15).

The combination of Unia data with evidence from the charters leads to the conclusion that the verb ending -e in the 1st pers. sg. pres. of verbs was quite often retained in normal word order until late in the 14th century. In inverse word order with the clitic <ic>, the ending is often missing, at least after the middle of the 14th century.
2.4.3.10 Summary: Old Frisian /ə/ in word-final position

The apocope of word-final /ə/ covers a period of more than a century in the history of West Frisian. The temporal development is illustrated in graph 2.16.

<table>
<thead>
<tr>
<th>Unia A-1, 2</th>
<th>Unia A-3</th>
<th>1370-</th>
<th>1400-</th>
<th>1430-</th>
<th>1460-</th>
<th>1490-</th>
</tr>
</thead>
<tbody>
<tr>
<td>âge nom. sg.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>habbe ik</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>fore</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>klagere</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>sone</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(mis)dêde sg.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>seke</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ik habbe</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>hûse dat. sg.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>âge dat. sg.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Graph 2.16: Apocope of Old Frisian /ə/. Black = forms with apocope attested; Light grey = forms without apocope attested; Dark grey = mixed; White = no attestations. The evidence from group A in Unia both from the archaic parts (A-1 and A-2) and from the early 15th century sections (A-3) is presented at the front of the timeline.

It is a subtle mixture of phonetic and morphological factors that determine the course and speed of the development. The main tendency is that the word-final /ə/ was phonetically weakened and finally disappeared. When a weak neuter word âge was realised as [a:γ], it became a perfect match for the class of strong neuters, which was far larger than the small group of weak neuters. Allowing the apocope made the structure of the grammar more transparent. An apocope of the dative singular marker /ə/ resulted in a loss of information. The ending endured for about as long as the dative persisted in the language.

Apart from a few cases like âge, fore and ic habbe, the language of Unia exhibited little apocope. Combined evidence from words such as fore, sone and klagere but also dore and bitale show that following a long root, and when not prohibited by any morphological considerations, apocope of the final /ə/ started in the late 14th century and was implemented in those words before 1420. The plural of ‘ship’ can be added to this group. Also, the special case of the 1st pers. sg. pres. with clitisation, habbe ik, shares the same fate as this group.

Speakers were far more reluctant to apply apocope to a feminine word such as misidêde. The reason mirrors the rationale that is given for âge. The grammar preferred feminine words ending in a vowel in the singular. The mirrored mechanism caused the transition of the noun bitaen < bitale from feminine to neuter. The short-rooted feminine noun seke was one of the last words with a word-final
/ə/ to lose it. The verbal ending of the 1st pers. sg. pres. shared the same fate. In contrast to the dative ending, the transition from habbe > hab did not encroach on its functionality. The explicit morphological marker of the dative singular of masculine and neuter nouns turned out to be the most resistant of the examples studied. Here, functionality overruled phonetics.

The purely phonetical process of reducing the word-final /ə/ seems best represented in fore, as a word with a (new) long root, and sees as a word with a short root.

Section summary:

- Apocope of word-final /ə/ was controlled by (at least) three factors:
  - Vowel Balance
  - voice of adjacent consonants
  - morphological patterns;
- The process covered the period from the middle of the 14th century to the late 15th century.
2.5 Vowel Balance

Vowel Balance is discussed in its Germanic context in § 2.1. This section is devoted to manifestations of Vowel Balance in other Frisian dialects (§ 2.5.1) and the impact of Vowel Balance on the reduction of unstressed syllables in late mediaeval West Frisian (§ 2.5.2). The default impact of Vowel Balance is that an element following a long root or syllable is quantitatively or qualitatively more reduced than when it follows a short one.

In the previous sections, Vowel Balance is mentioned four times:

• In § 2.3.3.1 / table 2.6, Vowel Balance is identified as the mechanism that controls the spelling alternation between the full ending <um> and the reduced form <em/im> for the dative plural ending in the language of the codex Uniar;
• In § 2.4.3.3, the dating of the reduction of protected unstressed /a/ to [a] is earlier for words with a long root than with a short one;
• In § 2.4.3.10, the dating of apocope of the word-final /a/ is earlier for words with a long root than those with a short root (being only one of a number of factors);
• In § 2.1. and § 2.4.2 Vowel Balance is mentioned as one of the controlling factors in the apocope or the retention of the word-final /a/ in (early) Modern West Frisian.

2.5.1 The Frisian context


In Riustringen Old Frisian, long root syllables caused a centralisation of unstressed vowels, for example:

/du-run/ ‘doars’, the rhyme consists of a short vowel, so the root is short. This short root is followed by the unstressed vowel /u/;
/ske:-ro/ ‘ploughshare’, the rhyme consists of an /ε:/, so the root is long. This long root is followed by a more centralised unstressed vowel /o/.

This is the same type of Vowel Balance reported for Old Swedish (§ 2.1, table 2.1).

Modern Frisian dialects do not have different vowel qualities in unstressed syllables, apart from recent loanwords such as pasta [pasta] ‘pasta’ and bureau
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(Also realised as \([\beta\delta\rho]\)). Qualitative Vowel Balance effects, such as those found in Riustringen Old Frisian or in Middle West Frisian (bitallat ~ kaepet), are out of the question. Modern dialects only show Vowel Balance effects in a quantitative way, for instance, levels of apocope of final vowels (cf. § 2.1 for synchronic Vowel Balance effects in Modern West Frisian).

In the early-modern dialects of Wangerooge and Land Wursten, the process of reduction and apocope of final unstressed vowels is controlled by historical root quantity. In the other Frisian dialects, the historical quality of the unstressed syllable, /a/ or /æ/, is the controlling factor (Versloot 2002a). The dialect of Harlingerland has an intermediate position, cf. table 2.14 / § 2.4.2.

In modern Mainland North Frisian dialects (illustrated by the dialect of Ockholm) and the extinct dialect of the East Frisian Harlingerland, there are historical Vowel Balance effects superposed on the historical /a/ ~ /æ/ contrast. The effects are different, as can be seen in graph 2.17. In Mainland North Frisian, the Old Frisian word ending /a/ is preserved better after an Old Frisian short root (85%) than after an Old Frisian long root (69%), mutatis mutandis for Old Frisian /æ/ with 21% and 6%. The vowel quality is dominant, but root quantity modifies the quality effect.

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Graph 2.17: A 3-D representation of apocope tendencies in Mainland North Frisian, Modern West Frisian and 17th century Harlingerland dialects. The percentages show the level of word-final /e/ in the dialects. Ockholm: contrasts on both axes are significant; West Frisian: only /æ/ ~ /a/-contrast is significant; Harlingerland: the distinct position of short root + /æ/ is significant.

---

The following conclusions are based on a corpus of ca. 100 words with word-final vowels in Old Frisian. The selection criterion was mainly the question of attestation in the Harlingerland dialect (the dialect with the poorest attestation). The North Frisian data is from the dialect of Ockholm.
A totally different effect is found in the Harlingerland dialect, where the root quantity overrules the /a/ ~ /ə/ opposition. After an Old Frisian short root, the vowel quality is the dominant factor in the preservation or apocope of word-final vowels. After an Old Frisian long root, the impact of the final /a/ versus the /ə/ is completely neutralised.

In West Frisian, the effect of the vowel quality is statistically significant, the contrast between long and short not. The reason may lie in the fact that Open Syllable Lengthening changed many short-rooted words into long ones. The modern language shows a Vowel Balance effect (§ 2.4.2), where long root syllables correlate with fewer final unstressed vowels and vice versa. Such a contemporaneous Vowel Balance effect is missing in Mainland North Frisian.

The conclusion is that historical Vowel Balance effects are visible in all East and North Frisian, but their impact is quite diverse.

Section summary:

- Vowel Balance effects based on Old Frisian syllable quantity structures are found in East and North Frisian dialects;
- In Modern West Frisian the situation is blurred by early Open Syllable Lengthening and synchronic Vowel Balance.

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104 This synchronic Vowel Balance effect is confirmed by the dataset that was used for this overview.
2.5.2 The West Frisian charters

The protected Old Frisian /a/ was written as <a> in short-rooted words such as *bitalad*/bitaliane as late as 1460, while <a> had already disappeared by 1430 in words such as *habbath*/habbane, with a long root (§ 2.4.3.3). This is a regular case of Vowel Balance, meeting the default expectation: syllables following a long root show more reduced vowels. In this section, the focus is on the qualitative contrast of [a] ~ [o] in late mediaeval West Frisian.

To make this hypothesis more secure, more words have been included in the sample:

• Old Frisian short root: wesane, gerund of weza 'to be', makad/-ath, past part. and 3rd pers. sg. pres. of makia 'to make';
• Old Frisian long root: kâpad/-ath, past participle and 3rd pers. sg. pres. of kâpia 'to buy'.

In the first time frame, only few tokens are available and the differences are not statistically significant. There is no data for wesane and bitaliane from the first time frame. The differences are very clear in the second time frame, 1430 to 1460. All four examples of a short root show a similar level of <a> spelling (about 25%). For words with a long root, the levels are near 0%. The differences are statistically significant. This appears to be a straightforward case of Vowel Balance. The effect

Graph 2.18: Vowel balance in the reduction of Old Frisian /a/ / -a/. Shown is the percentage of tokens with an <a>.
was only temporary, although it lasted until the last time frame (1510 - ) before the differences disappeared.

The reduction process of Old Frisian /a/ to /a/ proceeded very quickly in the western part of Fryslân between 1380 and 1430, both after long and short roots. Vowel Balance effects were mainly a phenomenon of the central and the north-eastern regions, as can be seen in map 2.14. Graph 2.19 shows Vowel Balance in Old Frisian protected /a/ according to historical root length, i.e. before the degemination of long consonants. This degemination took place before the reduction of word-final /a/.

Map 2.14: Vowel balance effects between 1430 and 1460. Figures per region. The reduction of the Old Frisian /a/ following short roots (= black bar) and long roots (= white bar) is equally as progressed in the Mid-West and South-West (both 0% <a> in the latter region). The differences are the biggest in the Centre (Leeuwarden-region) and North-East.
Graph 2.19: Reduction trends for historical long and short-rooted words with a protected (<aC>) and word-final (<a>#) Old Frisian /a/: Short root, protected /a/: wesane, hitialane, hitialad, makad; Long root, protected /a/: habbat, habbane, kapad; Short root, final /a/: wea, hitalia, hiara; Long root, final /a/: habba (inf + pl), kapia; A Vowel Balance effect is clearly visible for protected /a/ (<aC>) in the first three time frames (-1460), but no such effect emerges for word-final /a/ (<a>#) after 1490.

Graph 2.20: Vowel Balance in the reduction of final /a/.

Vowel balance in the reduction of final /a/
In graph 2.20, seven examples of word-final /a/ are shown individually. The examples comprise of two instances from the class of verbs ending in -ia: bitilia ‘to pay’ and kápia ‘to buy’. The reduction of the final /a/ is faster in these two words than in the -a verbs (wesa ‘to be’, habba ‘to have’) and the pronoun hiara ‘their’. The contrast between these two groups is statistically significant from 1470 onwards. The verbal ending with an additional /i/ or /j/ in the second syllable made the word longer and, as a result, caused a Vowel Balance effect. The words may have been trisyllabic: /bi-ta-li-ja/, /kæ:-pi-ja/. This Vowel Balance effect is also shown in table 2.20. Note that the Vowel Balance effect is found both in the North-East and the South-East, cf. map 2.14.

Graph 2.20 shows a subtle difference between Old Frisian kápia and bitilia. In late 15th century Middle Frisian, the former was pronounced [kɛ:pɪa] or [kɛ:pɪa] with a long vowel, while the latter is pronounced [bi-ti lia] or [bɪti lia] with a short vowel. Between 1470 and 1510, the reduction seems to be faster in kápia with the long root vowel. This matches expectations: Vowel Balance effects based on the root vowel length are also attested in Modern Frisian (§ 2.1. and § 2.4.2). The mean values of bitilia and kápia do not deviate significantly. The test set was extended with examples from the verb makia ‘to make’. This verb appears as <metje> (short root as in bitilia) or <meitje> (long root as in kápia). The combined data from makia, bitilia and kápia shows a significant Vowel Balance contrast for root vowel length.

Section summary:

• Vowel Balance effects in the reduction of unstressed /a/ > /ə/ are found in both the protected and unprotected Old Frisian /a/;

• In the reduction of a protected /a/, the Old Germanic syllable quantity, including consonant quantities, is leading;

• The reduction of word-final /a/ takes place after degemination;

• Vowel Balance effects in Middle Frisian are controlled by the syllable structure of the entire word and the quantity of the root vowel.

105 In most tables the second time frame is from 1430 until 1460, in this graph it covers the period 1440 to 1470. For the overall picture this is not particularly relevant.
2.6 Vowel Harmony

Vowel Harmony can be defined as "[...] a state in which segments agree with respect to their value for some feature within the relevant domain". (Van der Hulst & Van de Weijer 1996, 503), i.e. a kind of agreement that is compulsory (to a certain, language-specific, extent) and not simply coincidental. Vowel Harmony usually leads to allophony in the root or affixes. The alternation accomplishes the assimilation of vowels or vowel features from different syllables, usually adjacent. In some languages Vowel Harmony influences non-adjacent syllables or all syllables of one word.

It is the author's opinion that Vowel Harmony, in the sense of sharing articulatory features, can only be phonetic. Once this has been phonologised, it becomes a template or pattern. Its constituting segments can be subject to further sound changes, obscuring the phonetic origin. Describing such petrified forms of Vowel Harmony in terms of synchronic phonological features, such as [+high] or [+round], may lead to curious interpretations, as the originally shared phonetic
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feature may be lost on either side of the harmony pair. Any feature-based phonological analysis of a petrified Vowel Harmony structure is therefore an anachronous enterprise. The synchronically existing patterns of (partly) shared phonetic features are merely the remnants of the original phonetic Vowel Harmony process.

2.6.1 The Germanic context

Vowel Harmony is a container word, because it comprises of various types of vowel feature assimilation. According to Van der Hulst & Van de Weijer (1996, 509 ff), eight types of Vowel Harmony can be distinguished. Examples are given in table 2.24, preferably from Frisian or other Germanic languages. The examples are not exhaustive. The Vowel Harmony effects can be limited to specific phonological contexts, as is the case in Rustringen Old Frisian, where Vowel Harmony patterns are limited to short roots, while progressive Vowel Harmony in Norwegian is found both in long and short-rooted words. The vowel which enforces the agreement (‘master’) is printed in bold face and underlined. The ‘slave’ is only underlined.

Backward Vowel Harmony is quite common in many Germanic languages, especially in older or geographically marginal dialects. In large modern Germanic languages, there is no Vowel Harmony, either as a productive phonetic feature, or as a petrified structural feature.\(^{108}\) Cases of backward Vowel Harmony are often considered as cases of *i*- or *u*-mutation. It is the progressive Vowel Harmony that is usually referred to as ‘real Vowel Harmony’. Note that Rustringen Old Frisian shows doublets like *keme - kimi* and *stede - stidi* with either forward or backward Vowel Harmony. Agreement in palatalisation and rounding is found in Fennic-Uralic and Turkish-Altaic languages in particular, all of which originate from Northern and Central Asia.

The categories ‘forward’ and ‘backward’ can be ambiguous when related to stress patterns in words. In Germanic languages, the stress is basically on the root syllable, and the root syllable is mostly the first syllable in the word. Forward Vowel Harmony by default equals agreement of the following unstressed syllable with the stressed syllable, and Backward Vowel Harmony equals agreement of the preceding stressed syllable with the unstressed syllable. But cases of agreement between a stressed root and an unstressed prefix are also found. The Wursten Frisian examples are such a case.

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\(^{108}\) With the exception of entirely morphologised features, such as the German umlaut in plural or compound forming.
Section summary:

- ‘Vowel Harmony’ is a container label for several phonetic accommodations between vowels in adjacent syllables;
- Regressive Vowel Harmony in particular is abundant in older stages of Germanic languages.
2.6.2 The Frisian context

Table 2.24 contains several examples from the group of Weser Frisian dialects (Wursten, Wangerooge, Riustringen Old Frisian). Careful examination of the Vowel Harmony patterns in West Frisian reveals that this table is not sufficient to describe every type of opening accommodation.

There appear to be two types of opening accommodation (table 2.24, upper row):

- The unidirectional opening accommodation, as in Middle Frisian <sacka> < seka, where /ɛ/ is lowered to /a/ due to the following open /a/;
- A type of Vowel Harmony that could be called ‘Seesaw’-Vowel Harmony, where centralised vowels attract each other, but where existing contrasts are stressed by dissimilation. The Riustringen Vowel Harmony, as described in Boutkan (1996, 27), appears to be of a similar kind. A centralised root vowel /ɛ/ or /o/ triggers a centralisation of the unstressed vowel /i/ > /ɛ/ and /u/ > /o/, for example: <hiri> ‘her’ ~ <kere> ‘choice’, <skipu> ‘ships’ ~ <felo> ‘many’ (Boutkan 1996, 27). Following a root with a short /a/, the unstressed vowel is not opened (further) as might be expected, but appears as a closed vowel, e.g <elagi> ‘complaint’, <elagire> ‘accuser’, <skadu> ‘sharp’.

These two types of accommodation operate in two directions:

- The historical quality of the unstressed syllable affects the quality of the root vowel, as in the <sacka> < seka example (= regressive Vowel Harmony);
- The quality of the unstressed syllable (either ending or prefix), phonologically considered /θ/, is affected by the quality of the root vowel, as in <elagire> < klagere < *klagari (= progressive Vowel Harmony).

The regressive Vowel Harmony is only possible when unstressed vowels have qualities other than /ɑ/. Given the gradual reduction of all unstressed vowels to /ɑ/ in Middle Frisian, this type is no longer found in late-Middle or Modern Frisian.

The two types plus two directions suggest four different (sub-)types of opening Vowel Harmony in Frisian. All four combinations can be found in West Frisian. In most cases, Vowel Harmony patterns are tendencies. They are rarely compulsory and sometimes cause no more than a small deviation of a few percentage points. The cells contain relevant examples of Vowel Harmony tendencies, all statistically
significant. The overview is not exhaustive. The vowel which enforces the agreement (‘master’) is printed in bold face and underlined. The ‘slave’ is only underlined:

<table>
<thead>
<tr>
<th>Unidirectional</th>
<th>from ending to root ('backward')</th>
<th>from root to ending/prefix ('forward')</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘seesaw’-</td>
<td><em>saka</em> ‘cases’ (pl) &gt; *&lt;saka&gt;</td>
<td>*bijtinket &gt; *&lt;bijtelje&gt; ~</td>
</tr>
<tr>
<td>accommodation</td>
<td>(14th/15th century)</td>
<td>*belang&gt; (18th century)</td>
</tr>
<tr>
<td></td>
<td><em>kuma</em> ‘to come’ (inf.) ~</td>
<td>*havij &gt; *&lt;hegovit ‘has’ (early 14th century)</td>
</tr>
<tr>
<td></td>
<td>*komg ‘come’ (subj.)</td>
<td>*bitallit &gt; *&lt;bitellet ‘paid’ (15th century)</td>
</tr>
</tbody>
</table>

Table 2.25: Examples of different Vowel Harmony types in several stages of West Frisian.

This complex of vowel accommodations deserves a separate treatment. This study concentrates on the *a*-mutation in the 14th/15th century West Frisian because this example provides information on the phonetic and phonological status and development of the Old Frisian unstressed /a/.

Section summary:

- West Frisian shows several types of both forward and backward Vowel Harmony;
- Vowel Harmony appears in Old, Middle and early-Modern Frisian.

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109 Preliminary studies suggest that the unidirectional type ‘from root to ending/prefix’ (top right cell in table 2.25) is a sub-type of the ‘seesaw’ accommodation, depending on the phonetic details of the prototypical realisation of /a/. Another likely factor in all cells is the quantity of the root. Note that all examples given have short root vowels/syllables.
2.6.3 The West Frisian charters

This section is devoted to a-mutation in late-Old Frisian and early Middle-Frisian. It is an example of accommodation in the degree of opening. It can be observed in the language of the West Frisian charters and 14th century language from Uniae: for example, *seka > *sacka* ‘cases’ (pl.), *wesete > *wessen/wassen* ‘to be’ (gerund). Special attention is paid to the Vowel Harmony /a/-mutation, caused by the masculine plural ending *-an*.

The bare manifestation of the Vowel Harmony resembles the late-15th century labialisation of /e/ > /a/, as in the Modern Schiermonnikoog dialect. For instance *wazze* ‘to be’, *watter ‘water’*, Standard Modern Frisian *weze < wezze, wetter*. Miedema (1986) treats word forms such as <wassa> ‘to be’ in the context of this labialisation. A map of the phenomenon described by Miedema, corrected for instances of *a*-umlaut is printed below (cf. Miedema 1986, 19). In Miedema’s map, the instances of <a> are not only found in the north-east but also in the centre and north-west. Comparison with map 2.16 showing the spread of the Vowel Harmony, reveals that labialisation and Vowel Harmony are two different phenomena.

There is another possible overlap between Vowel Harmony and Old Frisian, as well as Old English, velarisation. The latter causes the blocking of the general North-Sea

![Map 2.15: Dialectal alternation of /e/ ~ /a/ ~ /ɔ/ (labialisation) in Old Frisian words *setta ‘to set’, sella ‘to sell’ and *fenne ‘meadow’](image)
As Vowel Harmony is basically a phonetic phenomenon, it is assumed that [e] was opened to a sound that would have been near to [æ]. The sound was generally restored to [æ], later in the 15th century. This leads to the assumption that the Vowel Harmony realisation was [æ] rather than a fully open [a].

110 As Vowel Harmony is basically a phonetic phenomenon, it is assumed that [e] was opened to a sound that would have been near to [æ]. The sound was generally restored to [æ], later in the 15th century. This leads to the assumption that the Vowel Harmony realisation was [æ] rather than a fully open [a].
The number of attestations is quite low, but the combined evidence of all data before 1480 shows that in the plural, Vowel Harmony is significantly more common when the ending is <a> than when <en>.

<table>
<thead>
<tr>
<th>SEKE</th>
<th>Vowel Harmony -1460</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>sak-</td>
<td>88%</td>
<td>33%</td>
<td>1%</td>
<td>0%</td>
</tr>
<tr>
<td>seck-</td>
<td>12%</td>
<td>67%</td>
<td>99%</td>
<td>100%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Vowel Harmony 1460 - 1480</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>n = 98</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>sak-</td>
<td>32%</td>
<td>23%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>seck-</td>
<td>68%</td>
<td>77%</td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Table 2.26: The distribution of <sack> according to case and ending. Prior to 1460, 88% of the nom./acc. plural forms in <a> take <a> in the root (<sacka>), 12% take <e> (<secka>); nom.acc. plural forms in <en> have an <a> in the root in only 33% of cases (<sacken>), etc.

Paradigm forms with no historical /a/ in the second syllable exhibit a root in <e> in almost 100% of the tokens. The plural form is an interesting case. In the archaic context with a plural in -a, the Vowel Harmony is very strong, at 88%. The modern plurals in -en take an intermediate position. The phonological template asks for the root /e/: /sekən/, but the archaic morphology asks for an /a/ in the root in the nom./acc. pl.:

- Archaic: /saka/ = /sak/ + /a/;
- Modern: Option 1) reapplying the plural allomorph: /sak/ + new plural marker /ən/ = /sakən/;
  Option 2) using the singular root /sək/: /sək/ + new plural marker /ən/ = /səkən/;
  Option 3) applying the template /e-a/:
    /svk/ + new plural marker /ən/ = /svkən/.

With 33% <sacken> and 67% <secken>, the phonology is dominant, but the 33% with <a> is clearly higher than the almost 0% in other phonological cases, with no historical following of an unstressed /a/. This gradual difference remains during the following period.111

111 The number of attestations is quite low, but the combined evidence of all data before 1480 shows that in the plural, Vowel Harmony is significantly more common when the ending is <a> than when <en>.
The archaic genitive plural in -<a> is rare, and -<ena> seems to be the default ending. So the morphological category of ‘genitive plural’ does not have the same attraction to Vowel Harmony as the nom./acc. plural. The sole attestation to a genitive plural in -<a> does have Vowel Harmony: <sakka> (OFO IV-17, 1453).

In the period 1460 to 1480, Vowel Harmony fades away. When applied, it is still in the traditional phonological context before the unstressed /a/ (32%) and the morphologically related case of nom./acc. plural in -<en> (23%). Interesting are the instances of Vowel Harmony in singular forms in <a>: <sacka>. Vowel Harmony is significantly high in these forms, with 71% (12 examples). This is a firm indication that the spelling <a> in the singular ending in the late 15th century was not merely a written hypercorrection of a final /<a>/. This <a> in the ending represents a phonetic reality [a] that could evoke Vowel Harmony of the root.\footnote{Leaving open if this was by phonetic Vowel Harmony or by application of a sound template /<a>/.}

In the verb \textit{wesa}, spelling of the root with <a> is restricted to the infinitive and gerund, Old Frisian \textit{wes}, \textit{wesne}, while it never occurs in the past participle Old Frisian \textit{wesen}. In the actual attestations to gerund forms, 92% of the tokens with an <a> spelling of the root have an ending of <en>: <was(s)en> (24 examples). This means that after the reduction of the /a/ in the ending of the gerund, there was a phonetic contrast between the gerund and the past participle. This was not in the ending, but in the root:

\begin{verbatim}
gerund /\textit{væzan}/ \rightarrow [\textit{væzən}] \sim past. part. /\textit{væzən}/ \rightarrow [\textit{væzən}]
\end{verbatim}

The overall proportion of infinitives and gerund forms with roots spelled <a> is 38% between 1420 to 1470 (102 examples). In instances of a gerund with a spelled ending <an(e)>, the proportion is only 10% (10 examples; statistical testing returns no significant contrast). This might reflect a situation where an [æ], when followed by [a], sounded like an /æ/, and when followed by /a/ sounded like an /a/: \footnote{Leaving open if this was by phonetic Vowel Harmony or by application of a sound template /<a>/.}

\begin{verbatim}
[\textit{væ.zan}] \rightarrow <\textit{wessan}>, [\textit{væ.zən}] \rightarrow <\textit{wassen}>
\end{verbatim}

However tempting this explanation may seem, in the infinitive the ending is predominantly spelled with an <a> (cf. graph 2.9). However, spelling the root with an <a> is not restricted to instances of infinitives in <e>. The same yields mutatis mutandis for the Vowel Harmony in \textit{seke}.
After 1470, Vowel Harmony disappears almost entirely. All cases of \(<\text{wasse(n)}>\) after 1480 are from Leeuwarden, Dongeradeel and Ferwerderadiel. Three instances of \(<\text{sack->}>\) after 1480 are from Leeuwarden, Dongeradeel and Nijefurd. Except for the sole case from Nijefurd, all these \(<\text{a}>\) tokens are found in the north-east. The distribution of \(<\text{a}>\) in the Vowel Harmony context seems to have merged with the \(<\text{a}>\)-forms in the 'setta-sella' group (velarisation, map 2.15). In the largest part of the language area, the Vowel Harmony did not leave a trace in words, such as the early-Modern Frisian \(\text{lesse}^*\) 'to read', \(\text{wesse}^*\) 'to be' or \(\text{secken}^*\) 'cases'.

**Dating the Vowel Harmony**

The dating of the start of the development remains rather uncertain. For \(\text{seka}\), the two oldest attestation have the root \(<\text{sec/k}>\) (OFO II-2, 1379 and OFO I-2, 1386). The next instance is \(<\text{sacka}>\) (OFO II-20, 1435). For \(\text{wesa}\), the oldest relevant attestation in an original charter is from 1426: \(<\text{waza}>\). Including the copies gives seven tokens with only an \(<\text{e}>\) in the root before 1403; OFO III-2, 1403 has \(<\text{wasa}>\). This tendency is confirmed by one more example, the verb \(\text{lesa}\) 'to read'. Also, in this verb the first instance of Vowel Harmony is \(<\text{lasen}>\) from OFO I-9, 1402. In 11 older attestations, four from original charters, there is only \(<\text{les/z}->\). This suggests that the Vowel Harmony was a phenomenon from the very early 15th century, but not much earlier.

The evidence from \(\text{Unia}\) suggests an earlier dating. Already in group A-2, which is thought to be from the first half or middle of the 14th century, spelling forms such as \(<\text{wasa}>\) and \(<\text{dagan}>\) are quite common. Only the Older 'Skeltenaricht' barely shows any Vowel Harmony. The charter from 1329 has one relevant example, showing Vowel Harmony: \(<\text{stadan}>\) 'places' < \(\text{stedan}\). All this suggests that Vowel Harmony was abundant in the first half of the 14th century. In \(\text{Jus}\), spelling the root with an \(<\text{a}>\) is absent for \(\text{seke}\) and \(\text{lesa}\) and rare for \(\text{wesa}\), but common in the plural of \(\text{dei'}\)day', \(<\text{dag(h)en}>\). Perhaps dialectal variation was at stake? Map 2.16 shows a reasonably consistent application in the east, but varying distributions to the west and far north-east.

**Vowel Harmony and the masculine plurals on -an**

A masculine noun that appears quite frequently in the charters and in \(\text{Unia}\) is Old Frisian \(\text{dei'}\) day', nom./acc. plural \(\text{degan}\). In \(\text{Jus}\), \(\text{Unia}\) and the charters, parallel forms like \(<\text{daghan}>\), \(<\text{daghen}>\) are found. In the Older 'Skeltenaricht' there is only the nom./acc. plural \(<\text{degan}>\), but both in the \(\text{Unia}\) groups A-2 and A-3, \(<\text{dag(h)an}>\) is dominant. \(\text{Jus}\) contains a few instances of \(<\text{degan}>\), next to several attestations with \(<\text{a}>\) in the root.
Comparing table 2.26 with 2.27 is very informative. The distribution of <a> over the different cases in the lemma dei is very similar to the pattern for seke before 1460. The spelling of <deg-> is dominant with 96% in the genitive and dative plural, at least when not spelled as <en>. In the nom./acc. plural, 75% of the tokens are spelled <da(e)g(h)en>. The dative plural forms in <en> show a similar ambiguity as the nom./acc. plurals of seke in -en: the functional identity as dative plural asks for <e>, the formal identity with the nom./acc. pl. triggers the use of <a>.\textsuperscript{113} Note that the phonetic cause for the Vowel Harmony, the nom./acc. pl. ending [an] is missing in all the examples in the charters (the oldest example in an original charter is in OFO IV-8, 1421, the next one from 1451). The alternation seems to be already morphologised at that time.

\begin{table}[h]
\centering
\begin{tabular}{|c|c|c|}
\hline
& pl -en/* -an & dpl -en & dpl -um/gpl -ena \\
\hline
dag- & 75% & 50% & 4% \\
deg- & 25% & 50% & 96% \\
\hline
\end{tabular}
\caption{DEGAN Vowel Harmony - 1460}
\end{table}

\begin{table}[h]
\centering
\begin{tabular}{|c|c|c|}
\hline
& pl -en/* -an & dpl -en & dpl -um \\
\hline
dag- & 71% & 71% & 21% \\
deg- & 29% & 29% & 79% \\
\hline
\end{tabular}
\caption{Vowel Harmony 1460 - 1480}
\end{table}

Table 2.27: The distribution of <deg>/<dag> according to case and ending.

The difference with examples such as wesa and seka arises in the next time frame, 1460 to 1480. In wesa and seka, Vowel Harmony is gradually abandoned. In degan the forms with <a> in the root become dominant. The dative plural forms in <en> tend to adopt the root vowel <a> and even when the archaic dative plural ending <um> or <em> is used (no attestations to gen. pl. in this time frame) the root vowel steers towards <a>. The case system was finally abolished in the late 15\textsuperscript{th} and early 16\textsuperscript{th} centuries. The remaining data from the time frame 1480 - 1545 sees the forms with <a> in the root stabilise at 77%. The difference <da(e)gen> - <deggen> becomes a dialectal feature, with a slight preference for <deggen> in the west.\textsuperscript{114} This implies that the Modern Frisian plural form dagen ‘days’ (sg. dei) is a

\textsuperscript{113} The general Vowel Harmony pattern is statistically significant, but the position of dative plural forms in <en> is not. However, it matches the similar, significant pattern observed in seke.

\textsuperscript{114} In the dialect of Hindeloopen of the 17\textsuperscript{th} century, the plural form is degen, in the modern dialect dagen. The form degen is also attested in the language of Bogerman (Dongeradeel), in the far north-east, underlining that it was originally a paradigmatic variant of the entire language.
petrified instance of Vowel Harmony. Its superficial resemblance with the Modern Dutch dagen is a coincidence.

Section summary:

- The Vowel Harmony type of a-mutation is found in West Frisian words such as wesa <wassa> (‘to be’) or degan <dagen> ‘days (nom./acc.)’;
- This type is reflected in the spelling since the 14th century, but gradually disappeared after 1460;
- In most cases, the phonetic manifestation of Vowel Harmony is reversed in late-Middle Frisian, for example, early-Moder Frisian wesse, not *wasse;
- In the case of the plural form dagen ‘days’, the Vowel Harmony has been lexicalised.

area. The early-Moder Frisian form dagen ([dægən], later [dɐ̞ːɣən]) was concentrated in the west, mainly the north-west, but was the result of older /dəgən/, where the /a/ from the Vowel Harmony was lengthened in open syllable and joined the development of Old Frisian /a:/, as in brod, modern brot ‘bread’.

It is also possible that the Modern Frisian form saak, plural saaken is the result of a similar petrified plural form with Vowel Harmony, but the number of late-Middle and early-Moder Frisian attestations suggests that the modern form saak/saken is a loan from Dutch zaak/zaken.
3. Phonological Interpretation

The previous chapter presents an extensive range of data as well as a thorough overview of developments in Frisian syllable structure and unstressed vowels. The working hypothesis as formulated in § 1.3.3 is that spelling in the charters is phonemic in principle, in some cases expressing allophonic variations and phonetic details. In order to verify this hypothesis, the following questions need to be answered.

1) Do the graphemes <a>, <e>, <i> and <u> (dative plural only) indeed represent the four different phones [a], [e], [i] and [u]?
2) If so, are these different sounds an expression of different phonemes: /a/, /e/, /i/ and /u/?
3) Old Frisian had full vowels and the Modern Frisian language has predominantly /a/ in unstressed syllables. When and how did the transition take place? Was there a moment in time when [a] and [e] ceased to represent different phonemes? What did this mean for the distribution of phonemes and their realisations?

To answer these questions, the criteria for a valid phonological opposition must first be clarified. The standard structuralist approach is to find minimal pairs. Are there sets of words, differing only in the quality of the unstressed vowel, which results in a different meaning? In ‘normalised’ Old Frisian this is definitely the case. In the pair habbe ~ habba the contrast between the unstressed /a/ and the /a/ marks a difference between the 1° pers. sg. pres. and the plural present and infinitive. Also, in the pair seke ~ seka, the vowel quality opposition marks the difference between nom./acc. singular and plural.

In a purely qualitative approach, any co-occurrence of forms with alternative spelling, for example, <secke> ~ <secka> as the singular form, will undermine the phonological opposition. This leads to the conclusion that, whatever the eventual phonetic realisation, a phonological opposition is no longer at stake. Sections 1.3.7.9 (graph 1.9 in particular) and 1.3.7.10 illustrate that such alternations also appear as intra-writer / intra-speaker variations. This qualitative approach has been applied by scholars such as Sjölin and Boutkan. Their interpretations are discussed in § 3.1.

‘Normalised’ refers to a kind of ideal situation that is never reached in mediaeval writing. It fits the concept of a standardised grammar as would be created for modern purposes, based on the regularities that can be observed in the old writings. In fact, all Old Germanic language handbooks present such ‘normalised’ grammars.
The focus in § 3.1 is on a structuralistic description, using traditional concepts of phone, phoneme and graph, but also incorporating the outcomes of quantitative analysis in chapter two. This study attempts to include the quantitative aspects of language. One 'mistake' or 'deviation' does not necessarily lead to the conclusion that a phonological opposition was missing completely. In practice, other scholars are not so strict. Individual deviations are often alluded to as 'scribal error' or 'copy error'.¹⁷

¹⁷ In a structuralistic approach, the two interpretations of written variation as a reflection of spoken variation and a phonological contrast are mutually exclusive (within one specific linguistic context).
3.1 The phonological status of Old Frisian \(<a\), \(<e\), \(<u\>\) and \(<i\>\) in current studies

In Old and Middle Frisian texts, the presence of characters other than \(<e\)\) in unstressed syllables is generally acknowledged. The question is: What phonological reality do they represent? The language from the Riustringen Old Frisian codices is considered to be a special case, for example by Boutkan (2001, 619) in his outline of Old Frisian phonology:

“The Riustringen sources are unique in maintaining qualitative oppositions between unstressed vowels.”

But what about Old and Middle Frisian language from other sources? Most scholars remain unconvinced that the contrast in spelling (\(<a\), \(<e\), \(<u\>\) and \(<i\>)\) reflects different phonemes, as the following citations show. Sjölin (1969, 22) writes:

“In sämtlichen Hss. stehen in derivativen und flexivischen Morphemen neben normalem \(<e\) auch \(<a\), \(<i\> und \(<u\>. [...] Da \(<a\) \(<i\> \(<o\) \(<u\> in fast allen Hss. in freier Variation mit \(<e\) auftreten, ist es wenig wahrscheinlich, daß diese Grapheme die faktische Aussprache von Vokalen in unbetonten Silben wiedergeben; vielmehr erklären sie sich durch die orthographische Tradition.”

Boutkan (2001, 619) says basically the same thing, in his own words:

“[...] the bulk of Ofr. attests to the merger of all vowels in unstressed syllables to /ə/. This can be concluded from the orthographic variation used to designate a single historical vowel. [...] The usual spelling of the unstressed vowel is \(<e\> (as in M[iddle] D[u]ch and M[iddle] L[ow] G[erman]).”

Nielsen (2001, 517, 518) explicitly refers to the abovementioned citation of Sjölin and writes:

“[...] nearly all Ofr. manuscripts render the vowels of the unaccented syllables graphically by means of \(<e\> in free variation with \(a\), \(i\), \(o\) and \(u\).”

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\(^{118}\) “In all the manuscripts, \(<a\), \(<i\> and \(<u\> are found alongside the usual \(<e\) in derivational and inflectional morphemes. [...] As \(<a\> \(<i\> \(<o\> \(<u\> freely alternate with \(<e\> in all codices, it is unlikely that these vowels represent actual pronunciation, but they are more likely to be explained by spelling tradition.”
A possible reason why letters other than <e> appear, is formulated by De Haan (2001, 188):

“Presumably, the process of vowel reduction had given rise to phonetic variants of schwa, or it was already completed, but not yet consistently represented in the orthography.”

De Haan’s second option is the same as Sjölin’s “orthographische Tradition”. The same rationale is used by Boutkan, when he tries to explain the spelling <um> - matching the presumed Proto-Frisian ending - alongside <em>, <en> and <im> in the dative plural; he refers to dative plural forms in <um> as “historical spellings” (Boutkan 2001, 619).

The opinions can be summarised as follows:

• With the exception of Riustringen Old Frisian, in Old and Middle Frisian there is only an /a/ in unstressed syllables;
• This /a/ is preferably spelled as <e>;
• The ‘free variation’ suggests the following relationship: <e> = <a> = <i> = <u> = /a/;
• Writing <a>, <i> and <u> is either a consequence of ‘historical spellings’ or reflects synchronic phonetic variation.

Reading Old Frisian texts and recalling the many structured spelling patterns of the Middle Frisian charters in the previous chapter, the emerging trend is not one of ‘predominantly <e>’ and ‘free swapping’ of <e> with <a>, <i> or <u>. In the oldest texts ‘historical’ spellings are dominant.

The assumed ‘free variation’ (Sjölin, Nielsen, Boutkan) suggests that an <e> is freely interchangeable with any other vowel character. These authors follow a qualitative, structuralistic analysis (cf. Sjölin 1969, 22-23). The explanation, applying general principles from logic, is as follows:

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119 In unstressed syllables, <o> is almost only found in Riustringen Old Frisian. There are no more than five relevant tokens with <om>/<on> in the charters, cf. § 2.4.2. These are not considered further here.
(a) Example 1: \(<\text{tunga}\> = <\text{tunge}\> \text{ ('tongue' nom. sg.)}\)
\[<a> = <e>\]

(b) Example 2: \(<\text{ethum}\> = <\text{ethem}\> \text{ ('oaths' dat. pl.)}\)
\[<u> = <e>\]

(c) \(i\)f \(<a> = <e> \text{ and } <u> = <e>\) \(\rightarrow <a> = <u>\)

(d) The phonological interpretation of this spelling is: /\text{a}/.

In the small printed sections of Sjölin (1969, 22), it is possible to conclude that the distribution of <e>, <i>, <a> and <u> is not free at all. The texts contain correspondences such as:

\(<a#> \sim <e#> \not\sim *<i#>\),
for example, <hona> \sim <hone> \not\sim *<honi> ‘cock’ (sg.)

\(<es> \sim <is> \not\sim *<as>\)
for example, <ethes> \sim <ethis> \not\sim *<ethas> ‘oath’ (gen. sg.)

In specific contexts, <a> and <e> are allophones, while in others <e> and <i> are. There are, for example, no contexts where, both <a> and <u> regularly appear alongside an <e>.

According to Sjölin’s small printed text (Sjölin 1969, 22 at ‘<a>’ and ‘<u>’), there are also time variations in the spelling. The graphs <a> and <u> are often in positions expected in line with the historical phonology of Frisian. In more recent texts <e> appears more often. The <i> is often written in positions where, for example, <a> or <u> are expected. This matches evidence from the charters, for example, in graph 2.4. Altogether, Sjölin is far more specific in his detailed description of facts than in his conclusions. There seems to be ample reason to reconsider the rigid conclusion of a complete neutralisation of unstressed vowels in /\text{a}/.

Section summary:

- Most scholars assume that Old and Middle Frisian had only one unstressed phoneme /\text{a}/, written as <e, a, i, u>;
- This position is based on a simplified interpretation that neglects diachronic, etymological and positionally defined patterns.
3.2 Variation in time and space and phonological interpretations

It is important to exercise caution when discussing variation within a corpus, let alone ‘free variation’, which is the sole, sound argument for a phonological neutralisation interpretation, cf. §1.3.7.4. Considering the language of the charters as one uniform language type and evaluating spelling variations within the charter corpus as a whole, brought Sjölin to the conclusion that the charters were written in a “willkürliche Orthographie” ('random spelling'). Grouping the charters per time frame and region as carried out in chapter two, reveals that these supposedly ‘random spelling’ is consistent with historical and phonological patterns.

In order to draw the correct conclusions, the time scale and geographical radius need to be limited to the extent that variation can no longer be considered to be a result of diachronic or dialectal variation. The remaining variation is then synchronic language internal variation. This language internal variation is demonstrated in §1.3.7.9 in graph 1.9. Taking this and the information from chapter two into consideration, there are several types of spelling variation. These are presented in table 3.1 (below). The content of each field is discussed later.

<table>
<thead>
<tr>
<th>Through time (= diachronic)</th>
<th>Synchronically predictable</th>
<th>Synchronically not predictable = free variation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variation within one time frame (= synchronic)</td>
<td>A: shifting realisations, e.g.: (&lt;\text{skipum}&gt; \sim &lt;\text{schypem}&gt;)</td>
<td>C: individual appearances of a general transition (sociolinguistic variation), e.g.: (&lt;\text{bitellat}&gt; \sim &lt;\text{bitellet}&gt;) or intermediate sounds: (&lt;\text{bitellet}&gt; \sim &lt;\text{bitellit}&gt;)</td>
</tr>
<tr>
<td></td>
<td>B: positional alternation, e.g.: (&lt;\text{bitalat}&gt; \sim &lt;\text{kaepet}&gt;) or dialectal, e.g.: (&lt;\text{habba}&gt; \sim &lt;\text{habbe}&gt;)</td>
<td></td>
</tr>
</tbody>
</table>

Table 3.1: Possible interpretations of spelling variation

Table 3.1, field A:

A frequent pattern in chapter two is diachronic variation. This means that there are variations through time, but within each time frame one form is dominant. The data contains several examples of a statistically significant correlation between time and spelling change, for example, the case of the dative plural ending, archaic \(<\text{um}>\), later \(<\text{em}>\) and finally \(<\text{en}>\). A combination of historical linguistics information and statistical evidence extends the interpretation of \(<\text{um}>, <\text{em}>\) and \(<\text{en}>\) to \([\text{um}], [\text{em}]\) and \([\text{en}]\).
What does this mean for the phonological status of the archaic [u]? The archaic form [um] did not result in a different meaning by virtue of its vowel quality in Old Frisian; there was no contrasting ending *[am] or *[im]. The dative plural ending was the only context where <um> appeared in unstressed syllables in Old Frisian, with the exception of the Riustringen dialect. Therefore, in a strict theoretical, structuralistic approach, there is no unstressed phoneme /u/ at all. An unstressed [u] can be interpreted as an allophonic representation of an /æ/ before an /m/. Considering the diachronic correlations, the conclusion is that the old pronunciation of [um] was indeed replaced by the younger [əm] and later [ən].

Table 3.1, field B, positional:

Some variation is synchronically predictable, such as the difference between <bitalat> and <kaaper> in the north-east between 1400 and 1430. After long syllables an <e> is written, while after short syllables an <a> is written(cf. § 2.5.2). An interpretation of <a> as [a] and <e> as [æ] complies with known Vowel Balance patterns.

Table 3.1, field B, dialectal:

In the late 15th century, spelling of <habba> as an infinitive and present plural form of the verb ‘to have’ dominated in the south, whereas <habbe> was the regular spelling in the rest of the language area. This is a manifestation of (temporal) dialectal differences in pronunciation (cf. map 2.11). The singular of the word seke was sometimes spelled with a final <a> in the same southern regions. Spelling with an <a> in the ending is consistent with the phonetic effect of Vowel Harmony in the root (cf. § 2.6.3). This implies that the written final <a> in the singular of seke is not merely a spelling practice, but renders a sound [a].

In both cases from Table 3.1, field B, it remains open whether [a] and [æ] were allophonic realisations of an abstract phoneme /æ/ or whether they were two separate phonemes /a/ and /æ/.

Table 3.1, field C, sociolinguistic variation:

In dialectal or temporally defined variation, contrasts between regions or
time frames are not always sharp. Map 2.11 (<habbe> ~ <habba>) shows that [haba] may have been a characteristic of the south. However, not every charter in the south wrote the word <habba>, but this is no reason to question the close relationship between sign and sound. Competition between two forms, even among dialect speakers of a single village, is a well-known dialectological phenomenon.

The same may occur in the difference between <bitellat> and <bitellet> in the north-east during the early 15th century (map. 2.9 and 2.14). Spelling of the former complies with the Old Frisian form, while that of the latter complies with early-Modern Frisian. The transition from [bl'telat] to [bl'telct] was gradual, and at some stage writing bitelad in either form may have been written by people living alongside each other. One individual may have alternated between the two competing realisations. These are well-known examples of sociolinguistic variation. Here it becomes clear that there was no difference of meaning at stake, which implies no phonological opposition. This means the spelling changes reflected a purely phonetic or allophonic alternation.

Table 3.1, field C, intermediate sound values:
Another interpretation of synchronically competing <bitellat> and <bitellet> is that the <a> and <e> represented some intermediate sound between chronological stages [a] and [æ], for example, [æ] or [ɑ]. The option of transitional sounds is definitely an issue in the swapping of <e> and <i> in <bitellet> ~ <bitellit>. The historical vowel of the second syllable is /a/ and neither of the two graphemes, <e> nor <i>, seems to reflect [a]. Moreover, there is no temporal shift from one to the other (for example, graph 2.4), nor a fixed geographical core region. The alternation of <e> and <i> may, for example, reflect some fronted variant of [ɑ] (cf. further § 3.6).

Can the observed variation in chapter two be the result of random variation?
Sjölin (1969, 22) noticed distributional regularities in the alternative spellings, both from the perspective of history (for example, no final <i> in the infinitive), and a synchronous context (<e> and <i> alternate in protected position only). The data in chapter two brings a considerable number of statistically significant correlations between spelling alternations and well-known phonological and phonetic processes, such as reduction of full vowels, Vowel Harmony and Vowel Balance. The cumulative statistical evidence counters Sjölin’s labelling of the spelling in the charters as a “willkürliche Orthographie”. Sjölin’s interpretation does not even match his own factual observations.
Can the observed variation in chapter two be the result of ‘historical spelling’?
Section 3.1 looks at how some scholars consider the possibility of ‘historical spelling’. The conclusion of § 1.3.2. is that there was no sociological context for a firm Frisian spelling tradition in the 14th and 15th centuries. Without explicit or implicit conventions to rely on, writers would not spell the dative plural ending with an <um> if everyone were to say [om].

The case of /a/ and /ə/ in protected position provides a good example. By the year 1400, the spelling of <e> is already quite frequent in the second syllable of a word such as kāpad: <kapat> and <kaper>. A qualitative structuralistic analysis of the type presented in § 3.3 leads to the conclusion that <a> and <e> are alternative graphemes for one and the same phoneme, which implies one underlying vowel /æ/. Suppose there were a written tradition that authors could rely on, to know that the ending of the past participle of weak verbs of the type kāpia could be written with an <a>. What could possibly bring them to a writing practice where a contemporaneous [ə] was preferred as an <e> in a word such as kāpad, and yet frequently as an <a> in bitalad even though:

• Both vowels in the verbal ending were realised with an [ə],
• Both represented an historical /æ/,
• Both appear in the same morphological category?

The outcome of the statistical tests on the material in chapter two proves that the spelling variation is not the result of mere chance. Detailed linguistic information on quantitative syllable structures and Vowel Balance was not available to 15th century authors, neither by tradition, nor by fixed spelling regulations. Therefore, there can be no explanation other than that the second <a> in, for example, bitalad did indeed represent (something like) an [ə].

Section summary:

• Many of the spelling variations match diachronic or dialectal phonetic, or allophonic patterns and are not a ‘free, random variation’;
• A part of the remaining variation within one time frame and a limited region can still be regarded as a synchronic sociolinguistic manifestation of the aforementioned diachronic and dialectal variation;
• Only a small proportion of observed spelling variations seem to be ‘free’, and in those cases a phonetic interpretation is worth considering;

• Historically motivated spelling of a single phoneme /θ/ can be excluded. Spelling by convention (spelling rules) does not match the observed gradual quantitative patterns. Such spelling rules would ask for detailed historical-linguistic knowledge, that was not available at the time;

• The working hypothesis formulated in § 1.3.3, that <a> represents [a], <u> represents [u] etc. is largely confirmed. Spelling reflects phonetic and allophonic variations in the language;

• The question of a phonemic status of the vowels is still open.
3.3 Phonetic and phonological contrast

The following section discusses the phonological status of unstressed syllables in 15th century Frisian, applying synchronic, structuralist arguments for clarification.

A conclusion from the previous section is that the spelling of `<bitellat>`, written in the north-east in 1560 is not a manifestation of an underlying `/bitəlat/`. Does this imply that a realisation `[bitəlat]` from the same period and region, was an allophonic realisation of `/bitəlat/`? There was no contrasting inflectional suffix `*/at/`, so it is equally possible that there was a verbal ending `/Vt/` (`V = any vowel`) which was realised either `[at]` or `[t]`. The same applies to the historical dative plural ending `-um` with alternating realisations `[um]` and `[um]`.

Minimal pairs of unstressed vowels in protected position

The verbal endings of the strong past participle and the gerund provide examples of minimal pairs for protected unstressed `/a/` and `/æ/`. The gerund of ‘to be’ is `wesane` in Old Frisian, in the early 15th century `wesan`. Incidental cases of `<wessan>` are found up till 1506, but `<wessen>` became dominant in the early 15th century. This can be interpreted that `/vezan/` was the underlying form of the gerund, spelled as both `<wessan>` and `<wessen>`, and realised alternatively as `[vezan]` or `[vezan]`. The past participle was `wesen`. It is always written with a final `<en>`. The underlying form for the past participle is then `/vezan/`. That means that, throughout the entire 15th century, there was a phonological contrast between the vowels `/æ/` and `/a/` in protected unstressed position.

Minimal pairs of unstressed vowels in word-final position

In final position, the minimal pair `seke ~ seka` (`nom. ~ acc. sg. ~ nom. ~ acc. pl.`) provides a suitable example. In the first half of the 15th century, `/æ/` and `/a/` marked a paradigmatic contrast, so they are definitely phonemic. After 1460, the singular form became predominantly `<seck>`, while the plural remained `<secka>`. This is illustrative of all `/æ/ ~ /a/` contrasts in final position, because the word-final unstressed Old Frisian `/æ/` was generally subject to apocope in the 14th and 15th centuries. As a result, the majority of the remaining final vowels are the historical `/æ/`.

In `seke`, the plural ending `-a` is replaced by an `-en`. In the singular, with the historical ending `/æ/`, both an `<e>` and an `<a>` is written in those dialects where the apocope was not complete towards the end of the century. The same swapping, now for an

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121 In all protected positions where an `<e>` may appear, `<i>` is also written: `bitəlad` `<bitilit/-et>`, `habbit` `<habbit/-et>`, `wezen` `<wessin/-en>`, `sekan` `<sekim/-em>`. This is discussed further in § 3.6.
historical /a/, is found in the infinitive habba: <habbe> and <habba>. Therefore, in final position, basically one vowel was left at the end of the 15th century. In most cases, this was an historical /a/ or sometimes an historical /æ/. Historical semantic contrasts in the paradigm had been removed from the morphological system. This sole word-final phoneme /V/ had two possible realisations: [a] and [e]. The [a] was the prototypical realisation of the most frequent source of a word-final vowel, Old Frisian /æ/. The [e] was the prototypical realisation of Old Frisian /æ/ and the product of phonetic reduction of /a/. The realisation [a] was rapidly gaining ground during the first few decades of the 16th century.

An overview of the phonological contrasts is given in table 3.2:

<table>
<thead>
<tr>
<th>protected position</th>
<th>± 1400 - 1450</th>
<th>± 1450 - 1500</th>
</tr>
</thead>
<tbody>
<tr>
<td>/a/ /æ/ /é/ ~ /æ/</td>
<td>/a/ /æ/ /é/ ~ /æ/</td>
<td></td>
</tr>
<tr>
<td>before /m/: /æ/ /æ/ /é/</td>
<td>before /m/: /æ/ /æ/ /é/</td>
<td></td>
</tr>
</tbody>
</table>

Table 3.2: Phonemes in unstressed syllables in the 15th century.

The merging of word-final /a/ and /æ/ into a single phoneme /V/ in the late 15th century is an abstraction, where qualitative aspects are neglected. An historical /æ/ could occasionally be realised as an [a], but the frequency of this [æ] is much lower than in words with an historical /a/. The historical origin of the vowel was still reflected in the proportion of the two realisations [a] and [æ].

The outcome of this overview is that, where the realisation of an /a/ as an [a] declined in protected position early in the 15th century, the phonological contrast with /æ/ survived until the early 16th century. In word-final position, where the realisation [a] was far more common in the 15th century, the phonological contrast was lost by the middle of the 15th century. This seeming contradiction is the subject of the following section.

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122 The group of words with an historical final /a/ and a realisation of /æ/ /æ/ was enforced by the former weak feminine nouns. In some words, these nouns generalised the ending -a from the gen./dat. sg. cases to the entire singular, persisting in a frequent realisation with /æ/ /æ/, for example, streit <stre(e)ta> 'street', cf. § 2.4.2.
Section summary:

• Frisian maintained a vowel opposition in unstressed syllables in protected position until the early 16th century;

• In word-final position, the phonological opposition between /a/ and /ə/ was lost by the middle of the 15th century. The prototypical realisation of both phonemes, [a] and [ə], became optional realisations of the new phoneme.
3.4 Phonological contrast of underlying /a/ and /ə/

In this section, further arguments are provided as to why an underlying /a/, even when nearly always realised as an [ə], was still a contrasting phoneme, differing from the /ə/. An underlying /a/ in [hitə] and [hitət] can be confirmed when a surface vowel [ə] is derived from the underlying /a/ and behaves differently to the [ə], representing the underlying /ə/.

Different behaviour of the underlying /a/ and /ə/ in syncope

One process that reveals a contrast between an underlying /a/ and /ə/ is syncope. The verb kera ‘to choose’ is a good example of this. The sequence /ən/ was allowed in Middle Frisian, for example, in <swern> ‘sworn’ and <beren> ‘child’. The gerund of kera was keran(ə) and the past participle keren. Among the 35 attestations to the gerund from the 15th century, there is only one instance of <keran>: OFO II-102, 1482 (copy). In all other cases, the gerund ending is always written with an <e>, but without syncope: <ker(en)>.

Exactly the same pattern is observed in the verb swera ‘to swear’. The gerund of this word is always written with a final <en>, <swer(en)>.

Resistence of a protected unstressed /a/ to syncope is also very clear in the group of verbs ending in -ia, such as bitia and kâpia, that have unstressed protected /a/

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123 The past participle is often used as an adjective. In inflected forms of the past participle, syncope is frequently found: myn uterkerna broren ‘my chosen brothers’ (OFO I-307, 1481). Forms of the gerund of kera, with final vowel, are only attested in OFO II-2 (1379), <kerane>. The oldest attestations with syncope of /a/ in the sequence /VCV#/ are from about 1440. At that time, the final schwa of the gerund had already been lost, i.e., historical /kəran/ > /kan/, which could not result in <keren>. The gap in time between the apocope of the final /a/ in the gerund and syncope in /VCV#/ is too great. For differences in the spelling of /t/ as <t> or <tr> in the gerund and past participle, see § 2.3.3.2.

124 The combined evidence of swera and kera provides a significant correlation between syncope and the past participle, see appendix 1.
in many forms of the paradigm: 2nd and 3rd pers. sg. present tense and the entire past tense and past participle. This historical, or underlying, /a/ is never subject to syncope. For example, the past participle of the verb tella 'to count' regularly appears as <teld>, showing that the sequence /ld/ is quite possible in Middle Frisian. The past participle of bitella 'to count' never appears as *<bytld>. Words ending in /a/ + dental consonant /t, d, þ/ do not apply syncope to the vowel, but drop the final consonant, for example, modern mouane, not *moant < OF mûnath, modern betelle, not *beteld < OF bitalad. The syncope of the schwa in the Old Frisian sequence /øp/ that appears, for example, in the 3rd pers. sg. pres. of strong verbs and weak verbs in -a, had already taken place in the 14th century (cf. § 2.4.3.7).

The syncope in abbate 'abbot' is an interesting case of the contrast between the underlying /a/ and /ø/ in the north-east, the spelling <abbet> prevailed until 1460, whereas in the south-west the word was subject to early syncope: <abte>. Discussion of the words for 'Monday' (§ 2.3.4.2) and 'Sunday' (§ 2.4.3.2) show there were manifestations of protected unstressed /a/ in those words in the north-east, shortening before the older /a/ in <monnadey>, <moanndei>, accent shift in <snande> < /sonandði). The south-west showed forms that presuppose an /ø/, <moenendei> with long /ø:/, <sennedei>, Hindeloopen 17th century < /sonondði>. Syncope of /a/ in abbate in the south-west and the retention of <e> in the north-east may be attributed to a similar dialectal contrast as in 'Monday' and 'Sunday'. The second vowel of the word became /ø/ in the south-west and was subject to syncope, but the vowel remained as an /a/ in the north-east, preventing syncope.

South-west: /abbəʊ/ → <abte> normal development for sequence [ø-ø] (§ 2.4.3.7)
North-east: /abbəa/ → <abbet>

The underlying /a/ hardly ever appears in the word abbate, except in a copy of a 1453 charter (OFO II-34) from Dongeradeel (North-East). However, the two underlying vowels behave differently.

The underlying /a/, being historically an Old Frisian /a/, behaves differently to syncope than the underlying /ø/. The word abbate retained its underlying /a/ in the second syllable in the north-east. In the south-west, the word developed an underlying /ø/, a transition that has similarities with the 'Sunday' and 'Monday' examples.
Underlying /a/ and Vowel Harmony

In Vowel Harmony, the influence of underlying /a/, even when realised as [a], is also different to that of /a/. In welan(e), the gerund of the verb welan ‘to be’ with underlying /a/, the vowel of the ending is written <e> in 92% of the cases, and hence realised as [e] (§ 2.6.3). The past participle wesen has underlying /a/ in the ending, also realised as [e]. Vowel Harmony /a/-mutation is common in the gerund, but completely absent in the past participle. The underlying /a/ still controlled the distribution of the Vowel Harmony and provides evidence of the existence of two different unstressed vowels, historically to be identified as /a/ and /e/.

Section summary:

• The existence of two different vowels in protected, unstressed position is supported by the developments of syncope and Vowel Harmony;

• Phonological opposition also functioned when an /a/ was realised as an [e].
3.5 The nature of ‘underlying’ /a/

How did new speakers manage to learn the difference between a protected /a/ and an /ə/? The realisation of the /ə/ as [ə] was limited to a few pre-1450 occurrences. Even the oldest charter from 1329 contains pairs such as <komat ~ habbe t>. The alternation of [ə] and [ə] for an underlying /ə/ in protected position must have been common long before 1400. After 1450 the realisation with an [ə] was very rare. Many words with underlying /ə/ are hardly attested with <ə> spelling. The previous paragraph demonstrates that, when realised as an [ə], the ‘underlying’ /ə/ behaved differently.

Many speakers in about 1440 learned the language with only an [ə] in protected position. How could they or their children ‘decide’ upon syncope in 1460 or 1480, based on an underlying /ə/ that they had never come across when they were learning the language 20 or 40 years earlier? After 1450, the historical /ə/ was hardly ever subject to syncope, while the historical /ə/ was (cf. graph 2.13 with examples of syncope of historical /ə/ up till 1500). There must have been some additional observable feature that enabled language learners in for example, 1440 to distinguish the [ə] = /ə/ from an [ə] = /ə/.

Examples such as abbate, mōnan dei and sonnan dei show that words with an historical unstressed /ə/ could behave like words with /ə/ in the course of the reduction process of unstressed vowels. In all these words, the unstressed /ə/ was in word-interior position, followed by another unstressed syllable. § 2.4.1 mentions parallel examples of more intense reduction of unstressed vowels in word-interior position from Wallisian High German and Riustringen Old Frisian. Apparently, historical /ə/ could coalesce with historical /ə/ under more intense reduction circumstances. While the ‘underlying’ /ə/ was distinguished from the ‘underlying’ /ə/ on a regular basis, the distinctive feature was lost in specific reduction contexts.

Chapter four advocates that words with an unstressed /ə/ in the second syllable bore a contrasting tone contour, with a pitch peak late in the stressed syllable or even in the beginning of the second syllable (Level Stress). In words with an /ə/ in the second syllable, the pitch peak was positioned at the beginning of the first syllable. Words with an historical /ə/ that behave like words with /ə/ had lost their contrasting tone contour.
Section summary:

- The realisation of the historical /a/ by [a] was too weak and cannot account for the strict separation of historical /ə/ in the diachronic development of the 15th century;
- It is suggested that the underlying /a/ in the 15th century did not find its expression in the phonetic quality [a], but in a special tone contour on the whole word.
3.6 The nature of protected <i>

Section 3.2 briefly concludes that <i> is a variant of <e> in protected position. Irrespective of the historical origin of the /\alphashwa/, <i> could be written alongside <e>. In the words *bitalad and *habbath, spelling forms such as *bitalit and *habbit appear for the first time when the historical ending with [a] was already beginning to disappear (cf. graph 2.4 and 2.6). Also, in the dative plural ending with historical /u/, <im> could appear as a variant of <em>. The alternation between <e> and <i> is restricted to the protected position. In the dative singular ending of masculine and neuter nouns, with a final /\alphashwa/, the spelling with <i> never appears, as in the infinitive ending or the subjunctive: *<husi> for <huse> ‘house’, *<habbi> for <habba> ‘to have’ or *<komi> for <kome> ‘come’.

The exact phonetic relation between <e> and <i> is not easy to define. There are two options:

- The alternation of <e> and <i> is an expression of the effort to render an intermediate sound, for example, [i];
- <e> and <i> are the reflections of actual [\alphashwa] and [\iota] that alternate according to idiolectal, dialectal, phonotactic or prosodic circumstances. This could be compared with the situation in modern Dutch, where /\alphashwa/ is realised as [\iota] before /\eta/, but as [\iota] before /\omega/: *koning, zwaluw (Trommelen 1984, 33-34).

<i>/<e> alternation as a marker of an intermediate sound

In a two-vowel system of unstressed syllables, found in Old and Middle Frisian, with /a/ and /\alphashwa/, the /\alphashwa/ is likely to be less central than in languages with only /\alphashwa/, for example, a sound such as [\iota]. The realisation of /\alphashwa/ in Modern Frisian and Modern Dutch is very centralised with a strong tendency towards labialisation, close to [\alpha]. In other modern Germanic languages, with only /\alphashwa/ in unstressed syllables, such as High German and Danish, the realisation tends more towards [e] or [\iota].

A similar unrounded and rather fronted realisation of /\alphashwa/ is found in Modern Norwegian. In Modern Norwegian, with /\alphashwa/ and /a/ in unstressed syllables, the realisation of the schwa is clearly different to the realisation in modern Frisian, Dutch or English. It sounds like [e].

Descriptions made by grammarians Montanus and Ten Kate suggest a similar “ongeronde palatale realisatie”

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125 Observation by the author of a native speaker of Norwegian. The informant asserted that she could easily identify non-native speakers of Norwegian by their incorrect realisation of /\alphashwa/.
A.P. Versloot: *Mechanisms of Language Change*

(‘unrounded, palatal realisation’) of /ə/ in 17th and 18th centuries Dutch (Schönfeld / Van Loey 1970, 113). It is not unlikely that this realisation was also the common one in Frisian at that time. In early-Modern Frisian texts, spelling forms appear such as <Woutir> for ‘Walter’ <mackit> ‘makes’, in modern spelling <Wouter>, <makket>. The change in the realisation of the /ə/ in West Frisian is also reflected in the spelling of the indefinite article. In early-Modern Frisian texts, written without fixed spelling rules, the indefinite article is almost exclusively written as <in>. This is still the modern spelling form, but during a discussion on spelling reforms in the 1970s it was suggested it be written more ‘phonetically’ as <un> = [øn], reflecting the modern pronunciation of /ə/.

Conclusively, there is ample evidence of an unrounded, rather fronted realisation of the /ə/ in Germanic languages. This is also applicable to Frisian. A similar realisation is suggested by the alternating spelling of <e> and <i> in non-final position in Old Frisian texts (<1400), 15th and 16th century charters and early-Modern Frisian texts from the 17th and 18th centuries.

**<e> / <i> alternation reflecting phonetically contrasting sounds**

Both Old Frisian and Middle Frisian reveal a tendency towards ‘Seesaw’ Vowel Harmony, where <i> is combined with an extreme vowel in the root, while <e> has a preference for mid-open vowels (§ 2.6.2, table 2.25). The evidence implies a fairly consistent trend in West Frisian to develop a preference, albeit a relative one, for a more closed realisation of /ə/ when following a closed or open vowel, for example /I/, /a/, while the half-open root vowel /ɛ/ evokes a more centralised realisation of /ə/. The more closed realisation led several authors to render the vowel as <i> in the spelling.

The evidence from the Vowel Harmony, together with the information about actual pronunciation of /ə/ in previous centuries and in related languages can be combined very well to put together a consistent picture. It was only a fronted realisation of /ə/ which could become so closed due to Vowel Harmony effects to deserve the spelling <i> by some authors.

**Differences in spelling the /ə/ in word-final and protected position**

The reason why spelling with an <i> never appears in word-final position is a subtle interaction between spelling and pronunciation. A word-final, unstressed vowel exhibits more phonetic contrast (less centralised) than its protected counterpart. This phonetic phenomenon is, for example, the cause of the relative early reduction of protected, unstressed /a/, as in *wesam(e)* ‘to be (gerund)’, against word-final /a/, as in *wes* ‘to be (infinitive)’, cf. graph 2.10. This contrast results in a default interpretation of <i#> as [j], while the default interpretation of the vowel in <iC> is <i>. This difference is depicted in graph 3.1:
Graph 3.1 shows that the position of the fronted, moderately high [ə] is somewhere between the opening position of [i] and [ɛ]. This [ə] falls within the spread of the common realisation of protected <iC> and <eC>, but lies beyond the realisation of word-final <i#>. Both word-final [ə] and protected [ə] may have sounded equally fronted. Protected [ə] could be spelled both with <iC> and <eC>. In word-final position, the spelling <i#> is not a suitable approximation of [ə], because it would have meant [i].
Section summary:

- The spelling of `<i>` is a variant of `<e>` as an unstressed vowel `/ø/`.
- Swapping `<e>` and `<i>` reflects the phonetic nature of `/ø/` as a somewhat fronted vowel, as in Modern Norwegian, but distinct from the Modern Frisian and Dutch realisations, which tend to favour `[ø]`.
- This `/ø/`, with a fairly fronted realisation, was generally perceived as a mid-open vowel when it followed `/e/` and was spelled `<e>`. However, it was more often perceived as `[i]` and spelled `<i>`, when following a root with extreme vowels (such as `/i/`, `/l/`, `/a/`, `/u/`). The absolute ratio of this alternation depended on dialect, time, context, personal preference, etc.
- Due to an asymmetric relation between spelling and phonetics in protected and word ending position, the rendering of the fronted and somewhat raised realisation of `/ø/` as `<i>` is restricted to the protected position.
4. Late medieval Frisian as a tonal language

In previous sections, reference is made to the possibility that Frisian possessed phonologically contrasting tone contours. In the first section of this chapter, an overview of developments that may be linked with contrasting tone contours is given.

The next section offers a brief typological search through Germanic languages, especially East Frisian and North Germanic, revealing the distributional link between tonal oppositions and previously highlighted phonological developments.

In § 4.3 the tonal system of North Germanic languages is outlined briefly, followed by an explanation of the prominence of unstressed /a/ in Old Frisian in § 4.4. Quantitative and qualitative effects of contrasting tone contours in Frisian are assessed in § 4.5 and § 4.6. In § 4.7 an attempt is made to explain how tone contour became a distinguishing phonological feature of Middle Frisian in the 15th century. Section § 4.8 deals with the typical dialect-geographical character of the region of Wûnseradiel.

4.1 The heavy impact of Old Frisian /a/

The suggestion that a contrasting tone contour, or something similar, might be present arises in the following contexts:

- The Old Frisian protected /a/ was reduced to [o] in the early 15th century. This new [o] behaves differently to the [a] which represented historical /a/ in processes such as syncope, apocope and Vowel Harmony:
  - The historical /a/ was not reduced to o, even when the gradual erosion of unstressed vowels predicted a complete elimination of the vowel (§ 3.4), for example:
    Old Frisian kersan(e) ‘to choose (gerund)’ > Middle Frisian /kərən/;
    Old Frisian kersan ‘chosen’ > Middle Frisian /kərən/ or /kərn/;
  - The historical /a/, even when realised as [a] remained connected with Vowel Harmony of the root vowel: [e] > [æ]. The original root vowel [e] of the words was generally restored, although the actual cause of the harmony, a subsequent [a] had already disappeared. (§ 2.6.3 / 3.4), for example:
    Old Frisian wesan(e) ‘to be (gerund)’ > Middle Frisian [væzən] > early Modern Frisian /vəizən/, not */væzən/, cf. Modern Frisian /vēzər/ ≈ Old Frisian wēset without Vowel Harmony;
The historical, unstressed /a/ had a great influence on the quantitative development of root vowels:

- Open Syllable Lengthening generally does not take place when the vowel of the next syllable is an Old Frisian /a/ (§ 2.3.3.1 / 2.3.3.2), for example:
  Old Frisian *dore* 'door' > Middle Frisian /dɔ:r/;
  Old Frisian *dora* 'doors' > Middle Frisian /dɔr/;

- In language from the south and west of Fryslân, there are also indications of vowel lengthening before the subsequent /a/, but these contexts show frequent application of the statistically marked spelling sequence <VVCC> (§ 2.3.3.3, type 1), for example:
  Old Frisian *klagere* 'complainer' > Middle Frisian <cla(e)ger> /klaːɣər/;
  Old Frisian *bitalad* 'paid' > Middle Frisian <bytaellit> /biːta.lɛt/;

- In particular in the language from the north-east and also Wûnseradiel, shortening of historically long vowels sometimes appears when this vowel is followed by an /a/ in the next syllable (§ 2.3.4), for example:
  Old Frisian *mûnandei* 'Monday' > Middle Frisian NE: <mûnendey>;
  Old Frisian *mûnandei* > Middle Frisian SW: <mûnendei>;

- In the same regions, the spelling sequence <VVCC> sometimes appears in words with historically long vowels when followed by unstressed /a/ (§ 2.3.3.3, type 2), for example:
  Old Frisian *kâpad* 'bought' > Middle Frisian NE: <kaepit>;
  Old Frisian *kâpad* > Middle Frisian rest: <ca(e)pet>;

- There are several cases of accent shift from the root to the initially unstressed /a/ in the second syllable, as several place names and the word for 'Sunday' (§ 2.4.3.2) show:
  Old Frisian *sunnandei* 'Sunday' > Middle Frisian <sunande>;
  Old Frisian *Tunawerth* place name > Modern Frisian Ter'nauerd.

The distribution of this phenomenon is closely linked to the historical presence of unstressed /a/, but at crucial points, the developments could be independent of the actual realisation as [a], as in missing syncope. The Vowel Harmony illustrates that at the initial stage, the actual quality of the [a] was a prerequisite for the process, but at the final stage, the actual [a] was no longer needed to mark the (historical) Vowel Harmony in specific words.

The sometimes loose association between historical /a/ and the aforementioned phenomenon is also demonstrated in examples which used to have an historical
Note that this sign was hitherto used to mark the intensity stress.

126 Note that this sign was hitherto used to mark the intensity stress.
4.2 Finding typological parallels

Features connected with unstressed /a/ or its specific tone contour are most prominent in the centre and north-east of Fryslân. Several of these features, such as Vowel Harmony and Accent Shift, are well known in the Weser Frisian group of East Frisian dialects. Vowel Balance, in Frisian linguistics discussed only in the context of Riustringen Old Frisian, appears to be a prominent feature in late mediaeval West Frisian. Subsequently, explanations considered for the Weser Frisian data are also worth considering for West Frisian. A relatively late pitch peak in words with a short root syllable has recently been suggested as an explanation for...
In Scandinavia, several dialects show one or more of the following phenomena: Vowel Harmony, Vowel Balance and an absence of Open Syllable Lengthening (map 4.1). It is remarkable that the languages of the Faroe Islands and Iceland, known for their archaic linguistic character, do not show traces of these phenomena. There is no Vowel Harmony, nor Vowel Balance, and a rigid application of Open Syllable Lengthening. After Icelandic, Alvdalsk, the Swedish dialect from the Dalarna region, is probably the most archaic form of North Germanic. It does display the expected phenomena. Compare the following examples in table 4.1 an 4.2 (Alvdalsk here and later after Levander 1909):

<table>
<thead>
<tr>
<th>Meaning</th>
<th>Icelandic</th>
<th>Alvdalsk</th>
</tr>
</thead>
<tbody>
<tr>
<td>to taste</td>
<td>smella [sməlːa]</td>
<td>smella [sməlːa]</td>
</tr>
<tr>
<td>to steal</td>
<td>stella [stəːla]</td>
<td>stjælo [stjælɔ]</td>
</tr>
</tbody>
</table>

Table 4.1: Vowel Balance in Alvdalsk and Open Syllable Lengthening in Icelandic.

Icelandic has Open Syllable Lengthening in the word stela; the consistent application of Open Syllable Lengthening in Icelandic makes every root syllable long, i.e. [sməlː]- (sic!) and [stəːlː]-. The subsequent infinitive marker is always an [a]. Alvdalsk has no Open Syllable Lengthening and keeps the difference between long [sməlː] and short [stjæl]. Following the long root syllable, Alvdalsk has an [a], the modern equivalent of Old Nordic short /a/ in closed syllables. After a short root syllable, the qualitative equivalent of an Old Nordic /a:/ appears. Alvdalsk shows an historical balance between a long root ~ Old Nordic short /a/ and a short root ~ Old Nordic /a:/.

---

127 Icelandic shows a- and u-mutation, which are cases of backward Vowel Harmony (cf. table 2.24). Vowel Harmony and Vowel Balance seem to be closely linked to short syllables. It might be argued that the general application of Open Syllable Lengthening in Icelandic excludes the possibility of Vowel Harmony and Vowel Balance. However tempting this may appear from a modern point of view, it does not hold in an historical reconstruction, as Vowel Harmony and Vowel Balance features are older in North Germanic languages (13th-/14th centuries) than Open Syllable Lengthening in Icelandic (16th century, Haugen 1984, 263/327).

128 Note that it is a 'short version' of the modern representation of Old Nordic /a:/, which is long [a:] in Alvdalsk in stressed syllables. Quantitative contrasts do not appear in unstressed syllables in any modern Germanic dialect, cf. § 2.4.1. In structuralistic terms, it could be said that [a] is the realisation of 'underlying' /a:/ in unstressed position (cf. for a discussion of this phenomenon Bye, 2004b).
Table 4.2: Vowel Harmony in Álvdalsk and Open Syllable Lengthening in Icelandic.

<table>
<thead>
<tr>
<th>meaning</th>
<th>Icelandic</th>
<th>Álvdalsk</th>
</tr>
</thead>
<tbody>
<tr>
<td>harm (nom. sg.)</td>
<td>skaði [skɔðI]</td>
<td>skaði [skɔðI]</td>
</tr>
<tr>
<td>harm (acc. sg.)</td>
<td>skaða [skɔða]</td>
<td>skaða [skɔða]</td>
</tr>
</tbody>
</table>

As in the other example from table 4.1, Icelandic has Open Syllable Lengthening. Álvdalsk has no Open Syllable Lengthening. The Old Nordic root vowel /a/ is realised as [a] before the subsequent open back vowel [ø], but as [a] before fronted [ø] in Álvdalsk. This is an example of ‘Seesaw’ accommodation, as mentioned in § 2.6.2.

In some Scandinavian dialects, more extreme examples of Vowel Harmony can be found, for example, in Vemdalsk (Norway, cf. Bye 2004b, 13):

[komːɔ] ‘to come’ < Old Nordic koma
[leiːva] ‘to live’ < Old Nordic leva

Álvdalsk, Vemdalsk and most of the other North Germanic dialects with Vowel Harmony, Vowel Balance, and a sometimes omitted Open Syllable Lengthening, are found within the region that exhibits two contrasting tone contours, the so-called Scandinavian Accent I and II (cf. graph 4.1 in the next section).

The Swedish dialects spoken in Finland that do not have contrasting tone contours can be linked to relative recent influence from Finnish (Bye 2004a, 7). The typological parallels between the Scandinavian situation and the depicted phenomena in late mediaeval West Frisian suggest the possibility of contrasting tone contours in Frisian as well. This indication is only the first step in the reconstruction of the phonological events in late mediaeval West Frisian. Co-occurrence is not the same as a causal relationship. Even when the former has been concluded, the latter is open to further investigation.

It is important to note that the situation as found in the modern Scandinavian dialects is lexicalised and petrified. The distribution of the phenomena in the language reflects historical phonological and phonetic contexts. In modern language, things are no longer predictable as allophonic phenomena, nor do they match the original phonetic rationale.

A good example of this is Vowel Balance in Álvdalsk. The phonetic rationale of Vowel Balance is one of a spread of speech energy, compatible with the duration
In Ålvdalsk, a short root is followed by an [ə], which is perhaps no more centralised, but certainly less open than the vowel following a long root, [a]. If Vowel Balance were an active phonetic process in Modern Ålvdalsk, the reverse distribution of [ə] and [a] is expected. This confirms the statement in § 2.6.1 that many of these originally phonetically-induced phenomena are petrified structures which could develop independently of their original phonetic logic.

In addition, the distribution of the contrasting tone contours has been lexicalised in Scandinavian dialects, where they started as a predictable and redundant phonetic pattern (cf. § 4.3). Map 4.1 also illustrates that there are many dialects with contrasting tone contours, with none of the above-mentioned features of Vowel Harmony etc.

The conclusion from this typological comparison is that North Germanic dialects can provide an explanation for phonological phenomena of 15th century West Frisian, but modern dialects cannot be taken as a direct parallel of the Frisian situation in the 15th century.
4.3 The character of tonal contrasts in Scandinavian dialects

Norwegian and Swedish have two contrasting tone contours, regularly referred to as Accent I and Accent II (cf. Bye 2004a, 6 as the source for the following description). Accent I is the 'default' accent, which corresponds to the regular one in most West Germanic languages. In languages such as Modern Frisian, Dutch, English and German it is applied at the beginning of the root syllable, as in type 1A, Accent I (left column) in graph 4.1. It is important to note that the phonetic realisations of the two accents can be quite different. The realisation of Accent II in the dialect of Gotland for example, (graph 1.4, 1B right) is identical to the realisation of Accent I in Standard Swedish (graph 1.4, 2A left). All dialects share one characteristic: Accent I has only one pitch peak in every dialect while Accent II is characterised by a late or double pitch peak.

<table>
<thead>
<tr>
<th></th>
<th>One peak</th>
<th>One peak</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1A</td>
<td>early in</td>
<td>late in</td>
</tr>
<tr>
<td></td>
<td>stressed</td>
<td>stressed</td>
</tr>
<tr>
<td></td>
<td>syllable</td>
<td>syllable</td>
</tr>
<tr>
<td></td>
<td></td>
<td>South Sweden, West Norway</td>
</tr>
<tr>
<td>1B</td>
<td>late in</td>
<td>early in</td>
</tr>
<tr>
<td></td>
<td>stressed</td>
<td>post-stress</td>
</tr>
<tr>
<td></td>
<td>syllable</td>
<td>syllable</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Gotland, Bergslagen (Sweden)</td>
</tr>
</tbody>
</table>

Graph 4.1: Accent realisations in Scandinavian dialects; left column: Accent I right column: Accent II (Bye 2004a, 6). Stockholm has 2A, Oslo has 2B.

<table>
<thead>
<tr>
<th></th>
<th>Two peaks</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td></td>
</tr>
<tr>
<td>2A</td>
<td>late in</td>
</tr>
<tr>
<td></td>
<td>stressed</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>2B</td>
<td>in post-stress</td>
</tr>
<tr>
<td></td>
<td>syllable</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

129 In Danish, words that have Accent I in Norwegian and Swedish have the Danish 'stød', Accent II words have a 'normal' stress pattern. From a structural point of view, Danish resembles other Scandinavian languages in its contrasting 'accents'.

-232-
The origin of the Scandinavian tone contrast lies in Old Nordic. Accent I becomes a default in monosyllabic words. Accent II is found in bisyllabic Old Nordic words:

- **Old Nordic arm** → **Modern Norwegian arm** ‘arm’
- **Old Nordic armar** → **Modern Norwegian armers** ‘arms’
- **Old Nordic arm hinn** → **Modern Norwegian armen** ‘the arm’

The bisyllabic Modern Norwegian word *armen*, with the clitical definite article, has Accent I, because it originates from two separate Old Nordic words which merged into one at a later stage. This is an example where the situation in modern Scandinavian languages has been lexicalised and has deviated from the original process that led to it.

In the framework of the Old Nordic hypothesis, type 1A in graph 4.1 is the archetypical realisation. In an Old Nordic context, it is a 100% predictable, seemingly redundant, phonetic phenomenon, where the tone contour is spread evenly over the word. In a monosyllabic word, the pitch peak lies at the beginning. In a bisyllabic word, the pitch peak moves towards the middle of the word, following the distribution of the speech energy over multiple syllables.

According to Bye (2004a), types 1B, 2A and 2B are the result of a gradual peak delay. The pitch peak shifts gradually to the right, while new peaks are inserted in instances of extreme positioning on the right of the word in the Types 2A and B. These are specific later Scandinavian developments and are not relevant for the Frisian case.

There is an important category 1A sub-type involving words with a short root syllable (Bye 2004a, 14, note 6 / 2004b, 2). In type 1A, the pitch peak is on the first syllable, both in Accent I and Accent II, even though it is somewhat later in Accent II. When the first syllable is short, an alternative situation emerges, where the peak delay in Accent II matches the length of the entire first, short syllable, creating a situation where the peak is not reached before the beginning of the second syllable.

---

130 There is a competing theory, namely the Proto-Nordic theory, where pitch peaks are linked to Proto-Nordic long syllables. The Old Nordic theory seems more plausible. For recent evaluation of the two theories see Bye 2004a, 37-40.

131 It is dangerous to call linguistic features ‘redundant’. In a deterministic dynamic system, governed by self-organisation, apparently redundant features may be essential cues for the listener to overcome ambiguities.
This implies that Accent II, type 1B (cf. graph 4.1) was applied to short-rooted words, whereas long-rooted words exhibited pattern 1A. This is a subtle process. A shift in timing can result in an acoustic impression of Level Stress. The intensity stress (loudness) is concentrated on the first syllable, while the pitch peak is concentrated on the (beginning) of the second syllable.

In the framework of the Old Nordic hypothesis, all these variations are completely redundant, predictable from the syllable structure and moreover, gradual. This archaic situation forms the starting point for the reconstruction of Frisian developments in the 15th century.

The following sections deal with the following topics:

- Why do only bisyllabic words with an /a/ in the second syllable have Accent II in Old Frisian?
- Contrasting tone contours and quantitative effects: The non-presence of Open Syllable Lengthening and the shortening of root vowels before unstressed /a/ against a background of dialectal diversity in 15th century West Frisian;
- Contrasting tone contours and 'qualitative' effects: Vowel Harmony and Accent Shift;
- Lexicalisation of tone contour contrast in the 15th century;
- The special position of the dialect of Wûnseradiel in the early 15th century.
4.4 The prominence of unstressed /a/

In Proto-Germanic, intensity stress and pitch accent are independent. In most Modern West Germanic languages they are closely related: Pitch accent can only be realised when a syllable bears an intensity stress. In Proto-Frisian (± 1000?) the Old Nordic situation is assumed, where the tone contour stretched over the word syllables. The tone contour was phonetically predictable. In bisyllabic words, the pitch peak is found somewhere in the middle of the word. Due to individual variations in focus, the pitch peak may end up somewhere on the end of the first syllable or the beginning of the second syllable. This is a case of Level Stress. The latter situation is more likely in words with a short first root. All this is completely predictable from the word structure. Small differences in timing may affect the later developments.\(^\text{132}\)

The default tone contour on a bisyllabic word such as *dora* ‘doors’ is illustrated in graph 4.2. In the plural form of the word ‘door’ /d\(\text{ora}\)/, the tone contour follows the duration contour of the word, with the peak somewhere in the middle. Note, the width of the ‘letter boxes’ and the positioning of the peak are meant as models and do not represent absolute values. The importance of graph 4.2 and 4.3 lies in the depiction of a shift in relative values. Proto-Frisian has several full vowels in unstressed syllables and there is no reason to assume a different contour for the plural *dora* than for the singular *doru*.\(^\text{133}\) A pitch peak later on in the word is no protection against vowel reduction, as can be seen in the Scandinavian languages. Before the 12\(^\text{th}\) century, all unstressed vowels other than /a/ were reduced to /\(\text{a}\)/.

\(^{132}\) Bye (2004a, 47): “[... ] multidimensional discrete phonological variations may emerge from adjustments on a small number of continuous phonetic parameters. The engine of variation is phonetic.”

\(^{133}\) Leaving aside the question of Vowel Harmony, so *doru* versus *dora*. 
The oldest preserved Frisian text, the psalmglosses of the 12th century, has only an \(<a>\) (= /a/) and an \(<e>\) (= /ɛ/) in unstressed syllables, with the exception of \(<um>\) in the dative plural. The Weser Frisian group with /i/ ~ /a/ ~ /u/ is an exception in this respect.

Graph 4.3 (1) shows the original length configuration for /dɔrʉ/ and graph 4.3 (2) the application of the default tone contour. In Old West Frisian, the unstressed /u/ was reduced to /ø/. This had an automatic consequence for its duration: /ø/ is shorter than any full vowel. The new configuration is shown in graph 4.3 (3). Stretching the default tone contour over this shorter word with the pitch peak in the middle of the prosodic word duration, the peak is situated more to the left in structure than it is in the previous form /dɔrʉ/ or the plural /dɔɾə/, see graph 4.3. (4).

Graph 4.3 (4) is drawn in grey, because it is not a stable situation. The reduction of vowel duration in the final syllable and the subsequent shift of the pitch peak to the left, automatically causes another phonetic effect: stress invokes duration.

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[134] The oldest preserved Frisian text, the psalmglosses of the 12th century, has only an \(<a>\) (= /a/) and an \(<e>\) (= /ɛ/) in unstressed syllables, with the exception of \(<um>\) in the dative plural. The Weser Frisian group with /i/ ~ /a/ ~ /u/ is an exception in this respect.
A stressed /ə/ is phonetically longer than an unstressed /ə/. A late pitch peak counteracts this effect, as the relative (and absolute) length of root syllables in words with a relatively late pitch peak, shown in graph 4.3 (2), is shorter than in words with an early pitch peak (Van Leyden 2004, 68). When the pitch peak shifts towards the beginning of the word, thanks to the relatively short [ə], as depicted in graph 4.3 (4), the root syllable is freer to exhibit stress-enforced phonetic lengthening. The result is shown in graph 4.3 (5). In graph 4.3 (6) the default tone contour is applied to this new configuration of duration elements. The peak of the tone contour has shifted relatively towards the beginning of the word. Therefore, reduction of an unstressed vowel [u] to an [ə] automatically leads to an earlier pitch peak in /dəə/ than in /dəra/.

This contrast in tone contours becomes even stronger when Open Syllable Lengthening is phonologised, and becomes imperative when the final schwa is dropped. But these developments are not prerequisites for the phonologisation of Accent I. Accent I is also found in bisyllabic words without Open Vowel Lengthening and without apocope/syncope. For example:

\[
\begin{align*}
\text{wessen} &< /\text{wəsən}/ & \text{no Vowel Harmony} & \text{Accent I} & \text{‘been’ (past. part.)} \\
\text{wassen} &< /\text{wəsən(ə)}/ & \text{Vowel Harmony} & \text{Accent II} & \text{‘to be’ (gerund)}
\end{align*}
\]

or:

\[
\begin{align*}
\text{kerren} &< /\text{kərən}/ & \text{occasional /ə/-syncope} & \text{Accent I} & \text{‘chosen’ (past. part.)} \\
\text{keren} &< /\text{kərə(ə)}/ & \text{without syncope} & \text{Accent II} & \text{‘to choose’ (gerund)}
\end{align*}
\]

In graph 4.3 (6), stress cues for intensity, duration and pitch peak are aligned with the first syllable, even if the exact positioning of the pitch peak is slightly later than in usual Accent I words. The sound [ə] in the second syllable is found solely in unstressed syllables, and gives an additional negative cue for the positioning of stress in the second syllable. The listener receives cues for the positioning of stress in the word that shows similarity with the cues for Accent I. The similarity in cues may help explain the identification of short-rooted words with /ə/ in the second syllable with Accent I words.

---

135 The shortening effect due to a late pitch peak can be calculated from data provided by Van Leyden at approximately 10 to 20%.
Apart from affixes such as bi- and -lik, as well as [u] in the dative plural -um. The length contrast between [u] and [c] is far less than between [a] and [c] (De Graaf 1986, 5; there the length of [u] and [c] are the same.). This short [u] also appeared in protected position (-um), making it even shorter. The shift of the pitch peak, as demonstrated in graph 4.3, was a quantity induced process. So, the protected [u] in the dative plural followed the same fate as [c]. The realisation as [u] in the sequence [um] (instead of [am]) may be of the same nature as /a/, appearing as [I] and [j] in Dutch koning ‘king’ and zwaluw ‘swallow’ (cf. § 3.6).

These developments had important consequences for the phonetic marking of unstressed /a/ in Old (West) Frisian. In a language with almost only /a/ and /ø/ in unstressed syllables (other full vowels had already been reduced to /ø/ by that time\(^{156}\)), where words with an /ø/ in unstressed position were excluded from Accent II for purely phonetic reasons, Accent II became a unique and significant marker of words containing unstressed /a/.

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\(^{156}\) Apart from affixes such as bi- and -lik, as well as [u] in the dative plural -um. The length contrast between [u] and [ø] is far less than between [a] and [ø] (De Graaf 1986, 5; there the length of [u] and [ø] are the same.). This short [u] also appeared in protected position (-um), making it even shorter. The shift of the pitch peak, as demonstrated in graph 4.3, was a quantity induced process. So, the protected [u] in the dative plural followed the same fate as [a]. The realisation as [u] in the sequence [um] (instead of [am]) may be of the same nature as /a/, appearing as [I] and [j] in Dutch koning ‘king’ and zwaluw ‘swallow’ (cf. § 3.6).
4.5 Contrasting tone contours and quantitative effects

There are three quantitative effects of unstressed /a/:

- An absence of Open Syllable Lengthening;
- Occasional shortening of root vowels before unstressed /a/;
- Neither syncope nor apocope, but the preservation of [ə] < /a/.

All these trends are more profound in the north-eastern half of Fryslân.

The following section looks firstly at the fundamental causal relationship between the three phenomena and a late pitch peak. Then, the actual appearances of the effects with their geographical variations is addressed. The <VVCC> spelling (§ 2.3.3.3), showing significant geographical variation, is discussed in 4.5.2.

For a proper understanding of these developments, the four features of stress (Smith and Van Leyden 2007, 36) should be considered:

1. intensity/loudness
2. pitch
3. duration
4. vowel quality

The first two are primary stress markers. In modern West Germanic languages, such as Frisian, English and Dutch, intensity stress and pitch accent are closely linked. The features three and four are the two spontaneous side effects of stress.

The relationship between intensity (1) and duration (3):

- Stressed vowels last longer, and conversely a longer duration evokes the suggestion of stress to the listener;
- Unstressed vowels show less absolute duration contrasts than stressed vowels. The absence of duration oppositions in unstressed syllables in modern Germanic languages is a logical consequence of this fact.

The relationship between intensity (1) and quality (4):

- Stressed vowels show more contrast in their formant pattern. Inventories of vowels in unstressed syllables are usually more limited, /ə/ being the most profound marker of an absence of stress.
4.5.1 Stress and duration

Open Syllable Lengthening in for example, *dore*, and the absence of it in for example, *dora*, is the first item for discussion. Both are bisyllabic, and both have short vowels in open syllables: /dɔ-ra/, /dɔ-ra/. Syllable structure does not present a quantitative contrast. There are two differences, however:

- *dore* has Accent I, with intensity stress and pitch accent on the first syllable, while *dora* has a pitch accent on the second syllable (Level Stress);
- *dore* has /ə/ in the second syllable, being a cue for unstressed syllables, while the /a/ of *dora* is part of the inventory of stressed syllables. The root vowel inventory of Old Frisian words which could be subject to Open Syllable Lengthening consist of short monophthongs only. The /a/ is one of these.

The contrast between Accent I and II has an automatic quantitative side effect. When the pitch accent is not on the root syllable, the root is about 10 to 20% shorter than when both pitch accent and intensity stress are aligned on the root (Van Leyden 2004, 68). This duration contrast is enforced by perceptual stress cues. In *dore*, all four stress cues are aligned to the root syllable:

- The root bears the intensity stress;
- The pitch accent is aligned with the intensity stress;
- The root vowel quality /ə/ contrasts with the unstressed vowel /a/;
- Duration differs from the *dora* case, even though the purely phonetic duration increase of approximately 10 to 20% is not enough to make the originally ‘short’ vowel ‘long’.

The combination of a real, albeit limited, difference in duration between the root vowels of *dora* and *dore*, is enforced by the accumulation of stress cues. This may lead to a reinterpretation of the root vowel of *dore* as a long vowel, rather than as a short one in a phonological sense, as duration is the only missing stress marker on *dore*, so /dɔ-ra/ > /dɔ-ra/. It could be argued that the listener is deceived when he hears *dore* with a relatively long ‘short’ vowel plus a series of listener cues that are regularly associated with long root vowels.

In words such as *dora*, the absolute length of the /ə/ does not provoke any suggestion of lengthening, nor do the other stress cues. Level Stress, with intensity stress on the first, and pitch accent on the second syllable, provides ‘contradicting’ stress cues, as does the quality of the vowel /a/, belonging to the vowel inventory of short, stressed syllables. All this implies is that there is no objective acoustic signal, nor any perceptual suggestion of an additional duration for either of the two syllables.
The second quantitative effect of unstressed /a/ is the occasional shortening of a long root vowel. In the pair mōna/mōnath ~ fōren, the /a:/ in the former is phonetically shorter than the vowel in fōren, due to the same duration impact of Accent II compared to Accent I. But this difference was usually not enough to cause a total reinterpretation of the long vowel as short. In a multisyllabic word such as mōnandei, the absolute duration effects are even stronger, due to the word isochrony effect (cf. Nooteboom 1995, 168). Apparently, this was sufficient in some dialects to cross the threshold of vowel quantity reinterpretation. Shortening of an uncompounded word is found in the plural of fōt ‘foot’. The shortened form <fotten> is only found in the north-east (cf. § 2.3.4.1) in a region smaller than is the case with the shortening in mōna(ndei) ‘Monday’ (cf. map 2.5 and 2.6). There is also a word isochrony effect between the singular fōt and the plural fōtan. Together with the duration impact of the accent contrast, this was apparently enough to cause a categorical reinterpretation of the original /oː/ in the plural form from long to short in some dialects.137

Finally, there is the blocking of syncope and apocope of unstressed /a/. This could be a case of quantitative signal intensity, perceptual suggestion and interpretation. A vowel bearing a pitch accent is, per definition, not an unstressed syllable, influencing both its objective acoustic features and its subjective perception. This combination of factors is probably the reason for the retention of pitch-bearing Old Frisian /a/ as [ø] in Middle and early-Modern Frisian.

---

137 Unpublished studies on the morphological shortening process in Modern Frisian of the so-called ‘West Frisian Breaking’ (for example, Modern Frisian sg. [fu:.t], pl. [fwot.tən], cf. Hoekstra 2001a, 730) suggest that bare word frequency is an additional factor here. Highly-frequent words are pronounced faster, hence shorter, than low-frequent words. The word ‘foot’ is relatively frequent as a lemma, and the plural is relatively frequent compared with the singular form.
Section summary:

- The cumulative impact of physical and perceptual stress cues favours the reinterpretation of the root vowel of, for example, *dore*, as long;

- The cumulative impact of physical and perceptual stress cues confirms the interpretation of the root vowel of, for example, *dora*, as short;

- The cumulative impact of physical and perceptual stress cues in, for example, *môna* can evoke a reinterpretation of the quantity of the root vowel as short, when placed in additionally shortening contexts, such as compounds;

- The /a/ in a non-root syllable, bearing pitch accent, was probably not subject to syncope or apocope because it was stricto sensu not unstressed.
4.5.2 Regional diversity in quantitative effects

Regional diversity in quantitative developments connected with the special status of an /a/ is found in the following phenomena:

- The limitation of occasional shortening of long vowels before unstressed /a/ to the north-east (and Wûnseradiel) and a frequent appearance of <VVCC> spelling in words with originally long vowels in the same regions (VVCC type 2, § 2.3.3.3);
- A reluctant Open Syllable Lengthening before unstressed /a/, accompanied by a relative frequent appearance of the <VVCC> spelling, type 1 in the south-west, cf. map 2.3 and 2.4.

The regional variation is best understood when a gradual increasing pitch peak delay is assumed with a minimum shift in the south-west and a maximum one in the north-east of the West Frisian language area in the late-Middle Ages. The types in table 4.3 refer to graph 4.1:

<table>
<thead>
<tr>
<th>Type 1A: limited peak delay: South-west</th>
<th>Type 1A + Level Stress in short roots: Centre</th>
<th>Type 1B: strong peak delay in Accent II: North-east</th>
</tr>
</thead>
</table>

Table 4.3: Gradually differing types of tone contours in 15th century West Frisian. **bold** = intensity stress; `' = pitch peak; l.s. = Level Stress.

In a model with gradual quantity scales, it is logical that the quantitative impact of a strong pitch peak delay is larger than that of a moderate pitch peak delay. In the same framework of gradual duration contrasts, it should not be forgotten that the duration reduction factor which keeps a short vowel ‘short’ is not automatically sufficient to make a long vowel sound ‘short’. For example: A duration effect of Level Stress in *dora*, causing the retention of the short /ɔ/, in opposition to /dɔrə/ < *dore*, is not automatically enough to make the root vowel of *kâpad* sound short.
The combination of these two aspects is sufficient to explain the whole picture:

1) **Bitalad**: the peak delay on short-rooted words is relatively strong, both in the central and north-eastern regions (Level Stress) and more or less sufficient to prevent the lengthening of vowels in open syllables. In the south-west, the peak delay is less, and the acoustic and perceptual duration contrast with other vowels in open syllables is only limited. Therefore, Open Syllable Lengthening may eventually occur in words such as *bitalad* in the south-west. The intermediate position between complete lengthening and remaining totally short is expressed by the <VVCC> spelling. A spelling such as <bitaellet> shows that the /a/ is perceived as longer than in the /a/ in *falla* 'to fall', but shorter than the /a:/ in *haelen* 'half'. The <VVCC> spelling in words such as *bitalad* are well represented in the south-west (§ 2.3.3.3, type I; map 2.3).

2) **Kâpad**: only in the north-east, with its strong peak delay, the quantitative impact of this late pitch accent can reach a level where long vowels can be perceived as short. The primary stage of this is an intermediate half-long perception, expressed by <VVCC> spelling. This spelling is relatively well represented in the east in words such as *kâpad*. Complete shortening of long vowels is found in the mønandei, with further shortening in the long compound (word isochrony), and in occasional instances of *kâpia* as <keppet> in Leeuwarden, and the word *fûta* as *fotta* in the north-east.

The modern dialect of Schiermonnikoog, in the far north-east, exhibits even more examples of shortening of long vowels before the Old Frisian masculine plural ending -an, as in *priem - primmen ‘needle(s), bost - botten ‘boot(s), cf. § 2.3.4.1. Also, in Wûnseradiel, in the western part of the province, shortened forms appear such as <cappet> ‘bought’ and <burren> ‘neighbours/neighbourhood’. The exact conditioning for shortening of long vowels remains open here. The limited frequency of the examples proves an incidental transition of the perceptual duration threshold.

Differences in pitch peak delay between the south-west and the north-east may shed new light on the case of the levelling of the plural marker -en towards the feminine nouns.
A.P. Versloot: *Mechanisms of Language Change*

Consider the following paradigms:

<table>
<thead>
<tr>
<th><em>seko</em> 'case'</th>
<th>singular</th>
<th>plural: full form</th>
<th>plural: reduced form</th>
</tr>
</thead>
<tbody>
<tr>
<td>south-west</td>
<td>[sˈeːkə]</td>
<td>[sɛˈka]</td>
<td>[sɛˈkə]</td>
</tr>
<tr>
<td>north-east</td>
<td>[sˈeːkə]</td>
<td>[sɛˈkə]</td>
<td>[sɛˈkə]</td>
</tr>
</tbody>
</table>

Table 4.4: Pitch peak delay as an additional plural marker of feminine nouns.

§ 2.4.3.4 demonstrates that [sɛkə] is an acoustically reduced variant of the plural [sɛka]. Apart from tone contour, the singular form and the plural form with acoustically reduced plural ending, are identical, causing semantical ambiguity. In the south-west, the differences in tone contour between singular and reduced plural form are small: sg. [sɛka] ~ pl. [sɛkə]. In the north-east, the pair is: [sɛkə] ~ [sɛkə], with a firm contrast in tone contours. In the latter case, the redundant feature of the tone contour could compensate for the ambiguity caused by the vowel reduction in the plural. Therefore, the system pressure to compensate semantic ambiguity, for example, by levelling the plural marker from the masculine nouns, was greater in the south-west than in the north-east.

This effect is enforced by the fact that the acoustic prominence of the ending -ə is higher in the north-east than in the south-west, due to differences in pitch peak delay. This results in a kind of positive feedback loop: The south-western speech has both minimal tonal contrast and relatively high noise levels in the plural. In such a system with a relatively high ambiguity, the language system is sensitive towards any new, less ambiguous form, in this case seken with an unambiguous plural marker, levelled from the masculine nouns. In the north-east, the late pitch peak causes a lower proportion of reduced forms [sɛkə] and this reduced form is less ambiguous because of its distinct pitch peak: an accumulation of features, contributing to the (temporal) blocking of the new form seken. In the dialect of Schiermonnikoog, in the far north-east, the feminine plural ending -ə is retained to present day.\(^\text{138}\)

\(^{138}\) From this perspective, it is no surprise that the vast majority of feminine words with a plural ending -ə in the Schiermonnikoog dialect are monosyllabic in the singular, hence bisyllabic in the plural. For example, *daar* - *dare* 'door(s)' (Fokkema 1969, 16-17). The prominent impact of Level Stress is more prevalent in bisyllabic words than in words with three or more syllables. In 20th century mainland West Frisian dialects, a plural -ə was retained in only two nouns *bean* 'bean' and *eart* 'pea': *beane, earte*. 

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Section summary:

- Given that south-western dialects show fewer features which are typologically connected with pitch peak delay, it may be assumed that peak delay was weaker here than in the north-east;

- The translation of the different levels of peak delay into phonetic cues matches the details of the actual quantitative developments, i.e. the typological assumption is supported by a phonetic interpretation.
4.6 Qualitative impact of unstressed /a/

There are two qualitative phenomena in Middle Frisian connected to unstressed /a/:

- Marking of Vowel Harmony, also after the reduction of Old Frisian /a/ from [a] > [ɔ];
- Accent Shift in sonnandei.

4.6.1 Vowel Harmony and Accent II

Section 3.4 concludes that an ‘underlying /a/’ was still ‘controlling’ the Vowel Harmony. In § 3.5, this abstract, ‘underlying /a/’ is found to be basically an historical Old Frisian /a/ which could be realised in Middle Frisian either as [a] or, in the majority of instances, as [ɔ]. The correlation between the historical Old Frisian /a/ and the Middle Frisian Vowel Harmony does not imply that an abstract Middle Frisian ‘underlying /a/’ was still the cause of the Vowel Harmony. In § 2.6, a distinction is made between Vowel Harmony as a phonetic process and the petrified phonological template. The latter may cause ‘Vowel Harmony’ by analogy, but not by its phonetic impact. These two aspects become very clear in the rise and fall of Vowel Harmony in Middle Frisian.

Vowel Harmony as a phonetic process is strictly limited to the presence of a realised [a]. Both for the Weser Frisian dialects with Vowel Harmony and for the North Germanic dialects, there is a distributional overlap between Vowel Harmony and Level Stress situations. Therefore, there are sufficient indications that Level Stress is at least a factor facilitating Vowel Harmony. Phonetic Vowel Harmony caused allophonic distributional patterns (the realisation of the root vowel as [æ] instead of [a] is an assumption; it was regularly spelled <a>, cf. § 2.6.3):

Gerund: Accent II /vɛ-ˈzən/ ⇒ [væzən], later [ vazən]
Past part.: Accent I /vɛ-ˈzən/ ⇒ [vɛzən]

The rendering of an allophonic feature in spelling may depend on several factors such as the realisation of /ɛ/ and /a/ in other contexts. Map 2.16 (Vowel Harmony in seka and wea) reveals two core regions of Vowel Harmony in spelling. These are the eastern half of the province and the region of Wûnseradeel in the west. The long-lasting unambiguous realisation of /a/ as [a] in the north-east may account for the limited spelled representation of Vowel Harmony effects in the far north-east. Where the phonetic context is unspoiled, there may be less awareness of allophonic realisations. Towards the central region, the /a/ was subject to reduction earlier and was less marked with a late pitch peak, so the automatic allophonic character of the [æ] in words with Vowel Harmony was less obvious. This could give rise to the explicit spelling of the allophone. In the far south-west, the weak Level Stress may
have been the reason Vowel Harmony did not occur at all.

In the beginning of the 15th century, when an unstressed /a/ in protected position evolves into an [ø] with a late pitch peak, the following allophonic template emerges:

With Accent I: [ɛ-ø]
With Accent II: [æ-ø]

Vowels [ɛ] and [æ] were in paradigmatic alternation in verbs such as lesa, with [ɛ] in present singular and past participle and [æ] in the infinitive and gerund, or in words such as seke with [ɛ] in the singular and genitive and dative plural, but [æ] in the nominative and accusative plural. Why the [ɛ] is restored in the second half of the 15th century is unknown for this study, but paradigmatic relations and the allophonic template with an accent contrast enabled speakers of the time to identify both [ɛ] and [æ] as allophones of /æ/.

The reverse of the root vowel to [ɛ] fails in the plural form dagen. In § 4.1, the assumption is made that this is due to the loss of Accent II. That implies that somewhere in the late 14th century or early 15th century the following change took place, for example, in the plural of dei:

[dæg’ön] → [d’æg’ön], perhaps even [d’æg’ön]

The first element of the sound pattern [æ-ø] could no longer be identified with the allophonic realisation of /æ/ in Accent II. The sounds [ɛ] or [æ] rather resemble the realisation of Middle Frisian /a/.

139 There are two Old Frisian sounds which contributed to a Middle Frisian long /a/:
Old Frisian /æ/, for example in nist ‘red’, and Old Frisian /a/ in open syllables which was lengthened, for example mager ‘meagre’. Depending on the lemma and region, these two /a:/ sounds could blend together or remain separated. In general, the historical long /a:/ shifts towards a more palatal realisation in the late Middle Ages: [æc] or even [ɛc]. In the western part of Fryslân, this tendency yields both an Old Frisian /æ/ and a lengthened /a/ in open syllables. This can be seen in the rendering of the plural of dei ‘day’ in several sources from the 17th to the 19th centuries, all from the western part of the province: J. van Hichtum (Hichtum) <deagen>; Gysbert Japicx (Bolsward) and Durk Lenige (Makkum) <deagen>; Workum 1681 <degin>, ± 1850 <deagen>, corresponding to a modern not attested *deagen [dɛˈən]. The Modern Frisian form is dagen [dæɣən]; cf. wagen [vəˈən] < OF wagen ‘waves’.

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Section summary:

- Vowel Harmony must be split into two stages: Firstly, a phonetic origin (14th century), based on the presence of the subsequent [a], probably facilitated by the effect of Level Stress, and secondly, a phonological template relying on the tonal contrast (15th century);

- Differing developments in accent types due to morphological levelling, for example, explains the variance in development of words with historical Vowel Harmony.
4.6.2 Accent Shift

Smith & Van Leyden (2007) advocate that the Level Stress in Riustringen Old Frisian was the cause of the accent shift (oxytonisation) in the East Frisian dialect of Land Wursten. They provide an impression of what might have happened in the interaction between speaker and listener:

"When there is poor perceptibility of first-syllabic stress cues like duration, intensity and pitch excursion, the second syllable tone patterns may be reinterpreted as signalling stress." (Smith & Van Leyden 2007, 56).

It should be noted that accent shift is a limited phenomenon in West Frisian, while it is a regular process in historically bisyllabic short-rooted words in the Frisian dialect of Land Wursten. The instances in West Frisian are found in trisyllabic words:

- Place names, such as ‘Elawerth > *Elawerd > Hīlaard’;
- Family names: Buwlīlda;
- A trisyllabic word with an /a/ in the second syllable, sonnaidei ‘Sunday’.

In the place names, /a/ merged with the subsequent /w/ (or /v/) into a diphthong [au]. In the word ‘Sunday’, the /a/ developed a diphthong [ai] or [au] before /nd/. This suggests that the stress cue of pitch accent was enforced by the duration cue of the new diphthong.\(^{140}\)

---

\(^{140}\)The pitch accent on the /a/ is possibly helpful, but not always necessary to cause an accent shift. The word irdapped ‘potato’, shows an accent shift to [jɔr/apal] in the northern part of the Modern Frisian language area (Hoekstra e.a. 1994, 293 ff.). The potato was introduced into the Netherlands in the 17\(^{th}\) century, but did not become a popular vegetable before the 18\(^{th}\) century. The oldest attestation in early-Modern Frisian is from 1774. The authors suggest the syllable quantity as a cue for the attraction of the primary stress.

Studies by the author on the dialect of Schiermonnikoog and early-Modern Frisian suggest that Accent II disappears from the language not before the 18\(^{th}\) century, at least in the north. Therefore, the existence of an Accent II and accent shift in the word for ‘potato’ might still come together somehow.

A very old case of accent shift in Old Frisian is the word wurld ‘world’ < *wraeld. The accent shift precedes the written attestation to Frisian, so must be from before 1250. The cluster /ld/ causes lengthening of the preceding vowel in all Frisian dialects, but its dating is problematic as *<wraeld> or similar forms are not attested in Old Frisian sources; the oldest indication of vowel length in the charters is from 1473 (OFO I-238): <wraeldsch>. As the accent shift in wurld took place at a time where tone contours were not automatically aligned with the intensity stress, it is difficult to identify the impact of the sole prominence of the open /a/, the additional cue from a tone contour and possibly an initial lengthening or diphthongisation before /ld/. Both in irdapped and wurld, the /a/ is the attraction point.
Both cases illustrate that the ‘normal’ situation of Level Stress did not provide so many stress cues linked to the second syllable that listeners would identify the second syllable as the bearer of the primary stress. The extra duration of the new diphthong could cause a shift in the listener’s interpretation of primary stress.

Section summary:

• As pitch is one of the stress cues, a pitch peak is a prerequisite for attracting intensity stress;

• When a pitch peak bearing syllable developed a phonetic diphthong, creating extra vowel duration, the total of stress cues could cross the perceptual threshold to attract the intensity stress.
4.7 The phonologisation of tone contours

While the prosodic, redundant nature of the tone contour was a necessary prerequisite for the formation of an outstanding tone contour on words with unstressed /a/, the 15th century shows a change. The reduction of /a/ > [a] is not followed by the automatic transition of the pitch peak to the first syllable in the way described in § 4.4.

In other West Germanic languages, intensity stress and pitch accent were aligned on the same syllable: The stressed root. 15th century West Frisian developed the possibility of having those two stress markers on different syllables, independent of the quality of the second syllable. Minimal pairs developed, such as wessen with Accent II in the gerund but with Accent I in the past participle. The tone contour became an independent marker of semantic and morphological functions. The tone contour was no longer purely predictable from the syllable structure and new speakers had to learn it by lemma or at least by morphological category. There was a similar development in North Germanic languages, although there the fixation of the pitch peak took place before the reduction of most unstressed syllables to /a/.

At this stage of research, it is hard to say anything definitive about the cause of the phonologisation of tone contours in West Frisian. One reason may be language contact, as the neighbouring languages did not have the option of pitch peak delay. Facing this limitation, the options were either to copy the tonal system from the neighbouring languages, or lexicalise the tone contours. The functional load of these contrasts in the relatively archaic morphology of early-15th-century West Frisian may constitute a reason for the course of the developments. It is not possible to provide a final answer to this 'why' question here.

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141 From the data presented in this study, combined with data from studies on early-Modern Frisian, it is possible to conclude that the following morphological categories preserved Accent II, contrasting with the default Accent I:

- All nouns with a singular in -e,
- Plural feminine nouns, as long as they survived as a distinct group into the later centuries (especially the Schiermonnikoog dialect),
- Weak verbs in -je, primarily in the forms taking /a/ directly after the root in Old Frisian (2nd, 3rd sg. pres., entire past tense and past participle).

Accent I was most likely generalised in the following grammatical categories:

- The entire paradigm of the strong verbs and weak verbs in -e. Little evidence was found for Accent II already in for example, the pl. pres. tense in Middle Frisian (no Vowel Harmony before the Old Frisian ending -adij, but the infinitive and gerund of these verbs definitely bore Accent II in the first half of the 15th century.
- Adjectives, even when they often had the ending -a in inflected forms, seem to have generalised Accent I to the entire paradigm at an early stage.
Both Frisian and North Germanic are peripheral languages within the Germanic family. Both preserved the phonetic archaic feature of varying tone contours, at least for a while. Phonologically, they became modernised as much as the ‘major’ languages did.

Section summary:

- The phonologisation of tone contours was a break with the past, where tone contours were completely predictable from the word structure;
- Frisian and Scandinavian dialects share this innovation, as distinct from large West-Germanic languages.
4.8 The dialect of Wûns eradie in the 14th and 15th century

The dialect of Wûns eradie and direct surroundings (such as the city of Harlingen) situated in the western part of the province, show traces otherwise found in north-eastern dialects in:

- Vowel Harmony, cf. map 2.16;
- The shortening of long vowels before unstressed /a/, as in <cappet> ‘bought’, Old Frisian käpad and <burren> ‘neighbours/-hood’, Old Frisian bûran, cf. § 2.3.3.3, type 2.

It is, however, completely embedded in the rest of western and southern Fryslân in:

- The development of Open Syllable Lengthening before the Old Frisian /a/ as in bitalad, cf. § 2.3.3.2 and map 2.3;
- The absence of Vowel Balance effects for unstressed /a/ in words with a short root, cf. map 2.14;
- The apocope of word-final /a/ as in seke, cf. map 2.12.

A reason for this apparent contradiction lies in the chronological order of the events. ‘North-eastern’ features in Wûns eradie must be old, from the 14th century:

- The phonetic roots of Vowel Harmony lie in the 14th century, cf. § 2.6.3;
- Protected Old Frisian /a/, as in käpad and bûran was already weakened in the late 14th century (§ 2.4.3.2), so the full quantitative impact of this /a/ was most likely before that time.

The features where the dialect spoken in Wûns eradie behaves like the adjacent western and southern dialects are from the second half of the 15th century:

- Open Syllable Lengthening before unstressed /a/ is from the second half of the 15th century. The first attestation in bitalad is in 1447, OFO 1-99.
- The /a/ apocope in seke took place in about 1460, cf. § 2.4.3.8.

The phenomena in the dialect of Wûns eradie can be explained by assuming the region had a strong pitch peak delay in the 14th century, similar to that in the northeast. During the 15th century, the realisation of Accent II in Wûns eradie fits in with the rest of western Fryslân. In Scandinavia, different realisations of Accent II are
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Also found in close geographical proximity. 142

The dating of the spelling forms <cappet> and <burren> in Wünseradiel seems contradictory to this interpretation: The first attestations to <cappet> (OFO I-487) and <burren> (OFO II-202) are from 1504. Earlier attestations from Wünseradiel, like OFO II-2, 1379 <bu(w)ren> and OFO I-66, 1436 <kapet> do not show this shortening. The oldest case of <kappeth> is from OFO I-24, 1417 a copy from Lüttenseradiel. Statistical evaluation of the data reveals that the lack of older examples may be the result of mere chance. The phenomenon of vowel shortening in kāpia is limited; even in Wünseradiel no more than 7% of the tokens. From the 15th century, there are only seven original attestations to kāpia which are linked to Wünseradiel. The probability of finding no instances of shortening is subsequently 60% (= 0.93). Therefore, shortenings such as <cappet> may very well be older in Wünseradiel.

Section summary:

- The dialect of Wünseradiel shared a relatively late pitch peak in words with Accent II with the dialects from the north-east in the 14th century;
- In the 15th century, Wünseradiel speakers drifted towards the Accent II realisation of speakers from the adjacent regions in the south-west, with an earlier pitch peak.

142 It is a frequent phenomenon in historical dialect geography that a feature appears in a more or less random distribution over the entire language region, and becomes a geographically distinct feature after some time. This kind of transition can be modeled by simple algorithms with a stochastic variation component and a component causing accommodation between adjacent agents (cf. Ball 2004, 392).
4.9 Conclusion

This chapter argues that a relatively late pitch peak on words with an /a/ in unstressed syllables is a logical consequence of a combination of a predictable, redundant prosodic tone contour as well as the stage of vowel reduction that Old Frisian had reached during the 12th century. Geographical and temporal variations are the result of gradual differences in pitch peak delay, which increases from the south-west to the north-east, and the cumulative impact of quantitative duration effects and perceptual biases in various cues for locating the primary stress. At the end of the period, early-Modern Frisian was a language with tonal contrasts comparable with Scandinavian languages.\footnote{A relatively recent observation in the literature is the tonal distinction in North Saxon, with an Accent II on formerly bisyllabic words such as /duːf/ < /duːva/ (Ternes 2006, 92 ff.). The case of tonal contrasts in Franconian dialects (Dutch and Belgian Limburg, the German Eifel region and Luxemburg) is well known. West Frisian may not have been that exclusive within the West Germanic family as may be understood from the final conclusion of this section. However, the Frisian case is definitely rooted in the late Middle Ages, the description of the Low Saxon case suggests that the tonal contrast is from a later period, as apocope of /a/ in North Saxon is a phenomenon from the second half of the 16th century onwards (König 2001, 159).}
5. Modelling Language Change

The following sections § 5.1 and 5.2 present two models of language change, based on the concept of language as a deterministic dynamic system, governed by self-organisation. The reductionistic approach states that knowing the characteristics of the constituting elements and their interactions is essential in order to understand the system’s controlling mechanisms. Knowing the mechanisms of a system, enables predictions to be made on the course of the developments taking place in the system. Based on the linguistic characteristics of Frisian in 1300, predictions could be made on the course of the developments. The retrospective approach to historical linguistics offers the opportunity to check the validity of these predictions. The data in this research from the language of the 14th-century Unia codex to early Modern Frisian of the 16th-century charters, covers a sufficient time frame to meet the challenges posed by such modelling.

These models help answering questions, such as:

• Was the order and direction of the transitions in any way predictable, logical or perhaps even inevitable? Or could the development have equally taken another direction or order?
• How did speakers manage to achieve their semantical objectives in a changing language environment?

Section 5.1 demonstrates a causal correlation between the quantitative phonetic features of unstressed vowels and the reduction of unstressed vowels. This reduction process is considered as a type of ‘sound erosion’.

In § 5.2, linguistic signs are evaluated for their quantitative semantical ambiguity in a bidirectional model. In this bidirectional approach, speakers consider both tradition and semantic ambiguity, while acoustic erosion remains a constant force when choosing any realisation. This section demonstrates that:

• Semantic contrasts are maintained while their phonetic realisation changes in a gradual process,
• ‘Mistakes’ or ‘ambiguous parallel forms’ are intrinsic parts of the transition process and their level of appearance can even be predicted. The ‘exceptions’ form part of the ‘rule’.

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Tony Feitsma once stated (oral communication by Willem Visser) that “marginal existence is a special case of non-existence, abundant presence is a special case of omnipresence”. A preferable alternative would be: “non-existence is a special case of marginal existence, omnipresence is a special case of abundant presence.”
5.1 Modelling the reduction of /a/ and /o/ as a phonetic process

The first model shows how it is possible to predict the order and speed of the reduction of unstressed vowels in late mediaeval Frisian from the phonetic features of these sounds in 1300. Vowel reduction is regarded as an erosion process. The vowel realisation is defined in physical, measurable terms, the *Intensity Integral Volume* (§ 5.1.1). The Intensity Integral Volume, the acoustic ‘mass’ of vowels, depends on their duration, quality and actual position in the word. The impact of the different features is quantified using values from contemporaneous phonetic observations (§ 5.1.2). A combination of Intensity Integral Volume and vowel erosion results in a prediction of order and velocity of vowel reduction (§ 5.1.3). This prediction is checked with real data from the historical sources from chapter 2 (§ 5.1.4). Section 5.1.5 shows how the phonetic parameters can be computed from the historical data, a kind of *reverse engineering*. Additional aspects of this model are discussed in § 5.1.6.

5.1.1 Vowel ‘mass’: reduction and erosion

The process of vowel reduction in Frisian over the studied time frame runs from /a/ to ø, with /ø/ as an intermediate state. The simplified conclusion is that, where there was ‘something’ at the beginning, ‘nothing’ was left at the end. The question is: what is this something’ or ‘nothing’ and how can it be expressed?

The model presented in this section is purely phonetic. Phonetic data is measured on continuous scales. Phonology is the categorical organisation of phonetic data. From a reductionistic point of view, phonology emerges from phonetics. It would be ‘greedy reductionism’ to deny any categorical ordering of sounds, as was recently done by Port & Leary (2005). This section takes the categorical interpretation of the phonemes /ø/ and /a/ for granted, but, for the description of their features and the way these might influence their ‘behaviour’ the analysis does not rely on discrete phonological features, but on the underlying phonetic data.\(^\text{145}\)

The mass or volume of a sound is defined both by its duration and its intensity / loudness. The combination of these two features creates an intensity integral, shown in graph 5.1:

\(^{145}\)The categorical interpretation of /a/ and /ø/ does not entirely match the structuralistic definition of a phoneme. The criterion is not that two sounds show minimal pairs, but that they represent two clusters of realisations with different centroids, irrespective of the reason for their separation. Two sounds in one language variant showing an allophonic distribution can show two separated clusters of realisations. In a diatopic case, it is possible to find two clearly different realisations for one ‘underlying’ phoneme. In both examples, structuralistic phonology does not distinguish between different phonemes, but for the purpose of this analysis they are identified as two different categorical groups.
The Intensity Integral Volume is a result of duration and intensity. A sound can have a greater Intensity Integral Volume due to a longer duration but also as a result of increased intensity. On its way from full sound to ø (= 'nothing'; [ø] is a phonetic notation), the volume of the Intensity Integral is reduced towards zero.

5.1.2 The controlling factors
The previous chapters note that the process of vowel reduction was controlled by the following phonological variables:

1. Vowel quality: /a/ and /ø/ behave differently;
2. Word-finality: Protected vowels show a different development than word-final vowels (habbath ~ habba), and, at a more detailed level, vowels in the word-interior behave differently from protected vowels in the last syllable, cf. abbate ~ habbath, dorena ~ sweren;
3. Word structure: Unstressed vowels that follow a long syllable behave differently to those that follow a short root.

In order to ensure the reliability of an experiment, variables other than the ones that are the subject of the test, should be kept as constant as possible. The reduction of /ø/ to ø (syncopé) was sometimes prohibited or delayed by wellformedness constraints. To keep the testing environment constant, the sub-patterning is left out and examples where wellformedness constraints do not pose any obstacle for the developments are concentrated on. Further research with considerably more fine tuning can build this into an extended model.
Section 1.3.3 mentions that the characteristics of the bio-physiological substratum of language (the shape of the speech organs, the working of the brain, the physical laws that describe acoustics, etc.) are universal and do not change during the period 1000 to 2000 AD. This means that existing phonetic measurements can be used on 14th and 15th century language.

As the following sections show, various existing measurements render different results. Each individual has his or her own phonetic characteristics, with sub-variations for speech. To avoid undesirable deviations, examples are taken from modern Germanic languages including Modern West Frisian, Dutch, Scots and Norwegian. Absolute figures found in modern languages are not the main focus. It is the relative numbers which are important, for example: “What is the relative impact of the contrast between word-final and protected position on vowel length?”, rather than: “How long is a protected unstressed vowel?” Daily practice shows that people are able to deal with different absolute vowel lengths (of different speakers and/or different speech velocities), while still able to distinguish words based on, for example, vowel length opposition. This implies that it is the relative dimensions, not the absolute figures, that matter (cf. Rietveld & Van Heuven 1997, 223). The following procedure builds on these assumptions.

This model uses numerical figures. Figures can provide a highly accurate result. It is therefore important to be precise, for example, when establishing the duration of a sound. Section 5.1.6 returns to the question of data accuracy.

\[ a \] - \[ o \]

The vowel \[ a \] is realised with a larger Intensity Integral Volume than schwa, due to the following physiological facts:

- As \[ a \] is the most open vowel, the jaw makes a long movement, which takes a ‘long’ time;
- The \[ a \] is an open vowel, with plenty of space for the vibrating air to escape from the mouth, causing a high intensity (dB).

De Graaf (1986, 4) mentions an average length of \[ a \] of 115 ms, and an average length of \[ o \] of 95 ms, for Modern Frisian. This difference in duration involves the X-axis in graph 5.1. This author’s own recordings found an intensity proportion of \[ a \] = 80dB : \[ o \] = 75dB. Therefore, the \[ a \] would be 115/95 times larger in its duration and 80/75 in its loudness than \[ o \] = 1*(115/95)*(80/75) = 1.29.

Additional information has been obtained from the illustrations in Nooteboom & Cohen (1995, 128-136). From those pictures, the total
volume of duration and intensity can be measured. The ratio of the Intensity Integral Volumes of the second [a] in java's and the final [a] in vaseline is [a] : [a] = 1.39 : 1. A similar case is provided by the [o] in kanon ‘canon’ and the [a] in mate ‘amount’, giving a ratio of [o] : [a] = 1.54 : 1. These two examples not only reflect the impact of quality contrast, but the word structures also differ. In both cases, the full vowel is followed by a consonant.

As an estimation, the average of the three described methods is taken:

\[(1.29 + 1.39 + 1.54)/3 = 1.41.\]

**Word-finality**

Lunden (2006) studied the case of ‘extrasyllabicity’ of word-final consonants in Norwegian. There (and in other North Germanic languages) word-final syllables with one vowel and one consonant (= 2 morae) count as ‘short’ (cf. § 2.3.1). Lunden found that the reason for this is the fact that a word-final vowel is longer than a protected vowel, making the duration extension of an extra final consonant of 27% less noticeable (idem, 76). The extra duration from the additional consonant is partly obscured by a shorter vowel.

The outcome of her research is that in non-word-final position, the ratio between unstressed syllables CV : CVC is 1 : 1.6. As only the rhyme of the syllable counts, it is possible to establish the equation for non-final vowels.

Note the following abbreviations:

\[V_{nf} = \text{Non-final vowel, for example, the second /a/ in makad 'made'.}\]
\[V_f = \text{Final vowel, for example the /a/ in sek[a] 'cases'.}\]
\[C = \text{Any word-final consonant, for example, the /d/ in makad.}\]

Expressing consonant duration as a ratio of the preceding non-final vowel:

\[\text{(1) } (V_{nf} + C)/V_{nf} = 1.6\]
\[\text{(2) } (V_{nf} + C) = 1.6*V_{nf} \Rightarrow C = 1.6*V_{nf} - V_{nf} = 0.6*V_{nf}\]

Adding a consonant to a word-final unstressed vowel \(V_f\) gives a quantity increase of 27%, compared to a ‘standard’ CV-syllable. As soon at that is done, the vowel becomes a non-final vowel, so:

\[\text{(3) } (V_{nf} + C)/V_f = 1.27\]

Substituting the outcome of equation (2) into (3) gives:
\begin{equation}
\frac{V_{rf} + 0.6V_{rf}}{V_f} = 1.27 \Rightarrow \frac{1.6V_{rf}}{V_f} = 1.27 \Rightarrow \frac{1.6V_{rf}}{1.27V_{rf}} = V_f
\end{equation}

i.e. an unstressed word-final vowel is $1.6/1.27 = 1.26$ longer than an unstressed protected vowel. As this is about vowels of the same quality, no extra loudness factor is expected.

The multiplication factor for word-finality is 1.26.

**Preceding syllable length**

Section 2.1, which deals with Vowel Balance, presents observations from modern Dutch (Jongman & Sereno 1991, 296). The ending /ən/ in the long-rooted plural form taken [takan] 'tasks' is on average 18% shorter than the same ending in the short-rooted takken [taken] 'branches'. This is the phonetic engine of all Vowel Balance features. From this, it is possible to establish a duration ratio of 100:82 = 1.22. Also here, the loudness effect is considered to be zero.

### 5.1.3 Making a forecast

A combination of two phonemes /a/ and /ə/ with the two phonological contexts (protected – word-final; following long or short root) creates eight different contexts. In the rest of § 5.1 the following symbols for these contexts are used:

To mark the difference between word-final and protected vowels:

- \( Vc\# = \) unstressed vowel in word-final syllable in protected position, for example, \( \text{mak\text{\text{3}}\text{\text{3}}} \)
- \( V\# = \) unstressed vowel in word-final position, for example, \( \text{wes\text{\text{3}}} \)

To mark the difference between unstressed vowels (in bold) following a long or a short root:

- \( V:Cv = \) unstressed vowel following a long root, for example, \( \text{för} \)
- \( VcV = \) unstressed vowel following a short root, for example, \( \text{se\text{\text{3}}} \)

Observations from modern Germanic languages are made to quantify integral intensity differences in Old Frisian. The minimum size of the Intensity Integral is by default, one. The size of the Intensity Integral for the other sounds can be computed from the ratios defined in the previous section. For example, the sound with the smallest Intensity Integral Volume, a protected /ə/ following a long root, has the default value of one. A word-final /a/, following a short root has an Intensity Integral Volume of \( 1*1.41*1.26*1.22 = 2.17 \).
The simple product is an assumption. There is sufficient evidence that this score should not be interpreted on a linear scale. From several sources, it is known that human perception scales are not linear but logarithmic. For instance:

- Each octave jump in music is a doubling of tone frequency (log₂).
- The Mel scale, (a perceptual scale of pitches judged by listeners to be equidistant from one another), and the Equivalent Rectangular Bandwidth, a similar scale that expresses equidistant interpretation of pitches, are both conveyed with a formula, including a logarithmic component (Rietveld & Van Heuven 1997, 209 / 369-370)
- The decibel (dB) is a logarithmic unit of measurement that expresses the magnitude of a physical quantity.
- To obtain the visual sensation of equidistant grey tones in graphical design, a logarithmic scale must be applied (Bertin 1967).

These observations make it likely that the perception of the Intensity Integral Volume by the language listener follows a logarithmic, rather than a linear, pattern.

Applying the ratios from § 5.1.2 produces the following relative Intensity Integral Volumes:

<table>
<thead>
<tr>
<th>example vowel</th>
<th>finality</th>
<th>root quantity</th>
<th>score</th>
<th>log₁₀(score)</th>
</tr>
</thead>
<tbody>
<tr>
<td>bîlîth ‘dies’</td>
<td>/ə/</td>
<td>VC#</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>kumith ‘comes’</td>
<td>/ə/</td>
<td>VC#</td>
<td>122</td>
<td>9</td>
</tr>
<tr>
<td>fare ‘for’</td>
<td>/ə/</td>
<td>V#</td>
<td>126</td>
<td>10</td>
</tr>
<tr>
<td>kîpad ‘bought’</td>
<td>/ə/</td>
<td>VC#</td>
<td>141</td>
<td>15</td>
</tr>
<tr>
<td>seke ‘case’</td>
<td>/ə/</td>
<td>V#</td>
<td>154</td>
<td>19</td>
</tr>
<tr>
<td>hitelad ‘paid’</td>
<td>/ə/</td>
<td>VC#</td>
<td>172</td>
<td>24</td>
</tr>
<tr>
<td>kîpîa ‘to buy’</td>
<td>/ə/</td>
<td>V#</td>
<td>178</td>
<td>25</td>
</tr>
<tr>
<td>wesa ‘to be’</td>
<td>/ə/</td>
<td>VC#</td>
<td>217</td>
<td>35</td>
</tr>
</tbody>
</table>

Table 5.1: Scores for the Intensity Integral Volumes of the vowel, based on extrapolation of modern phonetic measurements. The data is categorised according to computed scores.
If,
• The process of vowel reduction is an erosion of the Intensity Integral Volume;

and:
• The erosion is a purely quantitative process, in that it affects the volume of the Intensity Integral in a uniform way, irrespective of the kind of factors that contribute to it; then:
• The score in table 5.1 will be a prediction of the order in which the reduction will take place.

5.1.4 Checking the forecast
In this section, the forecast from § 5.1.3 is checked against historical data. Some remarks need to be made in advance. In some cases in chapter 2, geographical variations are observed. In these cases, the situation in the north-east will be the guide. In principle, any region would suffice, as long as it is a consistent choice. The choice of Middle Frisian data from the north-east has the advantage that it matches several sections of the codex Unia, in particular sections A-3, B and C, which were (re)written somewhere in the north-eastern half of Friesland.

A second point is the fixation of the year of transition, for example, from [a] to [ə]. Chapter § 2 is an ongoing illustration of the fact that changes are gradual. Incidental modern forms often appear a long time before a sound transition was fully implemented. A long time after the shift, isolated older forms may still be attested. To pinpoint 'the' year of transition, this analysis attempts to establish the year in which modern forms become more than ±10%, and the year in which older forms become less than ±10%. The average of these two years is taken as the 'year of transition'. Calculations are made on the basis of full decades.

V:C/ə/C# and VC/ə/C#
Finding a year for syncope of the protected /ə/ is difficult. There is a limited number of examples not traced back to the original /a/, such as abbete < abbatē 'abbot'. Most of the data from the charters concerns later instances of syncope, which were prohibited earlier by wellformedness constraints (graph 2.13). The process begins before the charter period, so the results rely on evidence from Unia.

The data about the syncope of protected /ə/ can be found in § 2.4.3.7 including

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\(^{146}\) This means, that if the Intensity Integral Volume of both vowel \(V_i = x\) and \(V_j = x\), both vowels will be reduced / deleted at the same time, even when the value of \(x\) is primarily dependant on the relatively long duration of \(V_i\) and the relatively high intensity of \(V_j\).
the case of syncope of verbal forms of the 3rd pers. sg. pres., such as *kumeth* ‘(he) comes’ and weak past participles, such as *edêlêd* ‘divided’ (past. part.). Examples of an intermediate *<e>* or *<i>* following a short root appear in Unia groups A-1 and A-2. Vowel reduction was therefore not completed in Unia before 1350. Following a long root, vowel reduction must have happened prior to 1300.

In § 2.4.3.7 it is shown that syncope in Old Frisian *kumeth* ‘comes’ happened earlier than in *edêlêd*. From examples in Nooteboom & Cohen (1995, 128) it can be seen that the Intensity Integral Volume of *an/ð̂/a* is greater when followed or preceded by voiced obstruents than by unvoiced ones. It is therefore possible to add even more detail to the description of the reduction process by including the voice of the context. For the forecast, the oldest figures from the 3rd pers. sg. pres. are used: the year 1300 for the syncope of /ð̂/ followed a long root and 1350 for the syncope of /ð̂/ that followed a short root.

**VC/ð̂/a/#**
The summary of § 2.4.3.10 illustrates that apocope of the word-final /ð̂/ following a long root starts in the late 14th century and is prevalent in various words by 1400, for example, in *fûre(ε) < fûre* ‘before’. The /ð̂/ is retained somewhat longer in the following circumstances:

- When the preceding consonant is a voiced obstruent, such as in *(mis)dêde* ‘crime’;
- When the final -e represents morphological information, as in *ic habbe* ‘I have’ and the dative singular masc./neuter in -e.

For the forecast the oldest instance of /ð̂/-apocope from 1390 is used.

**VC/a/C#**
The case of a protected /a/ following a short root is illustrated by examples such as *bîtalad* ‘paid (past. part.)’, *mâkad* ‘made (past. part.)’. The examples from Unia
show only <a>, including the groups B and C. In the charters it was prevalent until 1440 and remained present in the north-east until about 1470, giving an average year of 1455. This is rounded off to 1460.

**VC/a/ and V:C/a/**
The /a/ in word-final position was preserved until late in the 15th century. At that time, *habba* 'to have' had become a 'short-rooted' word, due to degemination of the consonants, but *bitalia* 'to pay' became a 'long-rooted' word (cf. § 2.5.2 and graph 2.20). The <a> was fairly resistant in the south, but in the north-east it disappeared in *habba* 'to have' and *wesa* 'to be' between 1490 and 1510, rendering the year 1500 for this overview. Graph 2.20 shows that in words such as *bitalia* 'to pay' and *kâpia* 'to buy', the reduction started some 20 years earlier, rendering the year 1480 for the forecast.

Table 5.2. shows the forecast from table 5.1 with an additional column containing the years defined in the above paragraphs. The correlation between the logarithm of the Intensity Integral Volume and the actual years of transition / vowel reduction is shown in graph 5.2. The correlation is high. Intensity Integral Volume values computed for original Old Frisian phonological settings are a fairly good basis for the prediction of developments over the next 200 years. The order of the changes is predicted by the values of the Intensity Integral Volume. When using the logarithm of the Intensity Integral Volume scores, the erosion of vowels appears to be an almost linear process. The linear development explains 95% of the observed variation ($r^2 = 0.95$; p < 0.1%).

<table>
<thead>
<tr>
<th>vowel quality</th>
<th>finality</th>
<th>root quantity</th>
<th>intensity integral score</th>
<th>log(score)</th>
<th>year</th>
<th>example</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ø] &gt; a</td>
<td>VC#</td>
<td>long</td>
<td>100</td>
<td>0.00</td>
<td>1300</td>
<td><em>bilîveth</em></td>
</tr>
<tr>
<td>[ø] &gt; a</td>
<td>VC#</td>
<td>short</td>
<td>122</td>
<td>0.09</td>
<td>1350</td>
<td><em>kumeth</em></td>
</tr>
<tr>
<td>[ø] &gt; a</td>
<td>V#</td>
<td>long</td>
<td>126</td>
<td>0.10</td>
<td>1390</td>
<td><em>fîre</em></td>
</tr>
<tr>
<td>[a] &gt; [ø]</td>
<td>VC#</td>
<td>long</td>
<td>141</td>
<td>0.15</td>
<td>1410</td>
<td><em>kâpad</em></td>
</tr>
<tr>
<td>[ø] &gt; a</td>
<td>V#</td>
<td>short</td>
<td>154</td>
<td>0.19</td>
<td>1450</td>
<td><em>ske</em></td>
</tr>
<tr>
<td>[a] &gt; [ø]</td>
<td>VC#</td>
<td>short</td>
<td>172</td>
<td>0.24</td>
<td>1460</td>
<td><em>makad/bitalad</em></td>
</tr>
<tr>
<td>[a] &gt; [ø]</td>
<td>V#</td>
<td>long</td>
<td>178</td>
<td>0.25</td>
<td>1480</td>
<td><em>kâpia</em></td>
</tr>
<tr>
<td>[a] &gt; [ø]</td>
<td>V#</td>
<td>short</td>
<td>217</td>
<td>0.35</td>
<td>1500</td>
<td><em>wesa</em></td>
</tr>
</tbody>
</table>

Table 5.2: Correlation between Intensity Integral values and years of vowel reduction.
5.1.5 Reverse engineering: The final proof

So far, it has been illustrated that a combination of results from modern phonetic measurements and historical data match well. Values obtained by phonetic measurements enable a prediction of the developments, that can be verified in a retrospective approach. In a reversed approach, the phonetic details should be deducible from the historical figures. This may enable us to define historical phonetic details in cases where modern phonetic research returns ambiguous results or offers ranges of possibilities.

In § 5.1.4, the parameter settings are obtained from modern phonetic measurements. The parameter settings can also be deduced from historical data. For each of the three phenomena (contrast between [a] and [b], word-finality and root quantity) the average year of vowel reduction can be computed:

An example is nasalisation, a spontaneous phonetic process. In most languages, speakers tend to colour vowels preceding a nasal consonant. But, the ratio of nasalisation is variable. Actual levels of nasalisation can cover a wide range and in some languages, it is allophonic, while in others, it can be phonemic. When reconstructing an historical process where nasalisation is involved, parameter settings are unknown. When parameter settings can be deduced from a longitudinal retrospective approach, it is possible to accurately reconstruct the specific phonetic realisation of speakers from the past. This is an example of reverse engineering.
Table 5.3: Defining the average year of reduction for [ø] versus [a]

As table 5.3 shows, the average year of reduction of [ø] > ø was 1373, while the average year of reduction from [a] > [ø] was 1463. As this is an average and given all other phenomena are equally well represented, the difference of 90 years (1463 to 1373) is solely the result of a difference in vowel quality. The impact of word-finality is computed in a similar way:

Table 5.4: Defining the average years of vowel reduction in protected versus word-final position
The difference between word-final and protected position results in a difference of 75 years. The impact of the third phenomenon, the root length, can be calculated using a similar procedure. The average year for vowels following a long root is 1395. For vowels following a short root, it is 1440. The difference is 45 years. This method demonstrates a delay in vowel reduction due to the specific phonetic / phonological conditions.

To define phonetic properties of the phenomena involved from the past, the years of delay (90 - 75 - 45) relate to the duration of the total process. The first transition dates back to 1300, the last one to 1500. The transition years are those in the middle of the transition period, which covered around 30 years (cf. the discussion in § 5.1.4). The first transition started in $1300 - (30/2) = 1285$ and the last one ended in $1500 + (30/2) = 1515$, producing a total transition period of 230 years:

A delay of 45 years refers to a total period of 230 years $= 45/230 = 0.20$.
A delay of 75 years refers to a total period of 230 years $= 75/230 = 0.33$.
A delay of 90 years refers to a total period of 230 years $= 90/230 = 0.39$.

A comparison of increase ratios from the historical data and from the modern phonetic measurements provides the following picture:

<table>
<thead>
<tr>
<th></th>
<th>ratio from modern phonetic measurements</th>
<th>ratio computed from the historical data</th>
</tr>
</thead>
<tbody>
<tr>
<td>[a] ~ [Ə]</td>
<td>41%</td>
<td>39%</td>
</tr>
<tr>
<td>V# ~ VC#</td>
<td>26%</td>
<td>33%</td>
</tr>
<tr>
<td>short ~ long root</td>
<td>22%</td>
<td>20%</td>
</tr>
</tbody>
</table>

Table 5.5: Measured and reconstructed phonetic increase ratios

The similarity is good, but not significant due to the low number of items ($r^2 = 0.74, p = 16.9\%$, one-tailed, $n = 3$). Using computed settings, instead of modern phonetic figures, to redraw graph 5.2 gives an even better match, with $r^2 = 0.96$ (was 0.95), but this is logical, as these figures are deduced from the same data. More important is that table 5.5 shows that historical data can be used to reconstruct the historical values of phonetic parameters.
5.1.6 Discussion

Four questions are considered in this section:

- How important are the exact figures?
- How is it possible that a linear erosion does not result in a uniform outcome: Ø?
- How can the Intensity Integral Volume of 1300 have an impact over a period of 200 years?
- How does this deterministic model interact with other parts of the grammar?

How important are the exact figures?

In section 5.1.2, absolute factors for the impact of phonetic context (word-final versus protected etc.) are estimated from phonetic observations, while in 5.1.5 the values of those variables are computed by reverse engineering. The results can be found in Table 5.5.

In phonology, contrasts are binary and not measured on continuous scales. The following graph 5.3 is a new version of 5.2, the difference being that binary scores have been applied. An /a/ gets one point, an /a/ no points, a vowel following a short root one point, a vowel following a long root no points, and finally, one point for the word-final vowels, and no points for protected vowels. The maximum score is three for a word-final /a/ following a short root and the minimum is zero for a protected /a/ following a long root. This is the outcome:

![Graph 5.3: Correlation between summation of a binary phonological score and the timing of the vowel reduction](image)

Graph 5.3: Correlation between summation of a binary phonological score and the timing of the vowel reduction
A.P. Versloot: Mechanisms of Language Change

The relative order of the developments is not contradicted by the totals, but the fine-tuning is missing. The three items with a score of ‘1’ follow point ‘0’ in time and precede the ‘2’ points score. However, the relative order of the three points with score of ‘1’ can not be deduced from the binary phonological score. Binary phonological features, even when used as ordering entities, can not explain why syncope of protected /ə/, following a short root, as in Old Frisian kunməθ ‘(he) comes’ precedes the reduction of /a/ > /ə/ in protected position following a long root, as in Old Frisian kalpəd ‘bought’.

**Linear erosion and non-linear outcomes**

If there is a volume, eroded by a linear process, how it is possible that ultimately in some instances there is nothing left (/ə/ > ə), and yet in other instances there is still /ə/ < /a/? The expected outcome is that when ‘mass’ is eroded, all vowels end up at level zero, (with exceptions in cases where total syncope or apocope is prohibited by wellformedness constraints). This expected outcome is observed in for example, the East Frisian dialect of Wangerooge, and also in English. Old Frisian hāwəd, sɛttə, mənəθ > Wangeroogic haud, sɛt, məont, cf. Old English heafəd, sɛtən, mənəθ, Modern English head, to set, month. Why does Modern West Frisian have baad next to sɛtte and moanne? The reason may reside in additional phonetic markings of the vowel by a pitch peak. A pitch peak can only be expressed through a vowel. Apparently, this results in the /a/ not being reduced to an ə, but staying as an /ə/ with a tonal peak. This was investigated in § 4.

**The problem of collective linguistic memory**

In § 5.1.4, in particular in graph 5.2, the reduction process is described as the linear erosion of the Intensity Integral Volume over 200 years, starting from late 13th century phonological configurations. Does this imply that speakers in for example, 1400, who had internalised (unconscious) knowledge of the phonetics of their time, knew about the phonetic properties of the language in 1300? This is highly unlikely.

The actual process is more complex than this linear degradation. Human speech organs and social conventions determine a fairly fixed range of vowel duration and loudness. There is a universal level of applicability in minimum length and loudness that is acoustically perceivable, while on the other hand, despite some cultural differences, the average loudness of utterances in any language, is compatible. The

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148 This matches observations from Wangerooge. Riutstringen Old Frisian did not have a late pitch peak / Level Stress on a word such as mənəθ, because of the long root. Short-rooted words such as kusma ‘to come’ and əkpiu ‘ships’ had Level Stress and preserved their final vowel in Modern Wangeroogic: kusmə, əkpiu (cf. Smith & Van Leyden 2007, p. 45 for the relationship between root quantity and Level Stress in Wangerooge). Both in Wangerooge and West Frisian, vowels with a pitch accent were preserved.
Intensity Integral Volume of all vowels is distributed over this fairly fixed range of duration and intensity. The sound at the bottom of the range is so weak, that it is often not heard by the (new) listeners and its reduction becomes a fact. By a process of self-organisation of vowel intensities, the remaining set of vowels is redistributed over the original range. At that moment, there is a new vowel at the bottom of the range, and the whole process is repeated. This is why reconstructed Intensity Integral Volumes from around 1300 provide a correct prediction of reduction order and time, but also why it is unnecessary to assume any kind of collective memory from the original figures.

In an experiment, the observation range has been shortened to the last six points, imagining that no older sources were available. The scores for the Intensity Integral Volume are redistributed over the same score range as the eight points from 1.00 to 2.17 used for the original scores. The result is shown in graph 5.4. The predictive power of the approach remains the same. Note that the year 1300 is an arbitrary point in time as well. Vowel reduction from older /u/ and /i/ > /ə/ or even ø, when following long roots (as in the long-rooted -i- and -u-stems, cf. table 2.2) or from /ə/ > ø in word-interior position (for example, *bōdelis > bōdlis*, table 2.21) had already taken place before 1300 and was probably controlled by the same mechanism. Therefore, the seemingly ‘collective linguistic memory’ is the result of ongoing interaction of speech organs, acoustics and speaker interactions, all of which are universal and constant over time.
Interactions with morphology

The retention of Old Frisian /a/ as /ə/ is already an indication that the linear reduction process could be blocked by other phonetic features. Morphology could also be a blocking factor. The word-final /ə/ serves as an example here. Word-final /ə/ appears both in Old Frisian dêde 'deed' and dêlde 'divided'. The former became Modern Frisian died or even die, with apocope of the /ə/ and /d/, the latter is Modern Frisian dielde, without apocope. The retention of the final /ə/ enables a semantic contrast with the past participle. As the verbal ending /ə/ still survives in modern language, this example illustrates that other phenomena in the language, in this case a semantic-morphological category, can counter phonetic tendencies.

The dative singular of masculine and neuter words have exactly the same word-final /ə/ (§ 2.4.3.9). And indeed, while the /ə/ in bitale, dore and dêde had disappeared by 1410, it survived until 1460/70 as a dative singular ending of masculine and neuter nouns. Why did it not stay longer than this, as was the case with the verbal ending? There is no obvious phonetic reason why it should collapse under the pressure of phonetic reduction, when the verbal ending did not.

Evidence from the noun skip is very illustrative (table 2.23):

- The old dative form, with Open Syllable Lengthening is /ski:pə/, written <schype>;
- The old form + apocope would return a new dative form */ski:p/, written *<schyp>;
- The attested new form in the syntactical dative context is /ski:p/, written <schip>.

The new forms without an -e which appear in a syntactic dative context in the late 15th century are not the old dative form minus [a], but are levelled from the nominative/accusative: <schip>. This is an indication that it was not the phonetic / phonological development that caused the drop of the -e and hence the loss of the dative category. It was in fact the loss of the semantic / morphological dative category which resulted in the abandonment of the dative forms of -e. Definite articles in the language of the writer Bogerman, from the first half of the 16th century, confirm the loss of the dative in the late 15th century. Bogerman uses a subject - object system in the definite article, for example, masculine subject (= nom.) <dy>, object (= dat. + acc.) <dan>, the latter being the form of the original accusative.149

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149 Bogerman actually uses three systems: Firstly, there are occasional appearances of old genitive and dative forms of all genders; Secondly, there is the subject - object system; Finally, there is a system that distinguishes gender only and not case, which is the situation found in the current dialect of Schiermonnikoog. The second system is dominant in Bogerman’s texts.
A.P. Versloot: *Mechanisms of Language Change*

This order of developments is contrary to general assumptions in historical linguistics, for instance that it was the reduction of the endings that caused the collapse of the inflectional system (cf. § 1.2.5). Also in other languages, the abandonment of semantical or morphological categories precedes the reduction of unstressed vowels. This can be observed in Swedish, Faroese and Wallisian High German. All these languages have at least as many full unstressed vowels and other possibilities to maintain an inflectional grammar as Icelandic. First the grammatical categories are abandoned, and then the endings are lost.\(^{150}\)

In early-Modern Frisian, the petrified historical dative form \(<'t\text{ schijp}\>\) (no longer perceived as a functional dative) is attested, suggesting that \(/\text{a}/\) apocope could take place in this context. In the interaction between phonetic reduction tendencies and the semantic-morphological concept of ‘dative’, the latter won. But as soon as the dative had been abandoned, the phonetic erosion continued its ‘attacks’, and the final \(/\text{a}/\) in \(*\text{te skîpe}\) was easy prey, just as in another petrified dative \(\text{yn 'e bûs < in da hûse}\) ‘in the house’. The final \(/\text{a}/\) was retained in a third petrified dative formula in Modern Frisian: \(\text{yn 'e (fytte) looge < in da loge}\)\(^{151}\) The word *looge* is limited to this idiomatic expression, so there is no attraction from \(*\text{loech}\). The retention of the final \(/\text{a}/\) was supported by phonetical reasons: The neighbouring voiced \(/\text{y}/\) enlarged the Intensity Integral Volume of \(/\text{a}/\) (cf. § 2.4.2).

The interaction of speaker strategies, phonetic tendencies and morpho-semantical categories is illustrated in the bidirectional simulation model in § 5.2.

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(Results are from an unpublished analysis of all articles in Bogerman’s texts in the Frisian Language Database.)

\(^{150}\) The question ‘why’ with respect to this development cannot be answered here. It is presumed that this has to be found in the interaction between syntax and semantics.

\(^{151}\) As the word is only attested in this fixed expression, this old neuter word is now perceived as a word of common gender, taking the article \(de\) / enclitic \(\text{e}\) (Hoekstra and Visser 1996, 72).
5.1.7 Concluding remarks

The successful application of this deterministic model of language change does not pretend to be the panacea for all questions concerning sound reduction. Complicating factors, such as wellformedness, tone contours and morphology illustrate that, in the overall language system, these simple linear correlations are not the only issues. However, compared with the frequently expressed agnostic position on language change (cf. for references Zuraw 2003, 139), this model does constitute a relative advance in the understanding of ‘why’ languages change.

Correlations found in this section are not only those which can be attributed to chance. The model is more than a descriptive, well-functioning 'black box'. The high correlation between the Vowel Intensity Integral and the temporal order of the vowel reduction, provides evidence of a causal relationship between them. In a reductionistic approach, the components are from the real world, their interactions are causal and their validity is proven outside the actual field of application. The results of this section expand on:

- Repeatable, acoustic observations, which depend on features such as muscular motion, and actual acoustics which obey the laws of physics;
- The applied logarithmic ordering of perception scales, widely attested outside the field of linguistics.

At the same time,

- The results match observations from random language utterances (in written form). Any possible subjective intuition on ‘grammaticality’ by the researcher is avoided.

Section summary:

- The reduction of unstressed vowels in West Frisian between 1300 and 1550 shows a very high correlation with the reconstructed Vowel Intensity Integrals of the vowels in question;
- This high correlation provides evidence of a causal relationship between Vowel Intensity Integral and the reduction process;
- As deterministic processes rely on causal relationships, this reconstruction provides evidence of a deterministic character of language change.
5.2 A bidirectional model of language change

In § 1.4, acoustics/articulation, meaning and the general working of the human mind (memory) are mentioned as the three keystones of a deterministic system of language. Section 5.1 is an illustration of the impact of articulatory convenience and acoustics. These tend to erode any language system. Without counter forces, this would lead to a total degradation of language utterances. This tendency is countered, however, by the demand for effective communication. In the balance between functional communication and convenience, people do not instantly apply the minimum effort possible, with only the restriction of communicating, they are also bound by seemingly inconvenient, social conventions.

Society is full of activities which cost people a great deal, but are not particularly good for them as individuals. These activities are performed because 'our neighbour is doing it as well'. To give an example from language: All grammatical persons of the verb in English can do without any specific marker. There is no misunderstanding with: “he sing” or “she make”. Some English learners do so, and they are understood perfectly well. However, with the exception of learners, people avoid making this mistake, because this is not how they learned the language and, moreover, it would sound silly speaking in such as way. The choice between “she make” or “she makes” is not random. Instead of being driven by constraints on the linguistic effect, it is driven primarily by constraints on the social effect, which apparently overrule the minimum linguistic system requirements. Individuals are storing in their memory both linguistic and context information, such as social conventions and individual circumstances (cf. Port & Leary 2005, 954-955). For this section, it is enough to signal that people take note of common practice when producing their own language.

Frequency figures are a suitable quantifier of the concept 'common practice'. Neurological and cognitive sciences indicate that frequency is not only an abstract numerical expression of 'common practice', but it is also an actor in the formation and structuring of our memory. This basic function of the brain is used in Oudeyer (2005) for example, in his modelling of the growth of vowel systems through self-organization. Bare frequency may be a somewhat crude component, however neural research is a hot topic currently and future results from such research will contribute further to the understanding of memory formation, also with respect to

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152 'Functional communication' resembles the Faithfulness Constraints, and 'convenience' matches Markedness Constraints in Optimality Theory.
The following section, 5.2.1, introduces the Bidirectional Table and explains how the three factors of phonetics (articulation and acoustics), meaning (semantics) and memory (taking notice of 'common practice') are represented in it.

Section 5.2.2 shows which predictions this model makes for the vowel reduction in the case of contrasting morphological endings. Morphological categories, such as singular and plural, or 1st person singular versus infinitive, are projections of the real world: the difference between one dog or two dogs is just as much a categorical interpretation of real world phenomena as the categorical contrast between a 'dog' and a 'cat', and hence a form of semantics. In § 5.2.3 the results will be compared with the actual developments in the language of the Middle Frisian charters for the pair habba, 1st pers. sg. pres. ~ habba, infinitive of 'to have'. In § 5.2.4, the example of the singular seke 'case' versus the plural seka/seken is assessed.

5.2.1 Introducing the Bidirectional Table

This first example illustrates the effectiveness of the Bidirectional Table, comparing the phonological contrast of the final /a/ and /a/ in the verb habba. The infinitive regularly appears with the final <a> in Old Frisian (cf. § 2.4.3.5). The regular historical appearance of the ending of the 1st pers. sg. pres. is <e> (§ 2.4.3.9). The early-Modern Frisian form of the 1st pers. sg. pres. is hab, with syncope. When followed by the clitical pronoun (habb‘ik), apocope becomes faster than in other contexts. Apparently here, a syntactic structure is interfering. The same holds for the frequent form of the 1st pers. pl. pres. with clitic: habba wi < habbath wi. These figures have been left out of this example, to enhance the picture. The effectiveness of the Bidirectional Table was then checked, including all data in the 1st pers. sg. pres and all instances of both the infinitive and pl. pres. tense forms without a final /t(h)/. The observed patterns remain the same, but the calibration data (see § 5.2.3) change slightly (no further treatment).
Over the period 1390 to 1430, the following verbal endings have been attested and are not followed by a clitical pronoun:

<table>
<thead>
<tr>
<th></th>
<th>1390-1430</th>
<th>ø</th>
<th>&lt;e&gt;</th>
<th>&lt;a&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st sg</td>
<td></td>
<td>1</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>inf</td>
<td></td>
<td>0</td>
<td>1</td>
<td>6</td>
</tr>
</tbody>
</table>

Table 5.6: Number of written endings in the original charters from 1390 to 1430 detailing the 1st pers. sg. present and the infinitive of habba ‘to have’

This table shows that there are six attestations to the 1st pers. sg. pres. of <habbe> and one of <hab>. The infinitive is written <habba> six times and <habbe> once. Note that these are real figures from the charters. The classical forms (1st pers. sg. pres. habbe and inf. habba) are dominant. The consequence of the evaluation of the charter data in § 1.3 and chapter 2 is that figures in table 5.6 can be taken as a reliable reflection of the linguistic reality of that time. The contrast between the 1st pers. sg. pres. and the infinitive for the endings <e> and <a> is statistically significant.

There are a number of circumstances that may cause an inaccurate perception to the listener of some unstressed vowels. These include:

- In faster speech, vowels are realised with a reduced formant contrast (cf. De Graaf 1986, 18), a manifestation of the speaker’s convenience tendency;
- The stress pattern of a sentence may place relatively little emphasis or energy on the unstressed vowel;
- There may be disturbing background noise;
- The listener may have a less than sharp ear;
- The listener’s attention may be flawed;
- etc.

Wherever it happens, somewhere between the speaker’s intended prototype and the listener’s final interpretation, something causes the listener to perceive a reduced version of the vowel, for example, [æ] instead of [a]. By chance, this may also work in the opposite way, where a listener hears something that he interprets as an /a/ while an /æ/ was intended. In vowel contrast reduction in allegro speech (cf. the mentioned study De Graaf 1986), acoustic and environmental noise can cause skewed deviations. The probability of an intended /æ/ being perceived as an ø is greater than that of it being perceived as an /a/. This skewed distortion effect can be found in the table. There is a secondary appearance of an /æ/ as an ø, while instances of /æ/ as an <a> are missing in table 5.6. For /a/, a similar,
'downgrading' leak is found from /a/ to /ə/. This disturbing acoustic and perceptual effect is referred to as 'noise' in the following paragraphs.

From an absolute number of forms, production ratios have been calculated.

<table>
<thead>
<tr>
<th>1390-1430</th>
<th>ə</th>
<th>&lt;e&gt;</th>
<th>&lt;a&gt;</th>
<th>production</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st sg</td>
<td>1</td>
<td>6</td>
<td>0</td>
<td>14%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>86%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0%</td>
</tr>
<tr>
<td>inf</td>
<td>0</td>
<td>1</td>
<td>6</td>
<td>0%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>14%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>86%</td>
</tr>
</tbody>
</table>

Table 5.7: Production ratios for full and reduced forms during the period 1390 to 1430

On the right hand side of table 5.7 production ratios of alternative verbal forms are shown. Six out of seven cases of the 1st pers. sg. pres. are formed with an <e>, which equals 86%. There is one case with no ending, representing 14% of the attestations. The sum of the cells in row one is 100% (horizontally). It is mutatis mutandis the same for the infinitive in the second row. The production figures represent the speaker’s perspective. They constitute a 'common practice' for all speakers. If a speaker wants to speak 'normally', he would prefer the use of [hab:ə] in the 1st pers. sg. pres., etc., but occasional realisations of [hab] are not ridiculous. It would, however, sound 'exaggerated' to use only [hab].

In a bidirectional approach, there is also the listener’s perspective. Being confronted with the form [hab:a], there can be no doubt about the speaker’s intended meaning: [hab:a] can be nothing else but an infinitive. Hearing [hab] is an unambiguous listener’s cue for the interpretation as a 1st pers. sg. pres. Hearing [hab:ə], the listener has to overcome some ambiguity. Six out of seven instances of <hab:e> in the charters from the period 1390 to 1430 are used as a 1st pers. sg. pres. The interpretation of [hab:ə] is that the speaker most likely (six out of seven or 86%) wants to express a 1st pers. sg. pres., but the possibility of an infinitive must also be considered (one out of seven or 14%). This perception is shown in additional cells at the bottom of the table. The sum of the cells in each column is 100% (vertically):

155 Note that the repeating cell values of '0' and '1' are purely coincidental. These are absolute token numbers from the charters.
Table 5.8 shows that for example, 14% of the actually produced forms of a 1st pers. sg. pres. in the speakers’ community are [hab] and that their interpretation by listeners is unambiguous. This form is 100% reliable. The same 1st pers. sg. pres. is realised as [hab:a] in 86% of the cases and a listener, being confronted with this form, will be fairly sure (86%) that he is dealing with a 1st pers. sg. pres., etc. This implies that there is a tension in the 1st pers. sg. pres. between the common form [hab:], and the semantically optimal form [hab]. For the infinitive, no similar tension is at stake. The secondary, reduced form of [hab:a] is not a reliable realisation of an infinitive (14% reliability) and new speakers will not become attracted to it.

Table 5.8 contains all three components mentioned:

- The acoustic properties are represented by the adjacent positioning of ø ~ [θ] and [θ] ~ [a], with a default skewed ‘leak’ to the left;
- Semantic aspects are expressed by perception / reliability ratios at the bottom;
- The memory component is expressed by production ratios on the right of the table: Which form has the highest frequency and suits the common practice?

5.2.2 Turning the table into a working algorithm
Which variant will speakers choose and how does this affect the development? What are the production strategies and how do they influence perception strategies? For this model, there is no extra-linguistic preference for any of the forms (for example, some educational standardisation) nor additional/phonological or phonetic factors which may favour any variants.

The algorithm is based on the habbe-habba case, but now the table starts with an idealised Old Frisian situation: 1st pers. sg. pres. (’1st sg.’) -e, infinitive -a. Because the number of attestations in each row affects reliability ratios in the columns, it is important to use proper numbers for both paradigm forms. From the database over the entire period studied, a proportion of 1.4 : 1 can be deduced for the ratio of
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1st sg : inf.\(^{16}\) In the idealised model, there are no secondary forms and every form is 100% in both production and percepational reliability. The situation in table 5.9 contains no tension whatsoever and is not likely to change.

<table>
<thead>
<tr>
<th>stage 1</th>
<th></th>
<th></th>
<th>production</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st sg</td>
<td>140</td>
<td>0</td>
<td>0% 100% 0%</td>
</tr>
<tr>
<td>inf</td>
<td>0</td>
<td>100</td>
<td>0% 0% 100%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>perception</th>
</tr>
</thead>
<tbody>
<tr>
<td>0% 100% 0%</td>
</tr>
</tbody>
</table>

Table 5.9: Idealised Bidirectional Table: Stage one

The next step is to introduce noise. Noise levels might be deduced from experimental phonetic research, but this example refers to an early 14th century situation with 14% reduced forms. A noise reduction ratio of 10% is assumed, i.e. 10% of the cases where [a] is meant by the speaker but heard as [æ] by the listener. The probability of noise working the other way around (i.e. an intended [æ] being understood as [a]) is much lower. An 'upgrading' noise ratio of 1% is also assumed. The result of the implementation of this noise factor is found in the stage two table:

<table>
<thead>
<tr>
<th>stage 2</th>
<th></th>
<th></th>
<th>production</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st sg</td>
<td>14</td>
<td>125</td>
<td>10% 89% 1%</td>
</tr>
<tr>
<td>inf</td>
<td>0</td>
<td>10</td>
<td>0% 0% 100%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>perception</th>
</tr>
</thead>
<tbody>
<tr>
<td>100% 93% 2%</td>
</tr>
</tbody>
</table>

Table 5.10: Bidirectional table with application of noise: Stage two

Following the noise factor, 10% (=14) of the 1st sg. cases of an intended [æ] are now realised in such a way that they are perceived as o, while 1% (=1) is realised / perceived as [a]; mutatis mutandis for the infinitive forms, without the possibility of 'upgrading'.

The next step is to determine the speaker’s choice for either of the variants. Social conformity by the speaker in using ‘common practice’ favours the choice of the

\(^{16}\) In the table, the absolute frequencies of 140 and 100 are used. They are only a measure of the ratio 1st sg : inf. Instead of 140 : 100, it would also be possible to use figures such as 70 : 50 or 1400 : 1000. For the early-Modern Frisian data, the ratio is also exactly 1:4 (including correction for the inverted word order hab iñk).
most common form. For the 1st sg., that would be habbe. If perception were the
only leading force, the less ambiguous forms should be chosen: In the 1st sg. that
would be hab. It is almost impossible to predict the choice of one speaker in one
utterance: In the 1st sg., the speaker will simply either say [hab:] or [hab]. Here, the
power of the large numbers offers a way-out. Throwing a die once, will return a ‘3’
or another number. The outcome is a binary event (it either happens or it doesn’t),
even though the probability of a ‘3’ is 1/6. When throwing a die 100 times,
approximately 17 throws will be a ‘3’, as 17/100 = 1/6. When an event is highly
frequent, the probability ratio and actually observed values approach each other. A
production ratio of 10%, apparently reflects an underlying probability factor of
10%. The probability factor equals the actual distribution ratio.\(^{157}\) For this model,
it is assumed that the observed form frequencies reflect the overall frequencies in
daily live speech and, therefore the underlying probability factors.

The choice between the two variants is controlled by two desires which can both
be expressed by probability factors:

- The desire to speak ‘normally’, to conform with common practice:
  to say [hab:] as the 1st pers. sg. represents an accommodation to the
  common practice of 89%;
- The desire to be understood, to use unambiguous forms:
  to say [hab:] as the 1st pers. sg. means that the signal is unambiguous for
  93%.

Combining two probability factors is usually expressed by multiplying the factors.\(^{158}\)
It is assumed that people are guided equally by common practice and the reliability
of the signal towards the listener.\(^{159}\) Now, the probability of [hab:] as the 1st sg. can

\(^{157}\) The probability of throwing a ‘3’ with a die can be deduced from the number of
faces on the die, six, so there is a 1/6 chance. But the die can be thrown 1000 times and the
number of times it lands on three is about 167. This reveals a 167/1000 chance or 1/6 ratio (cf.
Moore & McCabe 2003, 283).

\(^{158}\) Take a combination of a letter and a number, for example, A3 or T8. The
probability of guessing it right is 1/26 (for the letter) times 1/10 (for the number) = 0.0038 %, as
there are 26 different letters and 10 different numbers (0-9).

\(^{159}\) The model was tested for other ways of computation, for example to apply the
square of the production and perception factors, which favours frequent and/or reliable variants.
Applying the square of the production probability causes the system to come to a standstill, with
the persistence of the historical forms as a result. This may reflect a situation of a strong norm,
for example societies with high levels of literacy, such as modern European countries, but also
Iceland in earlier ages. Further testing of this kind of extensions to the model is definitely
worthwhile.
be computed as: $0.89 \times 0.93 = 0.83$. The choice of the form $[hab] = 0.1 \times 1 = 0.10$, while the choice of $[hab:a] = 0.01 \times 0.02 = 0.0002$, etc.

<table>
<thead>
<tr>
<th>stage 3</th>
<th>o</th>
<th>&lt;c&gt;</th>
<th>&lt;a&gt;</th>
<th>production</th>
</tr>
</thead>
<tbody>
<tr>
<td>1&lt;sup&gt;st&lt;/sup&gt; sg</td>
<td>14</td>
<td>125</td>
<td>1</td>
<td>10% 89% 1%</td>
</tr>
<tr>
<td>inf</td>
<td>0</td>
<td>10</td>
<td>90</td>
<td>0% 10% 90%</td>
</tr>
<tr>
<td>perception</td>
<td>100% 93% 2%</td>
<td>0% 1% 89%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 5.11: Bidirectional table with calculation of the new production ratios, based on the multiplication of the production and the reliability ratios.

Note that the sum of the row of probabilities has become less than 100%; in the first row: $0.1 + 0.83 + 0.00 = 0.93$. In order to compute new production figures, this has to be corrected. The total number of tokens must remain the same. To compute the new production figure for $[hab]$ as a 1<sup>st</sup> sg., the new production probability needs to be divided by the sum of the new production probabilities and multiplied by the number of tokens: $(0.1/0.93)\times 140 = 15$ tokens. For the form $[hab:a]$ this is: $(0.83/0.93)\times 140 = 125$ tokens while for $[hab:a]$ it is: $(0/0.93)\times 140 = 0$ tokens. The same calculation can be done for infinitive forms. This results in the sum of tokens in all cells remaining at 240. The result is shown in table 5.12.

<table>
<thead>
<tr>
<th>stage 4</th>
<th>o</th>
<th>&lt;c&gt;</th>
<th>&lt;a&gt;</th>
<th>production</th>
</tr>
</thead>
<tbody>
<tr>
<td>1&lt;sup&gt;st&lt;/sup&gt; sg</td>
<td>15</td>
<td>125</td>
<td>0</td>
<td>11% 89% 0%</td>
</tr>
<tr>
<td>inf</td>
<td>0</td>
<td>1</td>
<td>99</td>
<td>0% 1% 99%</td>
</tr>
<tr>
<td>perception</td>
<td>100% 99% 0%</td>
<td>0% 1% 100%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 5.12: Bidirectional table with new intentional production figures and corresponding perception ratios.

For the infinitive, the noise factor in stage two (table 5.10) produces 10 instances (= 10%) of forms that were meant as an [a], but perceived as an [o]. In table 5.12, it is shown that speakers are inclined to produce the infinitive form of [o] in only 1% of the cases. So, a form resulting from noise and causing ambiguity is cleaned up by this algorithm. This is exactly what should be expected from a functional communication system. There is no need for an explicit rule or constraint in the language stating that [haba] as an infinitive form would be prohibited. Actually, the form is not prohibited, it is discouraged. Where the algorithm confirms the position of [haba] as an infinitive form, it goes a different way in the choice between the
singular forms [hab] and [hab:a]. The unambiguous form of [hab] is gaining ground, albeit only marginally (from 10% to 11%). The infrequent and semantically unattractive 1st sg. form [hab:a] is swept away (< 0.1%).

The combination of being faithful to tradition (conforming to common practice and social behaviour) and the semantic intention of the speaker ensure the functionality of the system, even in a setting of continuous phonetic noise.

Now that the newly intended production figures are calculated, the same circle is entered again, because 10% (cf. commentary to table 5.10) of the cases of the 1st sg. *habbe*, intended as [hab:a], will reach the brain of the listener as [hab], due to noise. This means that the intended 15 cases of [hab] as the 1st sg., mentioned in table 5.12, are joined by 10% of 125 cases (= 12), intended as [hab:a], but perceived as [hab] due to noise. This brings the total of [hab] to 15 + 12 = 27. Applying the above-mentioned noise factors to the other cells as well, enables a new production / perception table to be prepared:

<table>
<thead>
<tr>
<th>stage 5</th>
<th>production</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st sg</td>
<td></td>
</tr>
<tr>
<td></td>
<td>o</td>
</tr>
<tr>
<td></td>
<td>0</td>
</tr>
<tr>
<td>perception</td>
<td>100%</td>
</tr>
<tr>
<td></td>
<td>0%</td>
</tr>
</tbody>
</table>

Table 5.13: New production ratios from table 5.12, now including phonetic noise.

This procedure can be repeated time after time, producing a series of tables. After 16 complete runs, the situation is as follows:

<table>
<thead>
<tr>
<th>stage 5</th>
<th>production</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st sg</td>
<td></td>
</tr>
<tr>
<td></td>
<td>o</td>
</tr>
<tr>
<td></td>
<td>2</td>
</tr>
<tr>
<td>perception</td>
<td>98%</td>
</tr>
<tr>
<td></td>
<td>2%</td>
</tr>
</tbody>
</table>

Table 5.14: New production rates after 16 runs, including the application of phonetic noise (stage five of the loop).

At this stage of the process the number of realisations of the 1st sg. as [hab] gradually increases and reaches almost 100%. The appearance of [hab:a] is solely
the result of the noise factor.\footnote{It is questionable if the ‘upgrading noise’ from ø > [a] indeed equals the ‘upgrading noise’ from [a] > [a]. Both have the value 1% in this model. The model can also run assuming that a sound which has disappeared cannot be revealed again, therefore setting the ‘upgrading noise’ from ø > [a] at 0%. The difference is that exactly the same configuration of table 5.14, apart from 1 x <e> in the 1\textsuperscript{st} sg., is reached after 14 runs instead of 16.} Table 5.14 is not yet in equilibrium; after 45 complete runs, the figures are as in table 5.15:

<table>
<thead>
<tr>
<th></th>
<th>ø</th>
<th>&lt;e&gt;</th>
<th>&lt;a&gt;</th>
<th>production</th>
</tr>
</thead>
<tbody>
<tr>
<td>1\textsuperscript{st} sg</td>
<td>139</td>
<td>1</td>
<td>0</td>
<td>99% 1% 0%</td>
</tr>
<tr>
<td>inf</td>
<td>7</td>
<td>60</td>
<td>34</td>
<td>7% 60% 34%</td>
</tr>
<tr>
<td>perception</td>
<td>95%</td>
<td>2%</td>
<td>0%</td>
<td>7% 60% 34%</td>
</tr>
<tr>
<td></td>
<td>5%</td>
<td>98%</td>
<td>100%</td>
<td>7% 60% 34%</td>
</tr>
</tbody>
</table>

Table 5.15: New production rates after 45 runs, including the application of phonetic noise (stage five of the loop).

The 1\textsuperscript{st} sg. reaches its final position already in table 5.14, but in the meantime, the infinitive starts to shift from predominantly [haba] to predominantly [hab:a]. The system reaches an equilibrium after 64 runs, with the infinitive [hab:a] calculated at 62%.

5.2.3 Verifying the model

Relative order predicted by the model

The verification of the model starts with the evaluation of the general trend. Section 2.4.3.9 assesses the development of the 1\textsuperscript{st} pers. sg. pres. habbe. The ending <e> starts to vanish in around 1430 and has disappeared by 1460. Note that this is later than expected from a purely phonetic reduction process point of view, (discussed in § 5.1). The word-final /a/ following a long root in, for example, fore 'before' has already disappeared by 1400. In accordance with the order predicted by the algorithm in § 5.2.2, the reduction of the infinitive ending from [a] to [a] first starts after the completion of the reduction of the 1\textsuperscript{st} pers. sg. pres. [hab:a] > [hab], i.e. not before 1490, cf. § 2.4.3.5. Where the algorithm reaches an equilibrium after 64 runs with still 31% [haba], both graph 2.10 and map 2.11 show that the final [a] in the infinitive was indeed ‘reluctant’ to disappear completely. This transition takes much longer than the reduction of the 1\textsuperscript{st} pers. sg. pres. habbe.

Absolute order predicted by the model

The real data can also be used to see if the relative order, predicted by the model and confirmed by the data, has any absolute implications. The transition period of
the 1st sg. can be used to calibrate the model. The development from [hab:a] to [hab] takes 30 years, from 1430 until 1460, represented by 15 runs in the model. This implies that 1 run represents 2 years in real time. Applying this calibration to the infinitive data returns the following figures: Near equilibrium is reached after 45 runs, representing $45 \times 2 = 90$ real time years. Adding 90 to the beginning of the entire process, the year 1430, becomes 1520. Between 1510 and 1550 <habba> is found as an infinitive in 39% of the attestations, being strikingly near to the predicted 34% from the model.

The final transition from /a/ to /ə/.

What this version of the model does not describe, is the final clean-up of the ending [a], which must have taken place before the end of the 16th century. In late 16th-century sources from early-Modern Frisian, the ending <a> is absent in contemporaneous texts. In the north, the transition process finishes prior to 1510. In the late 15th century there is only one phoneme /ə/, with a prototypical realisation of [ə] and a high tolerance for a more open distribution [a] in some contexts (cf. § 3.3, table 3.2). Additional algorithmic modelling is needed to simulate the actual concentration of realisations closer to [ə]. Another flaw of this model is that it only presumes the phonetic stages ø, [a] and [a], while the entire range is an acoustic continuum.\(^{161}\)

The detailed course of the development.

The previous discussion shows that both the predicted relative order and the predicted absolute speed of the development match the order and timing of the historical developments. The most intriguing aspect in the habbe-habba case is the form [haba]: In Old Frisian, this was the main form of 1st pers. sg. pres, but in early Modern Frisian, it was the prototype (as [haba] after degemination) of the infinitive. How does the language deal with meaning-form ambiguity in the model and does it match the real data?

Table 5.16 shows observed and computed data for production and perception reliability ratios of <habbe> as the 1st pers. sg. pres.:

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\(^{161}\) A dissertation by Bart de Boer (2006) indicates that the creation of vowel systems with a limited number of phonemes in acoustic continuum can be modelled by self-organisation.
The match between the computed and the observed data is high, with $r^2 > 0.9$ and $p < 0.1\%$, making it highly likely that both datasets are drawn from the same underlying dataset. The relationship between production and perception reliability can be shown in a two-dimensional graph, with production on the X-axis and perception scores on the Y-axis. The black points in graph 5.5 show the observed values from 5.16. The open points connected with a dashed line are based on computed data.

**Table 5.16: Observed and computed production and perception reliability ratios for <habbe> as the form of the 1st pers. sg. pres. of habba**

<table>
<thead>
<tr>
<th></th>
<th>Observed</th>
<th></th>
<th>Computed</th>
<th></th>
<th>1 run = 2 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>-1430</td>
<td>86%</td>
<td>86%</td>
<td>89%</td>
<td>93%</td>
<td>1</td>
</tr>
<tr>
<td>1430-1460</td>
<td>37%</td>
<td>97%</td>
<td>30%</td>
<td>78%</td>
<td>8</td>
</tr>
<tr>
<td>1460-1490</td>
<td>3%</td>
<td>29%</td>
<td>1%</td>
<td>3%</td>
<td>23</td>
</tr>
<tr>
<td>1490-1510</td>
<td>2%</td>
<td>7%</td>
<td>1%</td>
<td>2%</td>
<td>35</td>
</tr>
<tr>
<td>1510-1550</td>
<td>2%</td>
<td>5%</td>
<td>1%</td>
<td>2%</td>
<td>50</td>
</tr>
</tbody>
</table>

**Graph 5.5: Relationship between production and perception reliability ratios of <habbe> as the 1st pers. sg. pres. of habba, comparing observed data in the charters with the computed data from the Bidirectional Tables.**
For <habbe> as the form of the infinitive, the table is as follows:

<table>
<thead>
<tr>
<th>&lt;habbe&gt; inf</th>
<th>Observed</th>
<th>Computed</th>
<th>1 run = 2 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>-1430</td>
<td>14%</td>
<td>14%</td>
<td>10%</td>
</tr>
<tr>
<td>1430-1460</td>
<td>3%</td>
<td>3%</td>
<td>12%</td>
</tr>
<tr>
<td>1460-1490</td>
<td>9%</td>
<td>71%</td>
<td>47%</td>
</tr>
<tr>
<td>1490-1510</td>
<td>28%</td>
<td>93%</td>
<td>57%</td>
</tr>
<tr>
<td>1510-1550</td>
<td>63%</td>
<td>95%</td>
<td>60%</td>
</tr>
</tbody>
</table>

Table 5.17: Observed and computed production and perception reliability ratios for <habbe> as a form of the infinitive habba.

The correlation between observed and computed production is rated less than in the previous table, but is still strong with $r^2 = 0.48$, while the p-value of the one-tailed test is 9.8%. However, for perception, the levels are the same as in table 5.16 ($r^2 = 0.92$, $p = 0.5\%$). The graphical depiction of this data is found in graph 5.6. Note that the temporal direction of the curves in 3.6 and 3.7 is reversed. In graph 5.5, the points near the 0-0-point are the youngest ones, while in graph 5.6 the points from the oldest data are close to the 0-0-point. The graph shows that the course of the development is well predicted. The low correlation of production rates is the result of a different timing, not an incorrect sequence.

Graph 5.6: Relationship between the production and perceptional reliability ratios of <habbe> as an infinitive of habba, comparing observed data from the charters with computed data from the Bidirectional Tables.
Both graphs illustrate the ability of the language to overcome the problem of semantical ambiguity. First, the production rate of the ambiguous form of the 1st pers. sg. pres., <habbe> drops, while its perceptional reliability is still high, for example, in table 5.16, time frame 1430 to 1460: Production of the 1st sg. form [hab:] is 37%, the perceptional reliability is 97%. Subsequently, in the following time frame, the perceptional reliability also falls, reaching very low levels for both aspects after 1490. As a realisation of the infinitive, <habbe> is initially infrequent and unreliable. Between 1460 and 1490, the reliability improves drastically. It is then that it becomes an interesting form for speech production. Production reaches > 60% in the last time frame.

Concluding remarks

The algorithm using the Bidirectional Table, modelling speakers’ strategies by multiplying the production ratio by the perceptual reliability, provides a fairly good estimation of the development of [hab:] - [hab:a] towards [hab] - [hab:]. Both the relative and the absolute order of developments can be predicted from the model.

It is particularly worth noting that a speaker’s attitudes towards aspects of ‘common practice’ and communication effectiveness do not change over time, nor do phonetic noise levels. This is an essential characteristic of any algorithmic approach (cf. § 1.4). However, constant attitudes and values predict the non-linear course of the developments as depicted in graphs 5.5 and 5.6. Trying to describe this part of a speaker’s grammar, including observed variations, with something like a ‘rule’, would demand:

• Continuous adjustment of the rules, describing variations from year to year,

alternatively, where a static rule with a statistical component is used:

• Continuous adjustment of statistical components.

In both cases, neither the direction nor the velocity of the adjustments can be predicted. In this model, speakers’ attitudes, i.e. their intention to produce ‘grammatically’ correct utterances, remain constant. It is the deterministic interaction of reductionistic components which causes shifts in language production.

The choice of the three components: ‘articulatory convenience’, ‘common practice’ and ‘effective communication’ as the actors in a causal relationship receives support from the working of the model.
5.2.4 A second case study: seke

The effectiveness of the algorithm has also been tested on data from the noun seke ‘case’, Old Frisian singular form seke, nom./acc. plural seka. The description of the developments in the charters can be found in § 2.4.3.4 and § 2.4.3.8. To summarise the developments again:

- **North-East:**
  - singular: seke > sek between 1440 and 1460
  - plural: seka remains stable until at least 1490; -a is quickly replaced by the new ending -en in the late 15th century.

- **South & west:**
  - singular: seke remains dominant until 1470
  - plural: seken appears in around 1440 and gradually takes over during the next 30 years.

Developments in the region North-East

Developments in the North-East, with the -e / -a contrast acting as an engine for them, are very similar to the habbe/habba case. Firstly, the final -e of seke is dropped, while the plural keeps its final -a. But then the expected phonological development is disrupted by the replacement of a plural ending -a with -en, except in the dialect of Schiermonnikoog, where -a is subsequently reduced to -e, just as in the case of habba (§ 2.4.3.4).

The development can be modelled on the same settings as the habbe-habba case, with two differences:

- The sg : pl-ratio for seke is 3:1 (cf. it was 1.4 : 1 for habbe-habba). This ratio is based on the frequency figures from the corpus;
- Because seke has a short root and the final vowels are more prominent, the noise factor of [e] > [ə] and from [a] > [e] is set at 5%, instead of 10%.

Observed and computed figures for <secke> and <seek> as singular forms are given in table 5.18.12 The algorithm starts in the same year as the habbe-habba case, while the time frame 1430 to 1460 corresponds with run eight (cf. table 5.16). Figures from 1430 to 1460 represent an average year of 1445. Applying the same

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12 A comparison of production and perception rates for <secke> as a plural form in the North-East turns out worse. This is due to the low number of relevant tokens. The form <secke> is expected to be infrequent as a plural form between 1430 and 1510. The model produces 17% <secke>. The form <secke> is not attested in the corpus from the North-East. A chi²-test on the observed and computed frequencies returns a p-value of 10.3%, which is no reason to reject the null-hypothesis, formulated by the algorithm computation.
time scale as in § 5.2.3, the process would have begun in $1430 = 1445 - (8 \times 2)$. The first attestation to *seke* without an ending in the North-East is in 1441 (<seeck>, OFO I-83, Tytsjerkesteradiel).

The algorithm predicts a production ratio for *<secka>* as a plural form of 95% during the time frame 1460 to 1490. In the original charters, the plural is 100% *<secka/sacka>* until 1490. This shows that developments in the North-East are as expected, based on the *habbe-babba* case, until the late 15th century.

Developments in the south and west

In the south and west of Fryslân, the developments take a different course due to the introduction of the plural marker *-en* (map 2.10). The emergence of this ending *-en* is not a regular case of phonetic noise as implemented in the model. In fact, it is a kind of 'morphological noise' and needs a more extended algorithm to cover this aspect.

The key points on where the south and west differ from the North-East are (compare also table 5.18 and 5.19):

- *<secke>* is not falling to 0%;
- *<secka>* is not continuing as a plural and subsequently reducing to *<secke>* as plural form, but *<seecka>* becomes a variant of the singular form;
- The plural is soon expressed as *<secken>*.

To model the morphological levelling, the following method is used:

Instead of a constant noise factor from *seka* to *seken*, 1% *<secken>* is used to begin, to simply introduce the form into the table. The 'phonetic noise' used in the previous computations is replaced by a 'morphological noise'. The morphological noise is the difference between the reliability ratios of *<seecka>* and *<secken>*. To use an example, in the second run, the reliability ratio of *<secken>* is 100% and for *<secka>* this is 97%, causing...
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...morphological noise of 3%. This is fairly low, compared with the default 10% phonetic noise in the model from [a] > [ə]. After 22 runs, the difference is 100% - 96% = 4%, etc. This morphological noise is used for the ‘leak’ from <secka> to <secken>, instead of the phonetic noise in the previous case of habbe ~ habbu.

Run four of the algorithm matches the first time frame. This puts the beginning of the process at an average year for the first time frame of 1445 minus four runs multiplied by 2 year/run = 1435. This is slightly later than the start of the developments in the north-east. The oldest attestation to <seck> in the south or west is from 1452 (OFO II-217, Boarnsterhim; cf. 1441 for the north-east). The oldest plural form in -en, not as a dative, is from 1447 OFO I-99 (Wânsersdied). This implies that the small difference in timing, suggested by the calibration of the algorithm computations, is not contested by the data from the charters. These settings produce the following computed ratios, which can be compared with observed values in the charters:

<table>
<thead>
<tr>
<th>Production</th>
<th>&lt;secke&gt; as singular</th>
<th>&lt;secke&gt; as plural</th>
<th>1 run = 2 years</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Obs.</td>
<td>Comp.</td>
<td>Obs.</td>
</tr>
<tr>
<td>1430-1460</td>
<td>83%</td>
<td>80%</td>
<td>0%</td>
</tr>
<tr>
<td>1460-1490</td>
<td>26%</td>
<td>35%</td>
<td>9%</td>
</tr>
<tr>
<td>1490-1510</td>
<td>31%</td>
<td>22%</td>
<td>0%</td>
</tr>
</tbody>
</table>

Table 5.19: Observed and computed production ratios for <secke> as a form of the singular or plural of seke ‘case’ in charters from the south and west.

<table>
<thead>
<tr>
<th>Production</th>
<th>&lt;secka&gt; as singular</th>
<th>&lt;secka&gt; as plural</th>
<th>1 run = 2 years</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Obs.</td>
<td>Comp.</td>
<td>Obs.</td>
</tr>
<tr>
<td>1430-1460</td>
<td>4%</td>
<td>1%</td>
<td>83%</td>
</tr>
<tr>
<td>1460-1490</td>
<td>15%</td>
<td>0%</td>
<td>36%</td>
</tr>
<tr>
<td>1490-1510</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
</tbody>
</table>

Table 5.20: Observed and computed production ratios for <secka> as a form of the singular and plural of seke ‘case’ in charters from the south and west.
Table 5.21: Observed and computed production ratios for <secken> as a form of the plural of *seke* ‘case’ in charters from the south and west.

<table>
<thead>
<tr>
<th>Production &lt;secken&gt;</th>
<th>Obs.</th>
<th>Comp.</th>
<th>1 run = 2 years</th>
<th>Algorithm run</th>
</tr>
</thead>
<tbody>
<tr>
<td>1450-1460</td>
<td>17%</td>
<td>11%</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>1460-1490</td>
<td>55%</td>
<td>64%</td>
<td>19</td>
<td></td>
</tr>
<tr>
<td>1490-1510</td>
<td>100%</td>
<td>93%</td>
<td>31</td>
<td></td>
</tr>
</tbody>
</table>

The correlations between the observed and predicted data for <secke> as a singular, <secka> as a plural and the plural <secken> are all over 0.9. Data from tables 5.19 to 5.21 is computed from one bidirectional table with one set of input values and parameter settings. The reliability of the procedure should be tested on the total of the model. Combining all the data from the three tables into one correlation test, returns a $r^2 = 0.96$ and a p-value < 0.1%. The cumulative evidence of the results from the algorithm is strong.

The number of singular forms of <secka> is not correctly predicted for the second time frame. In run 63, the model reaches an equilibrium stage, with a level of 3% for <secka>. Therefore the model correctly predicts the existence of <secka> as a possible form of the singular, but at later stages and on a much lower level than observed in the second time frame. Closer evaluation of the base materials reveals that the six tokens of <secka> from the time frame 1460 to 1490, being the 15% in table 5.20, are all from one charter, OFO II-76 (1476) from Wymbritseradiel. Considering the remarks in § 1.3.7.10 (about token count or charter count) the figure of 15% <secka> in the observed data is probably too high.

Therefore, given the existence of the alternative plural ending -en, the algorithm correctly predicts three differences with the North-East:

- **<secke>** remains on a fairly high level as a singular in the last time frame (observed 31%, computed 22%) while for the north-east it is observed 0% and computed at 7%.
- The plural preferably becomes -en; a computed 100% -en in the plural is reached in run 37.
- **<secka>** becomes an optional form of the singular rather than the plural, despite the level and timing of this alternative not always being predicted correctly (or not always being rendered correctly from the scarce data).

The above-mentioned three structural differences between the North-East and the south and west are automatically captured by the algorithm when the introduction of the plural form -en is assumed. It is assumed that a full language simulation
would reveal that this introduction is a consequence of other processes or tensions in the language (a suggestion can be found in § 4.5.2). Where it is due to external, sociological factors such as language contact, it will be more difficult to predict by linguistic modelling.

The conclusion from this section is that the algorithm in the Bidirectional Table has confirmed its ability to make reasonable predictions on the development of different variants under different circumstances. The fact that the model is still useful with a small adjustment in parameter settings, complying with knowledge from § 5.1, generates further support for the concept of linguistic changes as a deterministic process. The interaction of elements is defined by underlying concepts (of articulatory convenience, effective communication and memory formation), while specific parameter settings can be obtained from empirical and phonetic research.

A future challenge is to enhance the model with items such as:

• Priming effect;
• The size of the sample set in the memory from which the 'common practice' is computed;
• Replacing probability proportions with statistical variables (cf. Ke 2004, 213 ff.);
• Incorporating different sized speech communities;
• Dynamic categories in the column and row heads.

Section summary:

• The Bidirectional Table model relies on the reductionistic components of ‘articulatory convenience’, ‘common practice’ and ‘effective communication’;
• Shifting ‘grammar’ describing the choice speakers have between different phonological variants, is the result of the interaction of these three components, assuming the language user is a probabilistic learner.
6. Concluding remarks

This study builds on late mediaeval written material, once described as being written in a ‘random spelling’ (“willkürliche Orthographic”, Sjölin 1969, 18). Investigation in § 1.3 shows this assertion to be true in a way that Sjölin never intended. Sjölin refers to the language of the oldest Old Frisian texts as being ‘remarkably homogeneous’ (“bemerkenswert homogen[...])” and the spelling as being ‘relatively consistent’ (“verhältnismäßig konsequent”; idem, 17). The syntax of the charters, however, would be ‘confused, often illogical’ (“[...] unübersichtlichen, oft unlogischen Satzbau”) and the spelling ‘at random’.

However, the charter language is random in an entirely different sense. While Sjölin uses the word ‘random’ pejoratively, it may well be understood from a statistical point of view, where ‘random observations’ provide a stochastically representative selection of material. These form the foundation of detailed, reliable reconstructions, both in time and space and are presented in chapter two.

Section 6.1 revisits the developments discussed in chapter two and four in Frisian between c. 1300 and 1550 in a synoptic overview. Section 6.2 looks again at the central question: How and why language change takes place?

6.1 Main developments in Frisian between 1300 and 1550

The following processes are investigated in chapter two:

- Vowel Balance
- Vowel Harmony
- Degemination
- Open Syllable Lengthening
- Vowel Reduction
- Pitch accent (discussed in chapter four)

The Old West Frisian language of the late 12th century had basically three different vowels in unstressed position: /a/ and /ə/ in all (unstressed) positions and /u/ in the dative plural ending -um only. The /ə/ had a fairly fronted unrounded realisation, something close to an [e] or an [ɪ] and depended partly on the colouring by the phonological surroundings.

In an even earlier period of Frisian, pitch accent was regularly positioned somewhere in the middle of polysyllabic, mostly bisyllabic, simplex words. The same pattern was adopted for Old Nordic. In modern language, the pitch accent is aligned with the intensity stress at the beginning of the stressed syllable. As a consequence of Vowel Reduction, the relatively late pitch peak was only preserved
in Old Frisian in words with an /a/ as the vowel of the unstressed syllable. As long as the unstressed /a/ remained intact as [a], this pitch accent was still phonologically predictable.

Open Syllable Lengthening of short root vowels /i, a, o, u/ was completed in the late 12th century, but only when the subsequent unstressed vowel was not an /a/.

During the period studied, Frisian was characterised by Vowel Balance and Vowel Harmony. Vowel Balance remained a sub-pattern or tendency rather than a consistent, phonologically conditioned allomorphy. For example: The [a] was more resistant in the past participle of the short-rooted verb *bitalia:* <bitalar>, than in the corresponding form of the long-rooted verb *kāpia:* <kaepit>. However, it never grew into the consistently applied morphological contrast of /at/ versus /ot/. Also, the ‘Seesaw’ Vowel Harmony, for example <bitellit> versus <bitallit> was never more than a tendency, but as such remained active for the duration of the period studied.

Another form of Vowel Harmony, the a-mutation, for example, in <saka> for seka, seems to have started in the 14th century. It shows regional differences and was never consistently applied over the entire language area, making it difficult to provide an exact reconstruction. In the 15th century, this alternation had grown into a phonological template. The unstressed [a] that caused the a-mutation had disappeared by then in several phonological contexts. For example, the Middle Frisian gerund of ‘to be’ *<wessen>* from Old Frisian *weisane.*

The gradual loss of the realisation [a] in unstressed position in the late 14th and during the 15th century, did not automatically lead to an alignment of the pitch accent with the initial syllable. The reason might be sought in the heavy functional load of the contrast /a/-/a/, but this has not been investigated or tested by modelling. For example, the gerund of ‘to be’ was phonetically [vəsˈän] or [væsˈän], where the late pitch peak marked the Vowel Harmony template and prevented syncope of the [s].

The a-mutation template was gradually lost after 1460. Even without Vowel Harmony, the pitch accent in the gerund *<wessen>* [vəsˈän] marked the contrast with the past participle *<wessen>* [vəsˈän]. This pitch accent marking was less prominent in the central and in particular, the south-western parts of the language area. In these regions, there was a tendency to lengthen short vowels in open syllables which had remained short before an unstressed /a/. This historical /a/ was not necessarily reduced to an [ə] before (some) lengthening could take place, as can be seen with the word *<naema>* *[næ.ma]* ‘name’ from OFO I-307 (1481) or *<boeda>* *[bɔ.da]* ‘messenger’ from OFO II-140 (1486) (both original charters).
Before 1460, geminated consonants, a phonetic phenomenon, disappeared. The reason may be a loss of functional loading.\footnote{Testing with the Bidirectional Table from \S\ 3.3 shows that the Probabilistic Learner needs input from contrasting environments, to be able to acquire different categories; otherwise the categories will merge into one, in the direction of the most convenient (the ‘unmarked’) variant, i.e. the single consonant. The model suggests that at least 50\% of the /C/ or /C:/ sounds in the language should appear in contexts that provide a contrasting meaning, otherwise the categories will merge into one.}

During the above-mentioned period, unstressed vowels were subject to an ongoing reduction process. This reduction process was generally triggered by a continuous erosion of the Volume Integral of the vowels, composed of duration and intensity (amplitude). Consistent subtle differences in these two variables for one phoneme on the phonetic level, define the order of reduction in time (\S\ 5.1). The functional load of the vowels could cause a non-linear tendency, as illustrated in \S\ 5.2, where consistently applied noise levels, depending on Volume Integral erosion, were translated into different reduction scenarios. This is illustrated with the differences between the \textit{habbe} /habba/ case (\S\ 5.2.3) and the \textit{seke} /seka/ /seken/ case (\S\ 5.2.4).

6.2 Theoretical implications

Returning to the central question of mechanisms of language change. The conceptual framework of this study is the hypothesis of language as a “deterministic dynamic system, governed by self-organisation” (cf. \S\ 1.2.5 and 1.4).

\textit{Once again ..., determinism}

Deterministic, dynamic systems are made up of reductionistic components which interact with each other. The features of these components and their basic interactions can be relatively simple. By the intensity of the interaction and the number of elements involved, the system may become complex and even chaotic. The coalescence of two air particles is easy to describe in Newtonian physics. However, making a correct weather forecast, in an atmosphere made up of an innumerable number of air particles, is a difficult job. Computing every individual particle in a reductionistic approach is impossible. But the foundation is still straightforward deterministic Newtonian physics. This implies that, if the hypothesis of language as a deterministic, dynamic system should hold, at least the deterministic behaviour of its reductionistic components must be proven.

The vowel reduction model in \S\ 5.1 is an illustration of primarily deterministic behaviour. Just as the coalescence of two air particles is the result of characteristics, such as size, shape, weight and direction, the reduction of unstressed vowels seems to be the result of features such as muscular motion and acoustics,
obeying the laws of physics and the logarithmic ordering of human perception scales, widely attested outside the field of linguistics.

For those scholars working within the current frameworks of structuralistic phonology and experimental phonetics, § 5.1 reveals some interesting conclusions. Section 1.3.3 formulates the following working hypothesis:

Because physical laws are universal both in place and time and the human species has not changed significantly during the last 1000 years, it is possible to assume that many phonetic performance effects were the same in 1400 as they are now.

This universality is the essential foundation of historical sciences such as palaeontology and palaeogeology, but also of astronomy, with claims about remote worlds which no one has ever really seen. But it is not so apparent in historical linguistics. Moreover, it is often difficult to prove. The reconstruction of § 5.1 shows that:

• Basic phonetic patterns are universal in time. Note that this does not imply that the actual phonetics of a language were constant over time. On the contrary. For example, the reconstruction in chapter four shows that 15th-century Frisian sounded quite different to Modern West Frisian in several aspects. The observed universality concerns a deeper level of phonetic patterns, directly controlled by the neuro-biological constraints of the human speech organs;
• The accepted position, that it is only possible to formulate tentative reconstructions about the past, is too conservative. Of course, strictly speaking, every reconstruction will always remain tentative. But knowing that a linguistic phenomenon from the past imperatively fits phonetic constraints that can be exactly determined in synchronic testings, is a much stronger position than assuming that something “may have sounded like” a possible parallel in a modern language variant;
• Finally, reverse engineering in § 5.1.5 shows that historical material from the Frisian charters can reveal details about historical phonetics in a very exact way. This may be useful in cases where modern phonetic experiments show margins of variation.

The model in § 5.2 is deterministic in a sense that every stage follows on from the previous one by a consistent application of the interaction rules. It is more complex than the model in § 5.1, because more components are involved at one time. The interaction of reductionistic components including ‘acoustics’, ‘memory formation’
and ‘meaning’\textsuperscript{164} produces the continuously changing mini-grammars which describe the choice between the different endings of the verb \textit{habba} and the noun \textit{seke} at shifting moments in time. The development was non-linear, despite the unchanged definition of the underlying algorithm. Structures and ‘rules’ which we usually call \textit{grammar}, appear as the result of self-organisation of the system.\textsuperscript{165} In these two relatively simple models, there are no instances of chaotic behaviour, but at least the prerequisites for such a system seem to be available in language.

If language is a deterministic dynamic system, there is a simple solution for the question: Why do languages change? A deterministic dynamic system is always on the move. For example, the atmosphere is the most well-known dynamic system. Even after a fortnight of sunshine in Fryslân, one day it will become cloudy and rainy again. The reason for such a ‘sudden change’ may seem a curious event from the perspective of the local observer, but changes and movements in other parts of the global weather system will sooner or later have their impact. Like the proverbial beat of a butterfly’s wing in the Amazons causing a hurricane in the Caribbean. In the same way local equilibria (relatively stable parts of the grammar) will be disturbed sooner or later by ongoing changes in other parts of the language system. This matches observations on basically every natural language. Despite the fact that some aspects of language stay relatively stable over time, every language exhibits changes in the long run.

This implies that the ‘why’-question is answered to the same extent that arguments are provided for the identification of language as a dynamic system. This study does not provide the full model necessary to make the assumption of language as a dynamic system, beyond a hypothesis. It does, however, show that some basic prerequisites for such a system can be positively identified.

This brings the question to a higher level: Why is the language system dynamic? Why does it not reach a state of equilibrium? There are two options:

\textsuperscript{164} Cf. § 1.4 for references to Chomsky e.a. concerning these items.

\textsuperscript{165} Here again this study seems to be in the good company of Noam Chomsky: “[…] the generative processes of the language system may provide a near-optimal solution that satisfies the interface conditions to \textit{F[aculty of] L[anguage] B[road]}. Many of the details of language that are the traditional focus of linguistic study […] may represent by-products of this solution, generated automatically by neural/computational constraints and the structure of FLB-components that lie outside of FLN\textit{[arrow]}.” (Hauser, Chomsky & Fitch 2002, 1574; italics by this author).
Are there chaotic or other unstable components causing intrinsic dynamics?

Is there an external engine, as is the case in the atmosphere, where insolation and earth rotation keep the atmosphere moving?

For languages, both questions can be answered affirmatively. As chaos, in the mathematical sense as outlined in Verhulst (2003), has not (yet) been found, there is a well-known phenomenon that constantly causes instability: Drift. The label ‘drift’ is sometimes used in the context of linguistics, where it differs substantially from its meaning as in ‘genetic drift’.

In a population where elements can have contrasting features and where the transmission of those features is (partly) the result of mere chance, the numerical ratio of those features may shift randomly. For example:

```
Every speaker has a variable realisation of one prototypical sound. The actual realisations are clustered around a centroid. They will be more or less in the vicinity of the average, showing a normal Gaussian distribution. New (and old) language users, behaving like probabilistic learners, depend on the production they are actually confronted with for their future choices. Due to statistically-defined variations, a language user can be confronted with a skewed distribution and therefore shift their realisation slightly, which results in more shifted variants, causing a positive feedback loop.
```

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166 Note that the scientific interpretation of ‘drift’ as a statistically-based phenomenon differs substantially from the way it is used by Sapir (1921, chapter 7). “What significant changes take place in [language] must exist, to begin with, as individual variations. This is perfectly true, and yet it by no means follows that the general drift of language can be understood from an exhaustive descriptive study of these variations alone. They themselves are random phenomena, […] The linguistic drift has direction. […] This direction may be inferred, in the main, from the past history of the language.” (italics by this author). Sapir misses the fact that individual random variations, in combination with some stochastically controlled form of inheritance, in this case imitation, can produce gradual changes. The deterministic process of gradual vowel reduction, as illustrated in § 3.2, is the kind of process that Sapir refers to as ‘drift’.

167 This is the effect that, even when the probabilities to throw the numbers one to six with a die are all 1/6, they do not appear in regularity. When throwing 60 times, you may have substantially more instances of six for example, than the expected 10 times, pushing the average of all throws over the theoretically-expected 3.5. When throwing 19 times ‘six’ and eight (and once nine) times each of the other numbers, the p-value of a chi²-test on the test results is still 8.1%. This is “nothing to worry about” from a statistical point of view, but the average of the 60 throws is now 3.9 instead of the expected 3.5. When the average forms the input for a fall of dependent events, this kind of random statistical variation may lead to enormous, sometimes irreversible changes.
Drift is most evident in phonetic features with normal distributions for realising features such as formant frequencies, duration aspects, tone contours, etc. The quantitative aspect of frequency also plays a role in the preservation and development of, for example, morphological alternation, such as irregular plural forms or strong and other irregular verbs. Drift may also be at stake there.

Apart from internal instability of languages, there is also social instability. There are several social factors, such as:

- The wish to distinguish oneself by linguistic means, or to express conformism with given (prestigious) groups; keywords are: group-languages, emancipation, popularisation, etc.;
- Shifting intentions of speakers;
- A shifting environment demands new words, new expressions, not only in a materialistic sense (for example the information technology), but also in a mental or social sense, such as the increase in frequency of Dutch *jij* (colloquial)’ as a consequence of the revolution of ‘1968’;
- Language contact is a well-known source of language change. The intensity and direction of contact depend heavily on historical processes. For example the rapidly growing influence of English in the aftermath of the Second World War.

Therefore, there are various reasons to assume that language is intrinsically dynamic, albeit with a much lower alternation rate than, for example, the atmosphere. For dynamic systems, the question is why (some aspects of) languages can remain stable over longer periods, rather than why languages change. A language which changes too quickly, is not suitable for enduring communication. Sudden changes are eliminated by the selection of signs (cf. the suppression of signs with a low reliability in the model of the probabilistic learner in § 5.2).

By a combination of language-internal drift (engineered by random variations) and social contexts which may give preference to some linguistic aspects (selection), the language system (grammar) enters the world of evolutionary sciences: cf. biological evolution, driven by spontaneous genetic mutations and natural selection.

The notion of language as an outcome of evolution is not new. Charles Darwin drew a parallel between the evolution of species and languages (c.f. Dennett 2006, 133). The founder of Generative Grammar, Noam Chomsky, sought an evolutionary framework for what he called “the faculty of language”. Dennett (2006, 420 ff.; original from 1995) and Pinker (1994, 355) criticise Chomsky for his vague position in the question of origins of language ability in former publications. Chomsky considers this a misunderstanding (Fitch, Hauser & Chomsky 2005, 183;
Pinker (1994, 124-125) is very explicit about his idea about an inborn language ability: “Grammar offers a clear refutation of the empiricist doctrine that there is nothing in the mind that was not first in the senses.” and: “Some of the organization of grammar would have to be there from the start [...].”

The opposite direction of causality is claimed by Jackendoff & Pinker (2005, 213): “[...] evolution, having made the basic computational units of language innate, [...]” (italics by this author). This author favours a sequence of events where phonological ‘rules’ are the result of self-organisation at the level of articulation, cf. Oudeyer (2006): “Indeed, we show that natural selection did not necessarily have to find genomes which pre-programmed the brain in precise and specific ways so as to be able to create and learn discrete speech systems. The capacity of coordinated social interactions and the behavior of imitation are also examples of mechanism which are not necessarily pre-required for the creation of the first discrete speech systems, as our system demonstrates.”

One example of how ‘rules’ and underlying reductionistic derivations are connected, is standard gravity on earth. This seems to be a more or less constant force over the entire globe and it is possible to conclude that it is an absolute, universal measure. However, it is still the result of the interaction between two mass bodies (the earth and the ‘falling’ object). This becomes obvious when man travels to the moon. Another mass body produces a different gravity. The more or
structures do not consist of discrete rules, but rather are probabilistic tendencies (which may approach 100%), ‘computed’ and applied by a probabilistic learner.\footnote{There remains a clear difference with generative grammar in any form, cf.: “F\textit{aculty of L\textit{language} N\textit{arrow} takes a finite set of elements and yields a potentially infinite array of \textit{discrete} expressions.” (Hauser, Chomsky & Fitch 2002, 1571); or Pinker & Jackendo\textit{ff} (2005, 210) about phonology: “Speech segments are drawn from a finite repertoire of phonemes, each defined by a set of \textit{discrete} articulatory or acoustic feature values [...].” (italics in both citations by this author). At least Jackendoff and Pinker (2005, 219 ff.) seem to have absorbed some influences from approaches like Construction Grammar and Functional Grammar, when they talk about “[...] a continuum of generality [...]”, and: “At one extreme are word-like constants such as dog and irregular forms [...]. Moving along the continuum, we find mixtures of idiosyncratic content and open variables in idioms [...]. Finally, at the other extreme are rule-like expressions consisting only of very general variables [...]” and finally: “The distinction between lexical storage and grammatical computation no longer corresponds to a distinction between simple morphemes and recursive combination of syntactic trees.” (idem, 221-222).}

These final considerations definitely exceed the inferences which can be made from this study. They demand extended discussion with existing literature and additional research. The application of evolutionary sciences and methods into the field of language as a deterministic dynamic system may bring up interesting results in the future.
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Appendix 1: Test data

In the text, the outcomes of statistical tests are mentioned. The exact data can be found in this appendix. The data are ordered according to the order they appear in the text, see section numbers, eventually joined by graph or table numbers.

FE = Fisher Exact Probability Test
1-t = 1 tailed
2-t = 2 tailed
$\chi^2$ = chi$^2$-value
p = probability value
df = degrees of freedom
n = number of observations

Appendix 1.1: $\chi^2$ test for goodness of fit

§ 1.3.7.6
Introduction $\chi^2$ test for goodness of fit

Example 1

<table>
<thead>
<tr>
<th>observed</th>
<th>expected</th>
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<tbody>
<tr>
<td>A 3</td>
<td>5.0</td>
</tr>
<tr>
<td>B 7</td>
<td>5.0</td>
</tr>
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</table>

$\chi^2 = p = df = n =$

1.60 20.6% 1 10

Example 2

<table>
<thead>
<tr>
<th>observed</th>
<th>expected</th>
</tr>
</thead>
<tbody>
<tr>
<td>A 9</td>
<td>15.0</td>
</tr>
<tr>
<td>B 21</td>
<td>15.0</td>
</tr>
</tbody>
</table>

$\chi^2 = p = df = n =$

4.80 2.8% 1 30

Graph 1.4: Dative plural of 'seke': $\chi^2$-test and correlation

<table>
<thead>
<tr>
<th>observed</th>
<th>&lt;Vm&gt;</th>
<th>other</th>
<th>avg. year</th>
<th>%</th>
<th>&lt;Vm&gt;</th>
<th>expected</th>
<th>&lt;Vm&gt;</th>
<th>other</th>
</tr>
</thead>
<tbody>
<tr>
<td>-1430</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>1402</td>
<td>100%</td>
<td>-1430</td>
<td>0.6</td>
<td>1.4</td>
</tr>
<tr>
<td>-1460</td>
<td>6</td>
<td>2</td>
<td>8</td>
<td>1450</td>
<td>75%</td>
<td>-1460</td>
<td>2.5</td>
<td>5.5</td>
</tr>
<tr>
<td>-1490</td>
<td>4</td>
<td>12</td>
<td>16</td>
<td>1476</td>
<td>25%</td>
<td>-1490</td>
<td>4.9</td>
<td>11.1</td>
</tr>
<tr>
<td>-1510</td>
<td>0</td>
<td>13</td>
<td>13</td>
<td>1502</td>
<td>0%</td>
<td>-1510</td>
<td>4.0</td>
<td>9.0</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>27</td>
<td>39</td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

$\chi^2 = p = df = n =$

17.88 <0.1% 3 39

$r^2 = p 1-T = p 2-T = df = n =$

0.94 1.6% 3.3% 2 4

In the upper version, there is one cell with expected value < 1. In the second version, this has been solved by aggregating the timeframes into only 2 contrasting periods.
### § 1.3.5/1.3.7.6

**Graph 1.2: Vowel alternation in the plural of 'son'**

<table>
<thead>
<tr>
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<th>&lt;o&gt;</th>
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<th>%</th>
<th>expected</th>
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<th>&lt;o&gt;</th>
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</thead>
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<td>&lt;1460</td>
<td>2</td>
<td>1</td>
<td>1444</td>
<td>67%</td>
<td>-1460</td>
<td>2.1</td>
<td>0.9</td>
</tr>
<tr>
<td>-1490</td>
<td>9</td>
<td>3</td>
<td>1481</td>
<td>75%</td>
<td>-1490</td>
<td>8.6</td>
<td>3.4</td>
</tr>
<tr>
<td>-1510</td>
<td>12</td>
<td>4</td>
<td>1503</td>
<td>75%</td>
<td>-1510</td>
<td>11.4</td>
<td>4.6</td>
</tr>
<tr>
<td>-1550</td>
<td>12</td>
<td>6</td>
<td>1528</td>
<td>67%</td>
<td>-1550</td>
<td>12.9</td>
<td>5.1</td>
</tr>
<tr>
<td></td>
<td>35</td>
<td>14</td>
<td>49</td>
<td></td>
<td></td>
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</table>

\[
\chi^2 = \frac{p}{df} = \frac{n}{Yates' correction} = 22.34 <0.1% 1 36
\]

\[
\chi^2 = \frac{p}{df} = \frac{n}{F_{E}} = 18.46 <0.1% <0.1%
\]

In the upper version, there is 1 cell with expected values < 1. In the second version, this has been solved by aggregating the timeframes into only 2 contrasting periods.

### § 1.3.5/1.3.7.6

<table>
<thead>
<tr>
<th>observed</th>
<th>&lt;e&gt;</th>
<th>&lt;o&gt;</th>
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<th>%</th>
<th>expected</th>
<th>&lt;e&gt;</th>
<th>&lt;o&gt;</th>
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<tbody>
<tr>
<td>&lt;1490</td>
<td>11</td>
<td>4</td>
<td>1444</td>
<td>67%</td>
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<td>4.3</td>
</tr>
<tr>
<td>&gt;1490</td>
<td>24</td>
<td>10</td>
<td>24.3</td>
<td>9.7</td>
<td>&gt;1490</td>
<td>24.3</td>
<td>9.7</td>
</tr>
<tr>
<td></td>
<td>35</td>
<td>14</td>
<td>49</td>
<td></td>
<td></td>
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</table>

\[
\chi^2 = \frac{p}{df} = \frac{n}{Yates' correction} = 0.04 84.5% 1 49
\]

\[
\chi^2 = \frac{p}{df} = \frac{n}{F_{E}} = 0.02 88.3%
\]
§ 1.3.8

Syncope in Old Frisian: Unia, group A-1 versus A-2

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</tr>
<tr>
<td>A-2</td>
<td>13</td>
<td>19.7</td>
<td>1899</td>
</tr>
</tbody>
</table>

\[ \chi^2 = p = df = n = \]

\[ 7.61 \quad 0.6\% \quad 1 \quad 28 \]

For this test, only the instances of the 3rd pers. sg. and the past participle without syncope were counted. The number of attestations was related to the length of the sections, expressed by the number of lines in the transcription. So, to compute the expected number of -eth in A-1: length of A-1 (= 804) / length of A-1 + A-2 (= 2703) * the number of attestations of -eth in the total of both sections (= 28) * 8.3; etc.

§ 2.1

Vowel Balance in Modern West Frisian

<table>
<thead>
<tr>
<th>observed</th>
<th>short</th>
<th>long</th>
<th>expected</th>
<th>short</th>
<th>long</th>
</tr>
</thead>
<tbody>
<tr>
<td>-e</td>
<td>622</td>
<td>241</td>
<td>863</td>
<td>-e</td>
<td>531.3</td>
</tr>
<tr>
<td>ø</td>
<td>1047</td>
<td>801</td>
<td>1848</td>
<td>ø</td>
<td>1137.7</td>
</tr>
<tr>
<td></td>
<td>1669</td>
<td>1042</td>
<td>2711</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\[ \chi^2 = p = df = n = \]

\[ 59.10 \quad <0.1\% \quad 1 \quad 2711 \]

Yates’ correction

\[ \chi^2 = p = \]

\[ 58.45 \quad <0.1\% \]

§ 2.2.3

Spelling <l> or <ll> before /i/

<table>
<thead>
<tr>
<th>observed</th>
<th>bitalia(ne)</th>
<th>bitalad</th>
<th>expected</th>
<th>bitalia(ne)</th>
<th>bitalad</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;l&gt;</td>
<td>43</td>
<td>24</td>
<td>67</td>
<td>&lt;l&gt;</td>
<td>228</td>
</tr>
<tr>
<td>&lt;ll&gt;</td>
<td>136</td>
<td>322</td>
<td>458</td>
<td>&lt;ll&gt;</td>
<td>156.2</td>
</tr>
<tr>
<td></td>
<td>179</td>
<td>346</td>
<td>525</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\[ \chi^2 = p = df = n = \]

\[ 30.93 \quad <0.1\% \quad 1 \quad 525 \]

Yates’ correction

\[ \chi^2 = p = \]

\[ 29.42 \quad <0.1\% \]
Table 2.6: Vowel Balance in the dative plural ending in Unia, group A; the full data are given in table 2.6; here the tests for the relevant contrast are presented.

<table>
<thead>
<tr>
<th></th>
<th>Long roots compared with the overall values</th>
<th>Short roots with no OSL, compared with the overall values</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Long expected</td>
<td>no OSL expected</td>
</tr>
<tr>
<td></td>
<td>&lt;um&gt; 171</td>
<td>1824</td>
</tr>
<tr>
<td></td>
<td>&lt;em/im&gt; 58</td>
<td>46.6</td>
</tr>
<tr>
<td></td>
<td>229</td>
<td>229</td>
</tr>
</tbody>
</table>

\[ \chi^2 = \frac{(O - E)^2}{E} \]

\[ p = 6.07\% \]

\[ df = 1 \]

\[ n = 229 \]

\[ \chi^2 = \frac{(O - E)^2}{E} \]

\[ p = 4.24\% \]

\[ df = 1 \]

\[ n = 25 \]

These two tests are tricky, because both the long-rooted and 'no-OSL' words contributed to the overall figures, which is strictly speaking not allowed (cf. Field 2005, 686). The following tests are more proper.

Long roots compared with short roots with OSL.

<table>
<thead>
<tr>
<th></th>
<th>observed Long OSL</th>
<th>expected Long OSL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt;um&gt; 171</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>&lt;em/im&gt; 58</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>229</td>
<td>10</td>
</tr>
</tbody>
</table>

\[ \chi^2 = \frac{(O - E)^2}{E} \]

\[ p = 74.0\% \]

\[ df = 1 \]

\[ n = 239 \]

Long roots compared with short roots with no OSL.

<table>
<thead>
<tr>
<th></th>
<th>observed Long no OSL</th>
<th>expected Long no OSL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt;um&gt; 171</td>
<td>24</td>
</tr>
<tr>
<td></td>
<td>&lt;em/im&gt; 58</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>229</td>
<td>25</td>
</tr>
</tbody>
</table>

\[ \chi^2 = \frac{(O - E)^2}{E} \]

\[ p = 1.6\% \]

\[ df = 1 \]

\[ n = 254 \]

\[ \chi^2 = \frac{(O - E)^2}{E} \]

\[ p = 1.6\% \]

\[ df = 1 \]

\[ n = 254 \]
A.P. Versloot: *Mechanisms of Language Change*

Short roots with OSL compared with short roots with no OSL

<table>
<thead>
<tr>
<th></th>
<th>OSL</th>
<th>no OSL</th>
<th></th>
<th>OSL</th>
<th>no OSL</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;um&gt;</td>
<td>7</td>
<td>24</td>
<td>31</td>
<td>8.9</td>
<td>22.1</td>
</tr>
<tr>
<td>&lt;em/ime&gt;</td>
<td>3</td>
<td>1</td>
<td>4</td>
<td>1.1</td>
<td>2.9</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>25</td>
<td>35</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\[ \chi^2 = 4.77, p = 2.9\%, df = 1, n = 35 \]

Yates' correction: \[ \chi^2 = 2.55, p = 11.0\%, FE 1-t = 6.1\%, FE 2-t = 6.1\% \]

Long roots compared with short roots with uncertain OSL

<table>
<thead>
<tr>
<th></th>
<th>Long OSL?</th>
<th></th>
<th>Expected Long OSL?</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;um&gt;</td>
<td>171</td>
<td>7</td>
<td>169.8</td>
</tr>
<tr>
<td>&lt;em/ime&gt;</td>
<td>58</td>
<td>4</td>
<td>59.2</td>
</tr>
<tr>
<td></td>
<td>229</td>
<td>11</td>
<td>240</td>
</tr>
</tbody>
</table>

\[ \chi^2 = 0.67, p = 41.4\%, df = 1, n = 240 \]

Yates' correction: \[ \chi^2 = 0.22, p = 64.2\% \]

Short roots with uncertain OSL compared with short roots with no OSL

<table>
<thead>
<tr>
<th></th>
<th>OSL? no OSL</th>
<th></th>
<th>Expected OSL? no OSL</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;um&gt;</td>
<td>7</td>
<td>24</td>
<td>31</td>
</tr>
<tr>
<td>&lt;em/ime&gt;</td>
<td>4</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>11</td>
<td>25</td>
<td>36</td>
</tr>
</tbody>
</table>

\[ \chi^2 = 6.69, p = 1.0\%, df = 1, n = 36 \]

Yates' correction: \[ \chi^2 = 4.26, p = 3.9\%, FE 1-t = 2.3\%, FE 2-t = 2.3\% \]

Vowel Balance in the dative plural ending in the charters from 1379-1430

<table>
<thead>
<tr>
<th></th>
<th>Long no OSL</th>
<th></th>
<th>Expected Long no OSL</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;um&gt;</td>
<td>4</td>
<td>5</td>
<td>9</td>
</tr>
<tr>
<td>&lt;em/ime&gt;</td>
<td>36</td>
<td>5</td>
<td>41</td>
</tr>
<tr>
<td></td>
<td>40</td>
<td>10</td>
<td>50</td>
</tr>
</tbody>
</table>

\[ \chi^2 = 8.67, p = 0.3\%, df = 1, n = 50 \]

Yates' correction: \[ \chi^2 = 6.17, p = 1.3\% \]
§ 2.3.3.2

Map 2.3 and 2.4: OSL in *bita(ne)*, *bitelad* and *nama*

<table>
<thead>
<tr>
<th>observed Gaasterl. rest</th>
<th>expected Gaasterl. rest</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;ae&gt; 7 22 29</td>
<td>&lt;ae&gt; 0.4 28.6</td>
</tr>
<tr>
<td>&lt;a/e&gt; 0 517 517</td>
<td>&lt;a/e&gt; 6.6 510.4</td>
</tr>
<tr>
<td>7 539 546</td>
<td></td>
</tr>
</tbody>
</table>

\[ \chi^2 = 126.41 \quad p = <0.1\% \quad df = 1 \quad n = 546 \]

Yates' correction: \[ \chi^2 = 108.06 \quad <0.1\% \]

idem, Gaasterlân vs. Wûns eradiel (both SW-Fryslân)

<table>
<thead>
<tr>
<th>observed Gaasterl. Wûns er.</th>
<th>expected Gaasterl. Wûns er.</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;ae&gt; 7 4 11</td>
<td>&lt;ae&gt; 1.8 9.2</td>
</tr>
<tr>
<td>&lt;a/e&gt; 0 32 32</td>
<td>&lt;a/e&gt; 5.2 26.8</td>
</tr>
<tr>
<td>7 36 43</td>
<td></td>
</tr>
</tbody>
</table>

\[ \chi^2 = 24.32 \quad p = <0.1\% \quad df = 1 \quad n = 43 \]

Yates' correction: \[ \chi^2 = 19.88 \quad <0.1\% \]

Spelling /r/ in gerund and past participle of *sweva* and *keren*, > 1450

<table>
<thead>
<tr>
<th>observed gerund past part.</th>
<th>expected gerund past part.</th>
</tr>
</thead>
<tbody>
<tr>
<td>-eren 1 10 11</td>
<td>-eren 5.9 5.1</td>
</tr>
<tr>
<td>-eren 14 3 17</td>
<td>-eren 9.1 7.9</td>
</tr>
<tr>
<td>15 13 28</td>
<td></td>
</tr>
</tbody>
</table>

\[ \chi^2 = 14.41 \quad p = <0.1\% \quad df = 1 \quad n = 28 \]

Yates' correction: \[ \chi^2 = 11.62 \quad <0.1\% \]

§ 2.3.3.3

<VVCC> and following vowel, total

<table>
<thead>
<tr>
<th>all types expected Unia</th>
</tr>
</thead>
<tbody>
<tr>
<td>-(i)a 142 85.8 67</td>
</tr>
<tr>
<td>-e 50 106.2 83</td>
</tr>
<tr>
<td>192 192</td>
</tr>
</tbody>
</table>

\[ \chi^2 = 66.65 \quad p = <0.1\% \quad df = 1 \quad n = 192 \]
A.P. Versloot: *Mechanisms of Language Change*

<table>
<thead>
<tr>
<th>VVCC and following vowel, type 1</th>
<th>VVCC and following vowel, type 2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>-i(a)</strong> expected</td>
<td><strong>Unia</strong></td>
</tr>
<tr>
<td>-e</td>
<td>22</td>
</tr>
<tr>
<td></td>
<td>89</td>
</tr>
</tbody>
</table>

\[
\chi^2 = \frac{(O - E)^2}{E} = p = df = n = \]
33.75 \(<0.1\%\) \(1\) \(89\)

\[
\chi^2 = \frac{(O - E)^2}{E} = p = df = n = \]
9.16 \(0.25\%\) \(1\) \(61\)

<table>
<thead>
<tr>
<th>VVCC and following vowel, type 3</th>
<th>VVCC and following vowel, type 4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>-i(a)</strong> expected</td>
<td><strong>Unia</strong></td>
</tr>
<tr>
<td>-e</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>24</td>
</tr>
</tbody>
</table>

\[
\chi^2 = \frac{(O - E)^2}{E} = p = df = n = \]
17.82 \(<0.1\%\) \(1\) \(24\)

\[
\chi^2 = \frac{(O - E)^2}{E} = p = df = n = \]
10.89 \(<0.1\%\) \(1\) \(18\)

**Regional contrast for VVCC type 1 (bitaellet): charter count**

<table>
<thead>
<tr>
<th><strong>Observed</strong></th>
<th><strong>Expected</strong></th>
<th><strong>Yates’ correction</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>SVCC</td>
<td>MW</td>
<td>rest</td>
</tr>
<tr>
<td>17</td>
<td>21</td>
<td>38</td>
</tr>
<tr>
<td>216</td>
<td>700</td>
<td>916</td>
</tr>
</tbody>
</table>

\[
\chi^2 = \frac{(O - E)^2}{E} = p = df = n = \]
8.85 \(0.3\%\) \(1\) \(954\)

**Regional contrast for VVCC type 2 (kaeppet): charter count**

<table>
<thead>
<tr>
<th><strong>Observed</strong></th>
<th><strong>Expected</strong></th>
<th><strong>Yates’ correction</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>SVCC</td>
<td>MW</td>
<td>rest</td>
</tr>
<tr>
<td>14</td>
<td>29</td>
<td>43</td>
</tr>
<tr>
<td>219</td>
<td>692</td>
<td>911</td>
</tr>
</tbody>
</table>

\[
\chi^2 = \frac{(O - E)^2}{E} = p = df = n = \]
1.61 \(20.4\%\) \(1\) \(954\)

\[
\chi^2 = \frac{(O - E)^2}{E} = p = df = n = \]
1.19 \(27.6\%\) \(1\) \(954\)
regiona I contrast for VVCC type 3 <weessa>; charter count

<table>
<thead>
<tr>
<th>observed SW+MW rest</th>
<th>expected SW+MW rest</th>
</tr>
</thead>
<tbody>
<tr>
<td>VVCC 8 12 20</td>
<td>VVCC 4.9 15.1</td>
</tr>
<tr>
<td>no VVCC 225 709 934</td>
<td>no VVCC 228.1 705.9</td>
</tr>
<tr>
<td>233 721 954</td>
<td></td>
</tr>
</tbody>
</table>

\[ \chi^2 = 269, \, p = 0.11, \, df = 1, \, n = 954 \]

regiona I contrast for VVCC type 4 <tredda>; charter count

<table>
<thead>
<tr>
<th>observed SW+MW rest</th>
<th>expected SW+MW rest</th>
</tr>
</thead>
<tbody>
<tr>
<td>VVCC 3 11 14</td>
<td>VVCC 3.4 10.6</td>
</tr>
<tr>
<td>no VVCC 230 710 940</td>
<td>no VVCC 229.6 710.4</td>
</tr>
<tr>
<td>233 721 954</td>
<td></td>
</tr>
</tbody>
</table>

\[ \chi^2 = 0.07, \, p = 0.79, \, df = 1, \, n = 954 \]

regiona I contrast for VVCC sum of types

<table>
<thead>
<tr>
<th>observed SW+MW rest</th>
<th>expected SW+MW rest</th>
</tr>
</thead>
<tbody>
<tr>
<td>VVCC 36 59 95</td>
<td>VVCC 23.2 71.8</td>
</tr>
<tr>
<td>no VVCC 197 662 889</td>
<td>no VVCC 209.8 649.2</td>
</tr>
<tr>
<td>233 721 954</td>
<td></td>
</tr>
</tbody>
</table>

\[ \chi^2 = 10.37, \, p = 0.1, \, df = 1, \, n = 954 \]

Table 2.11: *bitalad/ -th vs. bitalia(ne)*

<table>
<thead>
<tr>
<th>observed bitalad/thbitalia(ne)</th>
<th>expected bitalad/thbitalia(ne)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;ael&gt; 9 9 18</td>
<td>&lt;ael&gt; 11.6 6.4</td>
</tr>
<tr>
<td>&lt;aell&gt; 11 2 13</td>
<td>&lt;aell&gt; 8.4 4.6</td>
</tr>
<tr>
<td>20 11 31</td>
<td></td>
</tr>
</tbody>
</table>

\[ \chi^2 = 3.95, \, p = 0.05, \, df = 1, \, n = 31 \]
Table 2.11: *bitalia(ne)* vs. *bitalinge*

<table>
<thead>
<tr>
<th></th>
<th><em>bitalia(ne)</em></th>
<th><em>bitalinge</em></th>
</tr>
</thead>
<tbody>
<tr>
<td><em>&lt;ael&gt;</em></td>
<td>9</td>
<td>79</td>
</tr>
<tr>
<td><em>&lt;aell&gt;</em></td>
<td>2</td>
<td>76</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>11</strong></td>
<td><strong>87</strong></td>
</tr>
</tbody>
</table>

\[
\chi^2 = 1.22, \quad p = 27.0\%, \quad df = 1, \quad n = 87
\]

Yates' correction

Table 2.11: *bitalad/-th* vs. *bitalinge*

<table>
<thead>
<tr>
<th></th>
<th><em>bitalad/-th</em></th>
<th><em>bitalinge</em></th>
</tr>
</thead>
<tbody>
<tr>
<td><em>&lt;ael&gt;</em></td>
<td>9</td>
<td>79</td>
</tr>
<tr>
<td><em>&lt;aell&gt;</em></td>
<td>11</td>
<td>17</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>20</strong></td>
<td><strong>96</strong></td>
</tr>
</tbody>
</table>

\[
\chi^2 = 24.11, \quad p < 0.1\%, \quad df = 1, \quad n = 96
\]

Yates' correction

Table 2.11: *bitalinge* vs. Rest

<table>
<thead>
<tr>
<th></th>
<th><em>bitalinge</em></th>
<th>Rest</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>&lt;ael&gt;</em></td>
<td>70</td>
<td>224</td>
</tr>
<tr>
<td><em>&lt;aell&gt;</em></td>
<td>6</td>
<td>9</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>76</strong></td>
<td><strong>227</strong></td>
</tr>
</tbody>
</table>

\[
\chi^2 = 8.54, \quad p = 0.3\%, \quad df = 1, \quad n = 303
\]

Yates' correction

VVCC type 2 in Harlingen; charter count

<table>
<thead>
<tr>
<th></th>
<th>Harlingen</th>
<th>Rest</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>no VVCC</em></td>
<td>4</td>
<td>39</td>
</tr>
<tr>
<td><em>VVCC</em></td>
<td>10</td>
<td>901</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>14</strong></td>
<td><strong>940</strong></td>
</tr>
</tbody>
</table>

\[
\chi^2 = 19.12, \quad p < 0.1\%, \quad df = 1, \quad n = 954
\]

Note: one expected cell value < 1; p-value = 1.10^-5
### VVCC type 2: geographical contrast &<aapp> & <epp> vs. <app>

<table>
<thead>
<tr>
<th>observed</th>
<th>East</th>
<th>West</th>
<th>expected</th>
<th>East</th>
<th>West</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;(a)epp&gt;</td>
<td>10</td>
<td>0</td>
<td>10</td>
<td>6.5</td>
<td>3.5</td>
</tr>
<tr>
<td>&lt;Vpp&gt;</td>
<td>1</td>
<td>6</td>
<td>7</td>
<td>4.5</td>
<td>2.5</td>
</tr>
</tbody>
</table>

\[ \chi^2 = 13.25 \quad p = 0.001 \quad df = 1 \quad n = 17 \]

### VVCC type 2: geographical contrast: Wûnserd iel and the rest of western Fryslân

<table>
<thead>
<tr>
<th>observed</th>
<th>Wûn</th>
<th>rest-West</th>
<th>expected</th>
<th>Wûn</th>
<th>rest-West</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;pp&gt;</td>
<td>4</td>
<td>2</td>
<td>6</td>
<td>1.5</td>
<td>4.5</td>
</tr>
<tr>
<td>&lt;p&gt;</td>
<td>52</td>
<td>164</td>
<td>216</td>
<td>54.5</td>
<td>161.5</td>
</tr>
</tbody>
</table>

\[ \chi^2 = 5.61 \quad p = 0.018 \quad df = 1 \quad n = 222 \]

### VVCC type 3: North /e:/ versus South /æ:/

<table>
<thead>
<tr>
<th>observed</th>
<th>SW+SE</th>
<th>rest</th>
<th>expected</th>
<th>SW+SE</th>
<th>rest</th>
</tr>
</thead>
<tbody>
<tr>
<td>/e:/</td>
<td>0</td>
<td>8</td>
<td>8</td>
<td>4.0</td>
<td>4.0</td>
</tr>
<tr>
<td>/æ:/</td>
<td>12</td>
<td>4</td>
<td>16</td>
<td>8.0</td>
<td>8.0</td>
</tr>
</tbody>
</table>

\[ \chi^2 = 12.00 \quad p = 0.001 \quad df = 1 \quad n = 24 \]

\[ \chi^2 = 9.19 \quad p = 0.002 \quad df = 1 \quad n = 24 \]
§ 2.3.4.2

Table 2.13: relation between ending and <n(n)> in the word Monday

<table>
<thead>
<tr>
<th>observed</th>
<th>-en</th>
<th>-a/-e</th>
<th>expected</th>
<th>-en</th>
<th>-a/-e</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;nn&gt;</td>
<td>11</td>
<td>10</td>
<td>21</td>
<td>15.4</td>
<td>5.6</td>
</tr>
<tr>
<td>&lt;n&gt;</td>
<td>19</td>
<td>1</td>
<td>20</td>
<td>14.6</td>
<td>5.4</td>
</tr>
<tr>
<td></td>
<td>30</td>
<td>11</td>
<td>41</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>-ø</th>
<th>-e</th>
<th>overall</th>
<th>-ø</th>
<th>-e</th>
<th>overall</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ofr. -a</td>
<td>15</td>
<td>129</td>
<td>106</td>
<td>61</td>
<td>20</td>
<td>81</td>
</tr>
<tr>
<td></td>
<td>34</td>
<td>34</td>
<td>65</td>
<td>81</td>
<td>81</td>
<td>81</td>
</tr>
</tbody>
</table>

\[ \chi^2 = \frac{\text{Ofr.} - \text{expected}}{2} = \frac{\text{df}}{\text{n}} = \frac{9.48}{0.2\%} = 1 \]

Yates’ correction: \[ \chi^2 = \frac{7.43}{0.6\%} = 1 \]

§ 2.4.2

ad (1): apocope in weak masc. nouns

<table>
<thead>
<tr>
<th>overall</th>
<th>Ofr. -a/-e</th>
<th>expectedoverall</th>
</tr>
</thead>
<tbody>
<tr>
<td>-ø</td>
<td>30</td>
<td>34.7</td>
</tr>
<tr>
<td>-e</td>
<td>26</td>
<td>21.3</td>
</tr>
<tr>
<td></td>
<td>56</td>
<td>56</td>
</tr>
</tbody>
</table>

\[ \chi^2 = \frac{\text{Ofr.} - \text{expected}}{2} = \frac{\text{df}}{\text{n}} = \frac{1.68}{19.44\%} = 1 \]

ad (1): apocope in strong fem. nouns

<table>
<thead>
<tr>
<th>overall</th>
<th>Ofr. -a/-e</th>
<th>expectedoverall</th>
</tr>
</thead>
<tbody>
<tr>
<td>-ø</td>
<td>61</td>
<td>50.2</td>
</tr>
<tr>
<td>-e</td>
<td>20</td>
<td>30.8</td>
</tr>
<tr>
<td></td>
<td>81</td>
<td>81</td>
</tr>
</tbody>
</table>

\[ \chi^2 = \frac{\text{Ofr.} - \text{expected}}{2} = \frac{\text{df}}{\text{n}} = \frac{6.10}{1.35\%} = 1 \]
ad (2): vowel length and final schwa

<table>
<thead>
<tr>
<th>root /u/</th>
<th>expected overall</th>
</tr>
</thead>
<tbody>
<tr>
<td>-ø</td>
<td>64</td>
</tr>
<tr>
<td>-e</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>80</td>
</tr>
</tbody>
</table>

\[ \chi^2 = 5.16, \quad p = 2.31\% \quad df = 1 \quad n = 80 \]

<table>
<thead>
<tr>
<th>root /o/</th>
<th>expected overall</th>
</tr>
</thead>
<tbody>
<tr>
<td>-ø</td>
<td>118</td>
</tr>
<tr>
<td>-e</td>
<td>97</td>
</tr>
<tr>
<td></td>
<td>215</td>
</tr>
</tbody>
</table>

\[ \chi^2 = 17.48, \quad p < 0.1\% \quad df = 1 \quad n = 215 \]

ad (3): root in /b/

<table>
<thead>
<tr>
<th>root /-b/</th>
<th>expected overall</th>
</tr>
</thead>
<tbody>
<tr>
<td>-ø</td>
<td>16</td>
</tr>
<tr>
<td>-e</td>
<td>38</td>
</tr>
<tr>
<td></td>
<td>54</td>
</tr>
</tbody>
</table>

\[ \chi^2 = 36.96, \quad p < 0.1\% \quad df = 1 \quad n = 54 \]

ad (3): root in /d/

<table>
<thead>
<tr>
<th>root /-d/</th>
<th>expected overall</th>
</tr>
</thead>
<tbody>
<tr>
<td>-ø</td>
<td>86</td>
</tr>
<tr>
<td>-e</td>
<td>80</td>
</tr>
<tr>
<td></td>
<td>166</td>
</tr>
</tbody>
</table>

\[ \chi^2 = 20.47, \quad p < 0.1\% \quad df = 1 \quad n = 166 \]

§ 2.4.3.1
Graph 2.5: Overall-picture using % with .<a>

| observed -1496 1496-1510 1510+ |
|-------------------------------|-------------------|
| word fn. 100% 100% 33%        | word fn. 41% 41% 41% overall: |
| morph fn. 89% 13% 0%          | morph fn. 41% 41% 41% 33 x .<a> |
| protected 5% 0% 0%            | protected 41% 41% 41% 47 x .<e> |

\[ \chi^2 = 4.03, \quad p = 40.2\% \quad df = 4 \quad n = 9 \]
### Graph 2.5: Position of /a/ in the word: all originals

<table>
<thead>
<tr>
<th></th>
<th>word fn.</th>
<th>morph fn.</th>
<th>protected</th>
</tr>
</thead>
<tbody>
<tr>
<td>observed</td>
<td>&lt;a&gt; 5</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>&lt;e&gt; 1</td>
<td>5</td>
<td>22</td>
</tr>
<tr>
<td>expected</td>
<td>&lt;a&gt; 1.6</td>
<td>26</td>
<td>5.8</td>
</tr>
<tr>
<td></td>
<td>&lt;e&gt; 4.4</td>
<td>7.4</td>
<td>16.2</td>
</tr>
</tbody>
</table>

χ² = p = df = n =

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>observed</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>expected</td>
<td>5</td>
<td>3</td>
</tr>
</tbody>
</table>

χ² = p =

Yates’ correction: 20.81 <0.1%

### Graph 2.5: word final /a/ in monn(ι)a

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>observed</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>expected</td>
<td>5</td>
<td>3</td>
</tr>
</tbody>
</table>

χ² = p =

Yates’ correction: 4.44 3.5% 1 8

### Graph 2.5: morpheme final /a/ in monnadey

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>observed</td>
<td>28</td>
<td>9</td>
</tr>
<tr>
<td>expected</td>
<td>28</td>
<td>9</td>
</tr>
</tbody>
</table>

χ² = p =

Yates’ correction: 19.92 <0.1%

### Graph 2.5: word final /a/ in monna vs. morpheme final /a/ in monnadey between 1496-1510

<table>
<thead>
<tr>
<th></th>
<th>expected monna</th>
<th>monnadei</th>
</tr>
</thead>
<tbody>
<tr>
<td>observed</td>
<td>&lt;a&gt; 2</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>&lt;e&gt; 0</td>
<td>7</td>
</tr>
<tr>
<td>expected</td>
<td>&lt;a&gt; 0.6</td>
<td>24</td>
</tr>
<tr>
<td></td>
<td>&lt;e&gt; 1.4</td>
<td>5.6</td>
</tr>
</tbody>
</table>

χ² = p =

Yates’ correction: 5.83 1.6% 1 10

χ² = p =

Fisher’s exact test (FE 1-t FE 2-t)

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>observed</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td>expected</td>
<td>2</td>
<td>8</td>
</tr>
</tbody>
</table>

χ² = p =

Yates’ correction: 241 12.1% 6.7% 6.7%
§ 2.4.3.2

Reduction of /a/ in the verb habbae: Unia section A + OFO I-1 vs. Unia section B/C

<table>
<thead>
<tr>
<th>observed A+OFO B/C</th>
<th>expected A+OFO B/C</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;a&gt; 40 0 40 &lt;a&gt;</td>
<td>37.7 2.3</td>
</tr>
<tr>
<td>&lt;e&gt; 10 3 13 &lt;e&gt;</td>
<td>12.3 0.7</td>
</tr>
<tr>
<td>50 3 53</td>
<td></td>
</tr>
</tbody>
</table>

\[ \chi^2 = 9.78 \quad p = 0.2\% \quad df = 1 \quad n = 53 \]

No geographical contrast of <a> in forms of habba: 1392-1432

<table>
<thead>
<tr>
<th>observed NE rest</th>
<th>expected NE rest</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;a&gt; 4 6 10 &lt;a&gt;</td>
<td>4.2 5.8</td>
</tr>
<tr>
<td>&lt;e/i&gt; 12 16 28 &lt;e/i&gt;</td>
<td>11.8 16.2</td>
</tr>
<tr>
<td>16 22 38</td>
<td></td>
</tr>
</tbody>
</table>

\[ \chi^2 = 0.02 \quad p = 87.5\% \quad df = 1 \quad n = 38 \]

Graph 2.7: individual point values for 1420 compared with the average for that period. Only the values for U-tha-an and Chtha-an could be tested because only there straight forward token values are available. Neglecting the extreme values from Unia section B, the average portion of -an is 25% for that period.

<table>
<thead>
<tr>
<th>1420 U-tha-an</th>
<th>expected overall</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;an&gt; 4 2.0 25%</td>
<td></td>
</tr>
<tr>
<td>&lt;en&gt; 4 6.0 75%</td>
<td></td>
</tr>
<tr>
<td>8 8</td>
<td></td>
</tr>
</tbody>
</table>

\[ \chi^2 = 267 \quad 10.25\% \quad df = 1 \quad n = 8 \]

<table>
<thead>
<tr>
<th>1420 Ch-tha-an</th>
<th>expected overall</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;an&gt; 5 3.0 25%</td>
<td></td>
</tr>
<tr>
<td>&lt;en&gt; 7 9.0 75%</td>
<td></td>
</tr>
<tr>
<td>12 12</td>
<td></td>
</tr>
</tbody>
</table>

\[ \chi^2 = 1.78 \quad 18.24\% \quad df = 1 \quad n = 12 \]
A.P. Versloot: *Mechanisms of Language Change*

### Vowel Balance in the plural ending in Unia, group A

<table>
<thead>
<tr>
<th>observed</th>
<th>Long</th>
<th>Short</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;an&gt;</td>
<td>25</td>
<td>12</td>
</tr>
<tr>
<td>&lt;en&gt;</td>
<td>41</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>70</td>
<td>17</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>expected</th>
<th>Long</th>
<th>Short</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;an&gt;</td>
<td>41</td>
<td>5</td>
</tr>
<tr>
<td>&lt;en&gt;</td>
<td>46</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>87</td>
<td></td>
</tr>
</tbody>
</table>

\[ \chi^2 = p = df = n = \]
\[ 4.67 \quad 3.1\% \quad 1 \quad 87 \]

Yates' correction
\[ \chi^2 = p = \]
\[ 3.57 \quad 5.9\% \]

### Vowel Balance in the plural ending in Unia, group B & C

<table>
<thead>
<tr>
<th>observed</th>
<th>Long</th>
<th>Short</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;an&gt;</td>
<td>9</td>
<td>1</td>
</tr>
<tr>
<td>&lt;en&gt;</td>
<td>13</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>22</td>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>expected</th>
<th>Long</th>
<th>Short</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;an&gt;</td>
<td>10</td>
<td>1</td>
</tr>
<tr>
<td>&lt;en&gt;</td>
<td>15</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>25</td>
<td>5</td>
</tr>
</tbody>
</table>

\[ \chi^2 = p = df = n = \]
\[ 0.06 \quad 80.2\% \quad 1 \quad 25 \]

Yates' correction
\[ \chi^2 = p = FE_1-t \quad FE_2-t \]
\[ 0.14 \quad 70.6\% \quad 65.4\% \quad 100.0\% \]

### Vowel Balance in the plural ending in the charters, between 1379 and 1440

<table>
<thead>
<tr>
<th>observed</th>
<th>Long</th>
<th>Short</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;an&gt;</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>&lt;en&gt;</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>9</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>expected</th>
<th>Long</th>
<th>Short</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;an&gt;</td>
<td>14</td>
<td>7</td>
</tr>
<tr>
<td>&lt;en&gt;</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>16</td>
<td></td>
</tr>
</tbody>
</table>

\[ \chi^2 = p = df = n = \]
\[ 1.78 \quad 18.2\% \quad 1 \quad 16 \]

Yates' correction
\[ \chi^2 = p = FE_1-t \quad FE_2-t \]
\[ 0.33 \quad 56.8\% \quad 30.0\% \quad 47.5\% \]

### Geographical contrast between North-East and the rest, before 1440

<table>
<thead>
<tr>
<th>observed</th>
<th>NE rest</th>
<th>expected</th>
<th>NE rest</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;an&gt;</td>
<td>4</td>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td>&lt;en&gt;</td>
<td>2</td>
<td>7</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>10</td>
<td>16</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>expected</th>
<th>NE rest</th>
<th>expected</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;an&gt;</td>
<td>26</td>
<td>4</td>
</tr>
<tr>
<td>&lt;en&gt;</td>
<td>3.4</td>
<td>5.6</td>
</tr>
</tbody>
</table>

\[ \chi^2 = p = df = n = \]
\[ 2.05 \quad 15.2\% \quad 1 \quad 16 \]

Yates' correction
\[ \chi^2 = p = FE_1-t \quad FE_2-t \]
\[ 0.83 \quad 36.2\% \quad 18.2\% \quad 30.2\% \]
A.P. Versloot: Mechanisms of Language Change

Unia: *sunanda-* vs. Jus *sonanda-*

<table>
<thead>
<tr>
<th>Observed</th>
<th>Unia</th>
<th>Jus</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;an&gt;</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>&lt;en&gt;</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Expected</th>
<th>Unia</th>
<th>Jus</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;an&gt;</td>
<td>1.1</td>
<td>1.9</td>
</tr>
<tr>
<td>&lt;en&gt;</td>
<td>1.9</td>
<td>3.1</td>
</tr>
</tbody>
</table>

\[\chi^2 = \frac{p}{df} = \frac{n}{Yates' correction} \]

\[
8.00 \text{ (5\%)} \quad 1 \quad 8
\]

\[\chi^2 = p = FE_1-t \quad FE_2-t \]

\[
\begin{array}{ccc}
\text{Unia} & \text{Jus} \\
1.8\% & 1.8\%
\end{array}
\]

*abbate-* vs. *abbet-* in Unia en Jus

<table>
<thead>
<tr>
<th>Observed</th>
<th>Unia</th>
<th>Jus</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;a&gt;</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>&lt;e&gt;</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Expected</th>
<th>Unia</th>
<th>Jus</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;a&gt;</td>
<td>1.2</td>
<td>1.8</td>
</tr>
<tr>
<td>&lt;e&gt;</td>
<td>0.8</td>
<td>1.2</td>
</tr>
</tbody>
</table>

\[\chi^2 = \frac{p}{df} = \frac{n}{Yates' correction} \]

\[
222 \text{ (13.6\%)} \quad 1 \quad 5
\]

\[\chi^2 = p = FE_1-t \quad FE_2-t \]

\[
\begin{array}{ccc}
\text{Unia} & \text{Jus} \\
57.6\% & 30.0\% & 40.0\%
\end{array}
\]

Table 2.17: *abbate*, excluding *abt*

<table>
<thead>
<tr>
<th>Observed</th>
<th>NE</th>
<th>rest</th>
</tr>
</thead>
<tbody>
<tr>
<td>abbate</td>
<td>14</td>
<td>1</td>
</tr>
<tr>
<td>abte</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>14</td>
<td>6</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Expected</th>
<th>NE</th>
<th>rest</th>
</tr>
</thead>
<tbody>
<tr>
<td>abbate</td>
<td>10.5</td>
<td>4.5</td>
</tr>
<tr>
<td>abte</td>
<td>3.5</td>
<td>1.5</td>
</tr>
</tbody>
</table>

\[\chi^2 = \frac{p}{df} = \frac{n}{Yates' correction} \]

\[
15.56 <0.1\% \quad 1 \quad 20
\]

\[\chi^2 = p = FE_1-t \quad FE_2-t \]

\[
\begin{array}{ccc}
\text{Unia} & \text{Jus} \\
11.43 <0.1\% & <0.1\% & <0.1\%
\end{array}
\]

Table 2.17: *abbate*, including *abt*

<table>
<thead>
<tr>
<th>Observed</th>
<th>NE</th>
<th>rest</th>
</tr>
</thead>
<tbody>
<tr>
<td>abbate</td>
<td>14</td>
<td>1</td>
</tr>
<tr>
<td>abt(e)</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>18</td>
<td>9</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Expected</th>
<th>NE</th>
<th>rest</th>
</tr>
</thead>
<tbody>
<tr>
<td>abbate</td>
<td>10.0</td>
<td>5.0</td>
</tr>
<tr>
<td>abt(e)</td>
<td>8.0</td>
<td>4.0</td>
</tr>
</tbody>
</table>

\[\chi^2 = \frac{p}{df} = \frac{n}{Yates' correction} \]

\[
10.80 0.1\% \quad 1 \quad 27
\]

\[\chi^2 = p = FE_1-t \quad FE_2-t \]

\[
\begin{array}{ccc}
\text{Unia} & \text{Jus} \\
8.27 0.4\% & <0.1\% & <0.1\%
\end{array}
\]
A.P. Versloot: *Mechanisms of Language Change*

§ 2.4.3.9

Table 2.22: dative -e in idiomatic expression *fria kæfte*, 1470-1517

<table>
<thead>
<tr>
<th>observed idiom</th>
<th>expected idiom</th>
</tr>
</thead>
<tbody>
<tr>
<td>-e</td>
<td>-e</td>
</tr>
<tr>
<td>ø</td>
<td>ø</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>observed</th>
<th>expected</th>
</tr>
</thead>
<tbody>
<tr>
<td>-e</td>
<td>-e</td>
</tr>
<tr>
<td>ø</td>
<td>ø</td>
</tr>
</tbody>
</table>

Table 2.22: dative -e in *kâp* and *lôg*; original charters

<table>
<thead>
<tr>
<th>observed&lt; 1470</th>
<th>observed&gt; 1470</th>
</tr>
</thead>
<tbody>
<tr>
<td>-e</td>
<td>-e</td>
</tr>
<tr>
<td>ø</td>
<td>ø</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>observed</th>
<th>expected</th>
</tr>
</thead>
<tbody>
<tr>
<td>-e</td>
<td>-e</td>
</tr>
<tr>
<td>ø</td>
<td>ø</td>
</tr>
</tbody>
</table>

Table 2.22: dative -e in *kâp* and *lôg*; original charters

<table>
<thead>
<tr>
<th>observed&lt; 1470</th>
<th>observed&gt; 1470</th>
</tr>
</thead>
<tbody>
<tr>
<td>-e</td>
<td>-e</td>
</tr>
<tr>
<td>ø</td>
<td>ø</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>observed</th>
<th>expected</th>
</tr>
</thead>
<tbody>
<tr>
<td>-e</td>
<td>-e</td>
</tr>
<tr>
<td>ø</td>
<td>ø</td>
</tr>
</tbody>
</table>

§ 2.5.1

Graph 2.17: Vowel Balance in 3 Frisian dialects in the preservation of final -ø

Modern West Frisian, Long vs. Short Root

<table>
<thead>
<tr>
<th>observed Long -e</th>
<th>observed Short -e</th>
<th>expected Long -e</th>
<th>expected Short -e</th>
</tr>
</thead>
<tbody>
<tr>
<td>-e</td>
<td>-e</td>
<td>-e</td>
<td>-e</td>
</tr>
<tr>
<td>ø</td>
<td>ø</td>
<td>ø</td>
<td>ø</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>observed</th>
<th>expected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Long -e</td>
<td>Short -e</td>
</tr>
<tr>
<td>ø</td>
<td>ø</td>
</tr>
</tbody>
</table>

Graph 2.17: Vowel Balance in 3 Frisian dialects in the preservation of final -ø

Modern West Frisian, Long vs. Short Root

<table>
<thead>
<tr>
<th>observed Long -e</th>
<th>observed Short -e</th>
<th>expected Long -e</th>
<th>expected Short -e</th>
</tr>
</thead>
<tbody>
<tr>
<td>-e</td>
<td>-e</td>
<td>-e</td>
<td>-e</td>
</tr>
<tr>
<td>ø</td>
<td>ø</td>
<td>ø</td>
<td>ø</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>observed</th>
<th>expected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Long -e</td>
<td>Short -e</td>
</tr>
<tr>
<td>ø</td>
<td>ø</td>
</tr>
</tbody>
</table>

-331-
### Graph 2.17: Modern West Frisian, Ofr. -a vs. Ofr. -e

<table>
<thead>
<tr>
<th>Observed</th>
<th>Expected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ofr. -a</td>
<td>Ofr. -e</td>
</tr>
<tr>
<td>-e</td>
<td>28 29</td>
</tr>
<tr>
<td>e</td>
<td>6 45</td>
</tr>
<tr>
<td>Total</td>
<td>34 74</td>
</tr>
</tbody>
</table>

\[
\chi^2 = \frac{(\text{Observed} - \text{Expected})^2}{\text{Expected}}
\]

\[
p = \text{Yates' correction}
\]

<table>
<thead>
<tr>
<th>Yates' correction</th>
</tr>
</thead>
<tbody>
<tr>
<td>17.42 &lt;0.1% 1 108</td>
</tr>
</tbody>
</table>

### Graph 2.17: Mainland North Frisian (Ockholm), Long vs. Short Root

<table>
<thead>
<tr>
<th>Observed</th>
<th>Expected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Long</td>
<td>Short</td>
</tr>
<tr>
<td>-e</td>
<td>11 14</td>
</tr>
<tr>
<td>e</td>
<td>33 13</td>
</tr>
<tr>
<td>Total</td>
<td>44 27</td>
</tr>
</tbody>
</table>

\[
\chi^2 = \frac{(\text{Observed} - \text{Expected})^2}{\text{Expected}}
\]

\[
p = \text{Yates' correction}
\]

<table>
<thead>
<tr>
<th>Yates' correction</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.29 2.1% 1 71</td>
</tr>
</tbody>
</table>

### Graph 2.17: Mainland North Frisian (Ockholm), Ofr. -a vs. Ofr. -e

<table>
<thead>
<tr>
<th>Observed</th>
<th>Expected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ofr. -a</td>
<td>Ofr. -e</td>
</tr>
<tr>
<td>-e</td>
<td>20 5</td>
</tr>
<tr>
<td>e</td>
<td>6 40</td>
</tr>
<tr>
<td>Total</td>
<td>26 45</td>
</tr>
</tbody>
</table>

\[
\chi^2 = \frac{(\text{Observed} - \text{Expected})^2}{\text{Expected}}
\]

\[
p = \text{Yates' correction}
\]

<table>
<thead>
<tr>
<th>Yates' correction</th>
</tr>
</thead>
<tbody>
<tr>
<td>31.29 &lt;0.1% 1 71</td>
</tr>
</tbody>
</table>

### Graph 2.17: Harlingerland (East Frisian), Long vs. Short Root

<table>
<thead>
<tr>
<th>Observed</th>
<th>Expected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Short -a</td>
<td>Short -e</td>
</tr>
<tr>
<td>-e</td>
<td>7 2</td>
</tr>
<tr>
<td>e</td>
<td>3 10</td>
</tr>
<tr>
<td>Total</td>
<td>10 12</td>
</tr>
</tbody>
</table>

\[
\chi^2 = \frac{(\text{Observed} - \text{Expected})^2}{\text{Expected}}
\]

\[
p = \text{Yates' correction}
\]

<table>
<thead>
<tr>
<th>Yates' correction</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.42 1.1% 1 22</td>
</tr>
</tbody>
</table>
Graph 2.17: Harlingerland (East Frisian), Ofr. -a vs. Ofr. -e for Long Roots

<table>
<thead>
<tr>
<th>observed</th>
<th>Long -a</th>
<th>Long -e</th>
</tr>
</thead>
<tbody>
<tr>
<td>-e</td>
<td>10</td>
<td>33</td>
</tr>
<tr>
<td>o</td>
<td>8</td>
<td>23</td>
</tr>
<tr>
<td></td>
<td>18</td>
<td>56</td>
</tr>
</tbody>
</table>

\[ \chi^2 = \frac{(10 - 33)^2}{33} = \frac{(10 - 7.5)^2}{7.5} \]

Yates’ correction

\[ \chi^2 = \frac{(10.5 - 32.5)^2}{32.5} = \frac{(7.5 - 23.5)^2}{23.5} \]

\[ p = df = n = \]

0.06 80.1% 1 74

Graph 2.17: Harlingerland (East Frisian), Long vs. Short Root for Ofr. -e

<table>
<thead>
<tr>
<th>observed</th>
<th>Short -e</th>
<th>Long -e</th>
</tr>
</thead>
<tbody>
<tr>
<td>-e</td>
<td>2</td>
<td>33</td>
</tr>
<tr>
<td>o</td>
<td>10</td>
<td>23</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>56</td>
</tr>
</tbody>
</table>

\[ \chi^2 = \frac{(2 - 33)^2}{33} = \frac{(6.2 - 28.8)^2}{28.8} \]

Yates’ correction

\[ \chi^2 = \frac{(5.8 - 27.2)^2}{27.2} \]

\[ p = df = n = \]

7.07 0.8% 1 68

Modern Vowel Balance in West Frisian in data set used for graph 2.17

<table>
<thead>
<tr>
<th>observed</th>
<th>Short</th>
<th>Long</th>
</tr>
</thead>
<tbody>
<tr>
<td>-e</td>
<td>34</td>
<td>13</td>
</tr>
<tr>
<td>o</td>
<td>20</td>
<td>31</td>
</tr>
<tr>
<td></td>
<td>54</td>
<td>44</td>
</tr>
</tbody>
</table>

\[ \chi^2 = \frac{(34 - 13)^2}{13} = \frac{(25.9 - 21.1)^2}{21.1} \]

Yates’ correction

\[ \chi^2 = \frac{(28.1 - 229)^2}{229} \]

\[ p = df = n = \]

10.85 <0.1% 1 98

§ 2.5.2

Graph 2.18: Vowel Balance in the reduction of protected /a/ between 1430-1460

<table>
<thead>
<tr>
<th>observed</th>
<th>Short</th>
<th>Long</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;a&gt;</td>
<td>22</td>
<td>10</td>
</tr>
<tr>
<td>&lt;e/i&gt;</td>
<td>68</td>
<td>246</td>
</tr>
<tr>
<td></td>
<td>90</td>
<td>256</td>
</tr>
</tbody>
</table>

\[ \chi^2 = \frac{(22 - 10)^2}{10} = \frac{(8.3 - 23.7)^2}{23.7} \]

Yates’ correction

\[ \chi^2 = \frac{(81.7 - 232.3)^2}{232.3} \]

\[ p = df = n = \]

33.47 <0.1% 1 346

\[ \chi^2 = \frac{(31.06 - 0.2%)^2}{0.2%} \]

\[ p = df = n = \]

-333-
Graph 2.18: Vowel Balance in the reduction of protected /a/ between 1460-1490

<table>
<thead>
<tr>
<th>observed</th>
<th>Short</th>
<th>Long</th>
<th>expected</th>
<th>Short</th>
<th>Long</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;a&gt;</td>
<td>21</td>
<td>5</td>
<td>26</td>
<td>&lt;a&gt;</td>
<td>7.2</td>
</tr>
<tr>
<td>&lt;e/i&gt;</td>
<td>262</td>
<td>728</td>
<td>990</td>
<td>&lt;e/i&gt;</td>
<td>275.8</td>
</tr>
<tr>
<td></td>
<td>283</td>
<td>733</td>
<td>1016</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\[ \chi^2 = 37.18, \quad p = 0.001, \quad df = 1, \quad n = 1016 \]

Graph 2.18: Vowel Balance in the reduction of protected /a/ between 1490-1510

<table>
<thead>
<tr>
<th>observed</th>
<th>Short</th>
<th>Long</th>
<th>expected</th>
<th>Short</th>
<th>Long</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;a&gt;</td>
<td>5</td>
<td>0</td>
<td>5</td>
<td>&lt;a&gt;</td>
<td>1.4</td>
</tr>
<tr>
<td>&lt;e/i&gt;</td>
<td>268</td>
<td>690</td>
<td>958</td>
<td>&lt;e/i&gt;</td>
<td>271.6</td>
</tr>
<tr>
<td></td>
<td>273</td>
<td>690</td>
<td>963</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\[ \chi^2 = 12.70, \quad p = 0.001, \quad df = 1, \quad n = 963 \]

Graph 2.20: Contrast -a vs. -ia in verbs after 1470

<table>
<thead>
<tr>
<th>observed</th>
<th>-a</th>
<th>-ia</th>
<th>expected</th>
<th>-a</th>
<th>-ia</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;a&gt;</td>
<td>785</td>
<td>32</td>
<td>817</td>
<td>&lt;a&gt;</td>
<td>757.8</td>
</tr>
<tr>
<td>&lt;e&gt;</td>
<td>470</td>
<td>66</td>
<td>536</td>
<td>&lt;e&gt;</td>
<td>497.2</td>
</tr>
<tr>
<td></td>
<td>1255</td>
<td>98</td>
<td>1353</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\[ \chi^2 = 33.96, \quad p = 0.001, \quad df = 1, \quad n = 1353 \]

Graph 2.20: bitalia vs. käpia, 1470-1510

<table>
<thead>
<tr>
<th>observed</th>
<th>bitalia</th>
<th>käpia</th>
<th>expected</th>
<th>bitalia</th>
<th>käpia</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;a&gt;</td>
<td>24</td>
<td>6</td>
<td>30</td>
<td>&lt;a&gt;</td>
<td>21.9</td>
</tr>
<tr>
<td>&lt;e&gt;</td>
<td>22</td>
<td>11</td>
<td>33</td>
<td>&lt;e&gt;</td>
<td>24.1</td>
</tr>
<tr>
<td></td>
<td>46</td>
<td>17</td>
<td>63</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\[ \chi^2 = 1.42, \quad p = 0.234, \quad df = 1, \quad n = 63 \]
Graph 2.20 (+ text): *bitilia* + *meite* vs. *kâpia* + *meite*, 1470-1510

<table>
<thead>
<tr>
<th>observed</th>
<th>Short</th>
<th>Long</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;a&gt;</td>
<td>35</td>
<td>11</td>
</tr>
<tr>
<td>&lt;e&gt;</td>
<td>31</td>
<td>26</td>
</tr>
<tr>
<td></td>
<td>66</td>
<td>37</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>expected</th>
<th>Short</th>
<th>Long</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;a&gt;</td>
<td>29.5</td>
<td>16.5</td>
</tr>
<tr>
<td>&lt;e&gt;</td>
<td>36.5</td>
<td>20.5</td>
</tr>
</tbody>
</table>

χ² = 5.21, p = 2.2%, df = 1, n = 103

Yates’ correction

§ 2.6.2

Table 2.25: Vowel Harmony in Unia, A-1 and A-2: kuma - kome

<table>
<thead>
<tr>
<th>observed</th>
<th>-a/-i</th>
<th>-e</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;u&gt;</td>
<td>15</td>
<td>8</td>
</tr>
<tr>
<td>&lt;o&gt;</td>
<td>14</td>
<td>34</td>
</tr>
<tr>
<td></td>
<td>29</td>
<td>42</td>
</tr>
</tbody>
</table>

χ² = 836, p = 0.4%, df = 1, n = 71

Yates’ correction

χ² = 6.94, p = 0.8%

Table 2.25: Vowel Harmony in the 18th century language of Eikke Meinerts (North-East); data from 13 lemmas

<table>
<thead>
<tr>
<th>observed</th>
<th>-i-</th>
<th>-e/a-</th>
</tr>
</thead>
<tbody>
<tr>
<td>bi-</td>
<td>14</td>
<td>12</td>
</tr>
<tr>
<td>be-</td>
<td>1</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>14</td>
<td>24</td>
</tr>
</tbody>
</table>

χ² = 10.23, p = 0.1%, df = 1, n = 38

Yates’ correction

χ² = 8.05, p = 0.5%, df = 1, n = 38

FE 1-t: FE 2-t: 1-t FE 2-t: 0.1% 2.6%

Table 2.25: Vowel Harmony in Unia, a/u/i-i vs. e/o-e in the ending of the 3rd person singular without syncope: -eth

<table>
<thead>
<tr>
<th>observed</th>
<th>-a/i/u-</th>
<th>-e/o-</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;i&gt;</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>&lt;e&gt;</td>
<td>1</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>15</td>
</tr>
</tbody>
</table>

χ² = 8.53, p = 0.4%, df = 1, n = 22

Yates’ correction

χ² = 6.02, p = 1.4%, df = 1, n = 22

FE 1-t: FE 2-t: 0.7% 0.7%
Table 2.25: Vowel Harmony in Middle-Frisian *bitulath/-ad*

<table>
<thead>
<tr>
<th></th>
<th>observed</th>
<th>expected</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-tal(l)-</td>
<td>-tel(l)-</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>-tal(l)-</td>
<td>-tel(l)-</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;i&gt;</td>
<td>34</td>
<td>37</td>
<td>91</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;e&gt;</td>
<td>74</td>
<td>141</td>
<td>215</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>128</td>
<td>178</td>
<td>306</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

χ² = 16.32  p = 0.0001  df = 1  n = 306

Yates’ correction: χ² = 15.31 < 0.1%

§ 2.6.3

Table 2.26: Vowel Harmony in Middle Frisian *seke/saka* -1460

<table>
<thead>
<tr>
<th></th>
<th>observed</th>
<th>expected</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-a/-en</td>
<td>others</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>-a/-en</td>
<td>others</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>sak-</td>
<td>14</td>
<td>2</td>
<td>16</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>sek-</td>
<td>2</td>
<td>75</td>
<td>77</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>16</td>
<td>77</td>
<td>93</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

χ² = 67.04  p = 0.0001  df = 1  n = 93

Yates’ correction: χ² = 61.21 < 0.1%

Table 2.26: Vowel Harmony in Middle Frisian *seke/saka* 1460-1480

<table>
<thead>
<tr>
<th></th>
<th>observed</th>
<th>expected</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-a/-en</td>
<td>others</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>-a/-en</td>
<td>others</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>sak-</td>
<td>10</td>
<td>3</td>
<td>13</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>sek-</td>
<td>25</td>
<td>73</td>
<td>98</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>35</td>
<td>76</td>
<td>111</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

χ² = 14.05  p = 0.0001  df = 1  n = 111

Yates’ correction: χ² = 11.77 < 0.1%

Table 2.26: Vowel Harmony in Middle Frisian *seke/saka* 1480

<table>
<thead>
<tr>
<th></th>
<th>observed</th>
<th>expected</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-a/-en</td>
<td>others</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>-a/-en</td>
<td>others</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>sak-</td>
<td>21</td>
<td>4</td>
<td>25</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>sek-</td>
<td>17</td>
<td>12</td>
<td>29</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>38</td>
<td>16</td>
<td>54</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

χ² = 4.15  p = 0.052  df = 1  n = 54

Yates’ correction: χ² = 3.02  p = 0.08
§ 2.6.3

Table 2.27: Vowel Harmony in Middle Frisian *degan*/*dagen* -1460

<table>
<thead>
<tr>
<th></th>
<th>observed</th>
<th>expected</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>pl-en</td>
<td>others</td>
<td>pl-en</td>
<td>others</td>
</tr>
<tr>
<td>sak-</td>
<td>9</td>
<td>26</td>
<td>35</td>
<td>12.0</td>
</tr>
<tr>
<td>sek-</td>
<td>5</td>
<td>1</td>
<td>6</td>
<td>2.0</td>
</tr>
<tr>
<td></td>
<td>14</td>
<td>27</td>
<td>41</td>
<td></td>
</tr>
</tbody>
</table>

\[ \chi^2 = \text{p} = \text{df} = n = 7.56 \quad 0.6\% \quad 1 \quad 41 \]

Table 2.27: Vowel Harmony in Middle Frisian *degan*/*dagen* 1460-1480

<table>
<thead>
<tr>
<th></th>
<th>observed</th>
<th>expected</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>pl-en</td>
<td>others</td>
<td>pl-en</td>
<td>others</td>
</tr>
<tr>
<td>sak-</td>
<td>10</td>
<td>5</td>
<td>15</td>
<td>5.5</td>
</tr>
<tr>
<td>sek-</td>
<td>4</td>
<td>19</td>
<td>23</td>
<td>8.5</td>
</tr>
<tr>
<td></td>
<td>14</td>
<td>24</td>
<td>38</td>
<td></td>
</tr>
</tbody>
</table>

\[ \chi^2 = \text{p} = \text{df} = n = 9.47 \quad 0.2\% \quad 1 \quad 38 \]

Table 2.27: Vowel Harmony in Middle Frisian *degan*/*dagen* -1460

<table>
<thead>
<tr>
<th></th>
<th>observednom/acc dat. -en</th>
<th>expectednom/acc dat. -en</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>pl-en</td>
<td>others</td>
<td>pl-en</td>
<td>others</td>
</tr>
<tr>
<td>sak-</td>
<td>6</td>
<td>3</td>
<td>9</td>
<td>5.1</td>
</tr>
<tr>
<td>sek-</td>
<td>2</td>
<td>3</td>
<td>5</td>
<td>2.1</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>6</td>
<td>14</td>
<td></td>
</tr>
</tbody>
</table>

\[ \chi^2 = \text{p} = \text{df} = n = 0.93 \quad 33.4\% \quad 1 \quad 14 \]

\[ \chi^2 = \text{p} = \text{df} = n = 0.16 \quad 68.7\% \quad 34.3\% \quad 58.0\% \]
§ 3.4

Syncope in gerund and past participle of *swara* and *kerz*, >1450

<table>
<thead>
<tr>
<th>observed gerund past part.</th>
<th>expected gerund past part.</th>
</tr>
</thead>
<tbody>
<tr>
<td>-ren 15 16 31</td>
<td>-ren 126 18.4</td>
</tr>
<tr>
<td>-rn 0 6 6</td>
<td>-rn 24 3.6</td>
</tr>
<tr>
<td>15 22 37</td>
<td></td>
</tr>
</tbody>
</table>

\[ \chi^2 = 4.88 \quad p = 0.027 \quad df = 1 \quad n = 37 \]

\[ \chi^2 = 3.08 \quad FE 1-t = 7.9\% \quad FE 2-t = 3.2\% \]

\[ \text{Yates' correction} \]

§ 5.2.1

Table 5.7: Checking the contrast of the classical verbal endings in *habba* in the charters before 1430; *<habbe>* and *<habba>* only.

<table>
<thead>
<tr>
<th>observed</th>
<th>expected</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;e&gt; 6 0 6</td>
<td>&lt;e&gt; 3.2 28</td>
</tr>
<tr>
<td>&lt;a&gt; 1 6 7</td>
<td>&lt;a&gt; 3.8 3.2</td>
</tr>
<tr>
<td>7 6 13</td>
<td></td>
</tr>
</tbody>
</table>

\[ \chi^2 = 9.55 \quad p = 0.002 \quad df = 1 \quad n = 13 \]

\[ \text{Yates' correction} \]

\[ \chi^2 = 6.4 \quad FE 1-t = 1.1\% \quad FE 2-t = 4.7\% \]

§ 5.2.4

<*secke*> as a plural form 1430-1510

<table>
<thead>
<tr>
<th>observed</th>
<th>expected</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;secke&gt; 0 2.2</td>
<td>=17%</td>
</tr>
<tr>
<td>others 13 10.8</td>
<td></td>
</tr>
<tr>
<td>13 13</td>
<td></td>
</tr>
</tbody>
</table>

\[ \chi^2 = 266 \quad p = 10.27\% \quad df = 1 \quad n = 13 \]
§ 1.3.7.7

Graph 1.6: Correlation between point values and trend surface values.

<table>
<thead>
<tr>
<th>municipal.</th>
<th>/e/</th>
<th>/o/</th>
<th>point value %/e/</th>
<th>surface value %/e/</th>
<th>average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tyt</td>
<td>0</td>
<td>1</td>
<td>0%</td>
<td>34%</td>
<td>71%</td>
</tr>
<tr>
<td>Ldl</td>
<td>0</td>
<td>2</td>
<td>0%</td>
<td>39%</td>
<td>71%</td>
</tr>
<tr>
<td>Ldn</td>
<td>10</td>
<td>7</td>
<td>59%</td>
<td>46%</td>
<td>71%</td>
</tr>
<tr>
<td>Men</td>
<td>1</td>
<td>1</td>
<td>50%</td>
<td>52%</td>
<td>71%</td>
</tr>
<tr>
<td>Boa</td>
<td>2</td>
<td>2</td>
<td>50%</td>
<td>64%</td>
<td>71%</td>
</tr>
<tr>
<td>Don</td>
<td>1</td>
<td>0</td>
<td>100%</td>
<td>65%</td>
<td>71%</td>
</tr>
<tr>
<td>Fra</td>
<td>10</td>
<td>1</td>
<td>91%</td>
<td>71%</td>
<td>71%</td>
</tr>
<tr>
<td>Hee</td>
<td>1</td>
<td>0</td>
<td>100%</td>
<td>84%</td>
<td>71%</td>
</tr>
<tr>
<td>Bol</td>
<td>3</td>
<td>0</td>
<td>100%</td>
<td>92%</td>
<td>71%</td>
</tr>
<tr>
<td>Ska</td>
<td>1</td>
<td>0</td>
<td>100%</td>
<td>92%</td>
<td>71%</td>
</tr>
<tr>
<td>Wym</td>
<td>1</td>
<td>0</td>
<td>100%</td>
<td>95%</td>
<td>71%</td>
</tr>
<tr>
<td>Wun</td>
<td>2</td>
<td>0</td>
<td>100%</td>
<td>97%</td>
<td>71%</td>
</tr>
<tr>
<td>Nij</td>
<td>3</td>
<td>0</td>
<td>100%</td>
<td>100%</td>
<td>72%</td>
</tr>
</tbody>
</table>

| average /e/ | 71% | r = 88.2% | 21.3% |
| df = | 11 | r² = 47.7% | 4.5% |
| n = 13 | p 1-T < 0.1% | 24.3% |
| p 2-T < 0.1% | 48.7% |
Graph 1.7: Correlation between point values and trend surface values.

<table>
<thead>
<tr>
<th>municipal.</th>
<th>point value /e/</th>
<th>surface value /e/</th>
<th>%/e/</th>
<th>%/e/ average</th>
</tr>
</thead>
<tbody>
<tr>
<td>NE</td>
<td>50%</td>
<td>51%</td>
<td>71%</td>
<td></td>
</tr>
<tr>
<td>MM</td>
<td>53%</td>
<td>65%</td>
<td>71%</td>
<td></td>
</tr>
<tr>
<td>SE</td>
<td>67%</td>
<td>75%</td>
<td>71%</td>
<td></td>
</tr>
<tr>
<td>NW</td>
<td>85%</td>
<td>78%</td>
<td>71%</td>
<td></td>
</tr>
<tr>
<td>MW</td>
<td>100%</td>
<td>89%</td>
<td>71%</td>
<td></td>
</tr>
<tr>
<td>SW</td>
<td>100%</td>
<td>97%</td>
<td>72%</td>
<td></td>
</tr>
</tbody>
</table>

\[ r = \frac{35}{14} = 2.5 \]
\[ r^2 = 0.22 \]
\[ df = 4 \]
\[ p = 0.2\% \]
\[ n = 6 \]

Graph 1.8: Correlation between point values and trend surface values.

<table>
<thead>
<tr>
<th>municipal.</th>
<th>point value /e/</th>
<th>surface value /e/</th>
<th>%/e/</th>
<th>%/e/ average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nij</td>
<td>0%</td>
<td>0%</td>
<td>33%</td>
<td></td>
</tr>
<tr>
<td>Wun</td>
<td>0%</td>
<td>0%</td>
<td>33%</td>
<td></td>
</tr>
<tr>
<td>Boa</td>
<td>13%</td>
<td>32%</td>
<td>33%</td>
<td></td>
</tr>
<tr>
<td>Lit</td>
<td>50%</td>
<td>34%</td>
<td>33%</td>
<td></td>
</tr>
<tr>
<td>Fra</td>
<td>33%</td>
<td>37%</td>
<td>33%</td>
<td></td>
</tr>
<tr>
<td>Tyt</td>
<td>33%</td>
<td>37%</td>
<td>33%</td>
<td></td>
</tr>
<tr>
<td>Ldn</td>
<td>56%</td>
<td>38%</td>
<td>33%</td>
<td></td>
</tr>
<tr>
<td>Dan</td>
<td>20%</td>
<td>40%</td>
<td>33%</td>
<td></td>
</tr>
<tr>
<td>Don</td>
<td>67%</td>
<td>42%</td>
<td>34%</td>
<td></td>
</tr>
</tbody>
</table>

\[ r = \frac{37}{18} = 2.1 \]
\[ r^2 = 0.56 \]
\[ df = 7 \]
\[ p = 1.1\% \]
\[ n = 9 \]

\[ p = 2.2\% \]
Graph 1.9: Level of Mixture, charter count.

<table>
<thead>
<tr>
<th>words</th>
<th>mixed charters</th>
<th>% mixed charters</th>
<th>charter count</th>
<th>% charter count</th>
<th>variant 1</th>
<th>time</th>
</tr>
</thead>
<tbody>
<tr>
<td>bital</td>
<td>0</td>
<td>0%</td>
<td>7</td>
<td>20</td>
<td>32%</td>
<td>-1481</td>
</tr>
<tr>
<td>habb</td>
<td>12</td>
<td>8%</td>
<td>13</td>
<td>7</td>
<td>28%</td>
<td>-1435</td>
</tr>
<tr>
<td>kapu</td>
<td>6</td>
<td>9%</td>
<td>69</td>
<td>107</td>
<td>31%</td>
<td>all</td>
</tr>
<tr>
<td>wasa</td>
<td>1</td>
<td>4%</td>
<td>23</td>
<td>19</td>
<td>32%</td>
<td>-1471</td>
</tr>
<tr>
<td>degum</td>
<td>2</td>
<td>20%</td>
<td>10</td>
<td>37</td>
<td>41%</td>
<td>all</td>
</tr>
<tr>
<td>sek</td>
<td>6</td>
<td>23%</td>
<td>26</td>
<td>36</td>
<td>49%</td>
<td>1430-1480</td>
</tr>
<tr>
<td>sek</td>
<td>1</td>
<td>9%</td>
<td>11</td>
<td>18</td>
<td>49%</td>
<td>1460-1500</td>
</tr>
</tbody>
</table>

Graph 1.9: Level of Mixture, token count.

<table>
<thead>
<tr>
<th>words</th>
<th>tokens in mixed charters</th>
<th>% mixed tokens</th>
<th>token count</th>
<th>% token count</th>
<th>variant 1</th>
<th>time</th>
</tr>
</thead>
<tbody>
<tr>
<td>bital</td>
<td>0</td>
<td>0%</td>
<td>14</td>
<td>20</td>
<td>20%</td>
<td>-1481</td>
</tr>
<tr>
<td>habb</td>
<td>3</td>
<td>11%</td>
<td>28</td>
<td>10</td>
<td>26%</td>
<td>-1435</td>
</tr>
<tr>
<td>kapu</td>
<td>12</td>
<td>7%</td>
<td>174</td>
<td>137</td>
<td>31%</td>
<td>all</td>
</tr>
<tr>
<td>wasa</td>
<td>6</td>
<td>8%</td>
<td>72</td>
<td>39</td>
<td>36%</td>
<td>-1471</td>
</tr>
<tr>
<td>degum</td>
<td>4</td>
<td>18%</td>
<td>22</td>
<td>42</td>
<td>46%</td>
<td>all</td>
</tr>
<tr>
<td>sek</td>
<td>29</td>
<td>36%</td>
<td>80</td>
<td>58</td>
<td>47%</td>
<td>1430-1480</td>
</tr>
<tr>
<td>sek</td>
<td>3</td>
<td>12%</td>
<td>26</td>
<td>21</td>
<td>41%</td>
<td>1460-1500</td>
</tr>
</tbody>
</table>

average /e/ = 10%

\[ r = 75.8\% \]
\[ r^2 = 57.4\% \]
\[ df = 5 \]
\[ p = 1-T = 2.4\% \]
\[ n = 7 \]
\[ p = 2-T = 4.8\% \]
§ 2.3.3.3

Graph 2.3: <VVCC>-spellings in a temporal dimension.

<table>
<thead>
<tr>
<th></th>
<th>original\ncharters &lt;VVCC&gt;</th>
<th>avg. year &lt;VVCC&gt;</th>
<th>+Unia avg. year &lt;VVCC&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>-1430</td>
<td>39</td>
<td>1410 3%</td>
<td>1380 0%</td>
</tr>
<tr>
<td>-1460</td>
<td>127</td>
<td>1445 11%</td>
<td>1445 11%</td>
</tr>
<tr>
<td>-1490</td>
<td>313</td>
<td>1475 5%</td>
<td>1475 5%</td>
</tr>
<tr>
<td>-1510</td>
<td>312</td>
<td>1500 9%</td>
<td>1500 9%</td>
</tr>
<tr>
<td>-1550</td>
<td>195</td>
<td>1530 18%</td>
<td>1530 18%</td>
</tr>
<tr>
<td></td>
<td>986 93</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Charters only

<table>
<thead>
<tr>
<th>r²</th>
<th>p 1-T =</th>
<th>p 2-T =</th>
<th>df =</th>
<th>n =</th>
</tr>
</thead>
<tbody>
<tr>
<td>58%</td>
<td>6.8%</td>
<td>13.5%</td>
<td>3</td>
<td>5</td>
</tr>
</tbody>
</table>

Table 2.11: Skewed distribution of the sequence <aell>.

<table>
<thead>
<tr>
<th>order</th>
<th>% &lt;aell&gt;</th>
<th>log(% aell)</th>
</tr>
</thead>
<tbody>
<tr>
<td>bitala-</td>
<td>0</td>
<td>45%</td>
</tr>
<tr>
<td>bitalia-</td>
<td>1</td>
<td>18%</td>
</tr>
<tr>
<td>bitalinge</td>
<td>2</td>
<td>8%</td>
</tr>
<tr>
<td>rest</td>
<td>3</td>
<td>1%</td>
</tr>
</tbody>
</table>

Charters and Unia

<table>
<thead>
<tr>
<th>r²</th>
<th>p 1-T =</th>
<th>p 2-T =</th>
<th>df =</th>
<th>n =</th>
</tr>
</thead>
<tbody>
<tr>
<td>90%</td>
<td>2.5%</td>
<td>5.0%</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>96%</td>
<td>1.0%</td>
<td>1.9%</td>
<td>2</td>
<td>4</td>
</tr>
</tbody>
</table>
§ 5.1.4

Graph 5.2: Log(Intensity Integral Volume) and average year of reduction.

<table>
<thead>
<tr>
<th>log(IIV)</th>
<th>year</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>1300</td>
</tr>
<tr>
<td>9</td>
<td>1350</td>
</tr>
<tr>
<td>10</td>
<td>1390</td>
</tr>
<tr>
<td>15</td>
<td>1410</td>
</tr>
<tr>
<td>19</td>
<td>1450</td>
</tr>
<tr>
<td>24</td>
<td>1460</td>
</tr>
<tr>
<td>25</td>
<td>1480</td>
</tr>
<tr>
<td>34</td>
<td>1500</td>
</tr>
</tbody>
</table>

\[ r^2 = p_1-T = p_2-T = df = n = \]

95%  <0.1%  <0.1%  6  8

§ 5.1.5

Table 5.5: Phonetic increase ratios.

<table>
<thead>
<tr>
<th>from measurement computed</th>
<th>[a] ~ [ə]</th>
<th>V# ~ VC#</th>
</tr>
</thead>
<tbody>
<tr>
<td>41% 39%</td>
<td>26% 33%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>22% 20%</td>
<td></td>
</tr>
<tr>
<td>short ~ long</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\[ r^2 = p_1-T = p_2-T = df = n = \]

74%  16.9%  33.9%  1  3
§ 5.1.6

Graph 5.3: Binary phonological score and average year of reduction.

<table>
<thead>
<tr>
<th>phonol. score</th>
<th>year</th>
<th>word</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1300</td>
<td>billveth</td>
</tr>
<tr>
<td>1</td>
<td>1350</td>
<td>kumeth</td>
</tr>
<tr>
<td>1</td>
<td>1390</td>
<td>före</td>
</tr>
<tr>
<td>1</td>
<td>1410</td>
<td>kâpad</td>
</tr>
<tr>
<td>2</td>
<td>1450</td>
<td>seke</td>
</tr>
<tr>
<td>2</td>
<td>1460</td>
<td>bitalad</td>
</tr>
<tr>
<td>2</td>
<td>1480</td>
<td>kâpia</td>
</tr>
<tr>
<td>3</td>
<td>1500</td>
<td>wesa</td>
</tr>
</tbody>
</table>

\[ r^2 = 0.90 \quad p_1-T = 0.01 \quad p_2-T = 0.01 \quad df = 6 \quad n = 8 \]

Graph 5.4: Log(Intensity Integral Volume) and average year of reduction.

<table>
<thead>
<tr>
<th>log(IIV)</th>
<th>year</th>
<th>word</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>1390</td>
<td>före</td>
</tr>
<tr>
<td>15</td>
<td>1410</td>
<td>kâpad</td>
</tr>
<tr>
<td>19</td>
<td>1450</td>
<td>seke</td>
</tr>
<tr>
<td>24</td>
<td>1460</td>
<td>bitalad</td>
</tr>
<tr>
<td>25</td>
<td>1480</td>
<td>kâpia</td>
</tr>
<tr>
<td>34</td>
<td>1500</td>
<td>wesa</td>
</tr>
</tbody>
</table>

\[ r^2 = 0.94 \quad p_1-T = 0.1 \quad p_2-T = 0.1 \quad df = 4 \quad n = 6 \]
Table 5.16: Observed and computed production and perception reliability ratios for \(<habbe>\) as the form of the 1st pers. sg. pres.

<table>
<thead>
<tr>
<th>&lt;habbe&gt;</th>
<th>observed</th>
<th>computed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st sg.</td>
<td>produc. percep. produc. percep.</td>
<td></td>
</tr>
<tr>
<td>-1430</td>
<td>86% 86%</td>
<td>89% 93%</td>
</tr>
<tr>
<td>1430-1460</td>
<td>37% 97%</td>
<td>30% 78%</td>
</tr>
<tr>
<td>1460-1490</td>
<td>3% 29%</td>
<td>1% 3%</td>
</tr>
<tr>
<td>1490-1510</td>
<td>2% 7%</td>
<td>1% 2%</td>
</tr>
<tr>
<td>1510-1550</td>
<td>2% 5%</td>
<td>1% 2%</td>
</tr>
</tbody>
</table>

production: perception

- $r^2 = \frac{p_1 - T}{p_2 - T} = \frac{r^2}{p_1 - T} = \frac{p_2 - T}{p_2 - T} =
- 99% <0.1% <0.1% 92% <0.1% <0.1%

$df = n =$

3 5

Table 5.17: Observed and computed production and perception reliability ratios for \(<habbe>\) as the form of the infinitive.

<table>
<thead>
<tr>
<th>&lt;habbe&gt;</th>
<th>observed</th>
<th>computed</th>
</tr>
</thead>
<tbody>
<tr>
<td>infinitive</td>
<td>produc. percep. produc. percep.</td>
<td></td>
</tr>
<tr>
<td>-1430</td>
<td>14% 14%</td>
<td>10% 7%</td>
</tr>
<tr>
<td>1430-1460</td>
<td>3% 3%</td>
<td>12% 22%</td>
</tr>
<tr>
<td>1460-1490</td>
<td>9% 71%</td>
<td>47% 97%</td>
</tr>
<tr>
<td>1490-1510</td>
<td>28% 93%</td>
<td>57% 97%</td>
</tr>
<tr>
<td>1510-1550</td>
<td>63% 95%</td>
<td>60% 98%</td>
</tr>
</tbody>
</table>

production: perception

- $r^2 = \frac{p_1 - T}{p_2 - T} = \frac{r^2}{p_1 - T} = \frac{p_2 - T}{p_2 - T} =
- 48% 9.8% 19.5% 92% 0.5% 1.1%

$df = n =$

3 5
§ 5.2.4

Table 5.18: Observed and computed production ratios for <secke> and <seck> as a singular form, region North-East.

<table>
<thead>
<tr>
<th>region NE</th>
<th>&lt;secke&gt;</th>
<th>&lt;seck&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>seke (sg)</td>
<td>obs.</td>
<td>comp.</td>
</tr>
<tr>
<td>1430-1460</td>
<td>56%</td>
<td>64%</td>
</tr>
<tr>
<td>1460-1490</td>
<td>17%</td>
<td>24%</td>
</tr>
<tr>
<td>1490-1510</td>
<td>0%</td>
<td>7%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>r² = p 1·T =</th>
<th>p 2·T =</th>
</tr>
</thead>
<tbody>
<tr>
<td>100%</td>
<td>0.2%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>df =</th>
<th>n =</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
</tr>
</tbody>
</table>

Table 5.19: Observed and computed production ratios for <secke> as a form of the singular or plural, from the south and west.

<table>
<thead>
<tr>
<th>produc.</th>
<th>&lt;secke&gt; = sg</th>
<th>&lt;secke&gt; = pl</th>
</tr>
</thead>
<tbody>
<tr>
<td>MW + SE</td>
<td>obs.</td>
<td>comp.</td>
</tr>
<tr>
<td>1430-1460</td>
<td>83%</td>
<td>80%</td>
</tr>
<tr>
<td>1460-1490</td>
<td>26%</td>
<td>35%</td>
</tr>
<tr>
<td>1490-1510</td>
<td>31%</td>
<td>22%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>r² = p 1·T =</th>
<th>p 2·T =</th>
</tr>
</thead>
<tbody>
<tr>
<td>92%</td>
<td>9.4%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>df =</th>
<th>n =</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
</tr>
</tbody>
</table>
Table 5.20: Observed and computed production ratios for *<secka>* as a form of the singular or plural, from the south and west.

<table>
<thead>
<tr>
<th>produc. MW+SE</th>
<th>&lt;secka&gt; = sg obs.</th>
<th>comp.</th>
<th>&lt;secka&gt; = pl obs.</th>
<th>comp.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1430-1460</td>
<td>4%</td>
<td>1%</td>
<td>83%</td>
<td>84%</td>
</tr>
<tr>
<td>1460-1490</td>
<td>15%</td>
<td>0%</td>
<td>36%</td>
<td>34%</td>
</tr>
<tr>
<td>1490-1510</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>7%</td>
</tr>
</tbody>
</table>

| r² = p 1-T = | 7%               | 41.6% | 83.2%          |       |
| p 2-T =      | 99%              | 3.0%  | 6.0%           |       |

| df = n =     | 1                | 3     | 3               |       |

Table 5.21: Observed and computed production ratios for *<secken>* as a form of plural, from the south and west.

<table>
<thead>
<tr>
<th>produc. MW+SE</th>
<th>&lt;secken&gt; = pl obs.</th>
<th>comp.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1430-1460</td>
<td>17%</td>
<td>11%</td>
</tr>
<tr>
<td>1460-1490</td>
<td>55%</td>
<td>64%</td>
</tr>
<tr>
<td>1490-1510</td>
<td>100%</td>
<td>93%</td>
</tr>
</tbody>
</table>

| r² = p 1-T = | 95%               | 6.9%  | 13.7%           |
| p 2-T =      |                   |       |                 |

| df = n =     | 1                | 3     | 3               |       |
Table 5.19-5.21: Combined evidence.

<table>
<thead>
<tr>
<th>produc. MW+SE</th>
<th>observed</th>
<th>computed</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.21</td>
<td>83%</td>
<td>80%</td>
</tr>
<tr>
<td>3.21</td>
<td>26%</td>
<td>35%</td>
</tr>
<tr>
<td>3.21</td>
<td>31%</td>
<td>22%</td>
</tr>
<tr>
<td>3.21</td>
<td>0%</td>
<td>5%</td>
</tr>
<tr>
<td>3.21</td>
<td>9%</td>
<td>2%</td>
</tr>
<tr>
<td>3.21</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>3.22</td>
<td>4%</td>
<td>1%</td>
</tr>
<tr>
<td>3.22</td>
<td>15%</td>
<td>0%</td>
</tr>
<tr>
<td>3.22</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>3.22</td>
<td>83%</td>
<td>84%</td>
</tr>
<tr>
<td>3.22</td>
<td>36%</td>
<td>34%</td>
</tr>
<tr>
<td>3.22</td>
<td>0%</td>
<td>7%</td>
</tr>
<tr>
<td>3.23</td>
<td>17%</td>
<td>11%</td>
</tr>
<tr>
<td>3.23</td>
<td>55%</td>
<td>64%</td>
</tr>
<tr>
<td>3.23</td>
<td>100%</td>
<td>93%</td>
</tr>
</tbody>
</table>

\[
r^2 = p_{1-T} = p_{2-T} = df = n =
\]

|         | 96%   | <0.1% | <0.1% | 13 | 15 |

Graphic representation of the data from table 5.19-5.21. The observed data are on the x-axis, computed data on the y-axis. The ideal situation, where computed and observed data fully match, is represented with the dashed line (x = y).
Appendix 2: Computing trend surfaces in historical dialect maps

ILWIS - the Remote Sensing and GIS software -
The Integrated Land and Water Information System (ILWIS) is a PC-based GIS & Remote Sensing software, developed by IT&C up to its last release (version 3.3) in 2005. ILWIS comprises a complete package of image processing, spatial analysis and digital mapping. It is easy to learn and use; it has full on-line help, extensive tutorials for direct use in courses and 25 case studies of various disciplines.
As per July 1st, 2007, ILWIS software is freely available ('as-is' and free of charge) as open source software (binaries and source code) under the 52°North initiative (GPL license). This software version is called ILWIS 3.4 Open.
(information from http://www.itc.nl/ilwis/)

For this thesis version 3.2 was mostly used. Information from the ILWIS help function on:

Moving average > Algorithm

Moving average performs a weighted averaging on point values and returns a raster map as output. The user has to specify a weight function and a limiting distance.

1. First, for each output pixel, the distances of all points towards the output pixel are calculated to determine weight factors for the points:

For each output pixel, weight factors for the points are then calculated according to the weight function specified by the user. Two weight functions are available: inverse distance and linear decrease.

*Inverse distance:* weight = (1 / d^n) - 1

*Linear decrease:* weight = 1 - d^n

where:

- d = D / D_L = relative distance of point to output pixel
- D = Euclidean distance of point to output pixel
- D_L = limiting distance
- n = weight exponent

When the spherical distance option is used, distances (D) are calculated over the sphere using the projection of the coordinate system that is used by the georeference of the output raster map.

Figures 1 and 2 below show the manner in which weight values decrease with increasing distance, for different values of n. The X-axes represent d: the distance of a point towards an output pixel divided by the limiting distance. The Y-axes represent the calculated weight values.
The weight functions ensure that points close to an output pixel obtain a larger weight value than points which are farther away from an output pixel.

See that when the distance of a point towards an output pixel equals the limiting distance (value 1.0 at X-axis), or when the distance of a point towards an output pixel is larger than the limiting distance, the calculated weight value will equal 0; the weight functions are thus continuous.

The \textit{inverse distance} function can be selected when you have very accurately measured point values and when local variation, within a pixel, is small. This function ensures that the computed output values equal the input point values.

The \textit{linear decrease} function can be selected for point maps in which you know there are measurement errors, and when points lying close to each other have different values. This function will decrease the overall error by correcting erroneous measurements with other close points. The consequence is that the computed output values will not necessarily coincide with the measured point values.

2. Then, for each output pixel, an output value is calculated as the sum of the products of calculated weight values and point values, divided by sum of weights.

\[
\text{output pixel value} = \frac{\sum (w_i \times val_i)}{\sum w_i}
\]

where:

\(w_i\) = weight value for point \(i\)

\(val_i\) = point value of point \(i\)
Summary:

Mechanisms of Language Change. Vowel Reduction in 15th Century West Frisian

This study takes a detailed look at the different aspects of language change and considers how and why these take place. The research has been supported by analysis of data on Vowel Reduction from late mediaeval Frisian language history over the period ± 1300 - 1550. A large part of the study is concerned with the reconstruction of Vowel Reduction in Frisian over this period.

1. Introduction

In chapter one, documents from the corpus of historical Frisian texts are analysed for their suitability for historical phonological research. The second chapter comprises the actual linguistic facts retrieved from the historical sources. These provide considerable detailed information about Frisian phonology over the period ± 1300 to 1550. The third chapter gives a phonological interpretation of the data. The interpretation of Frisian as a tonal language is discussed in chapter four. Chapter five focuses on two reductionist models of language change.

In order to cover the period between 1300 and 1550, two main sources are used:

- The codex Unia. The manuscript is from the late 15th century and is preserved only in the form of a copy dating from the 17th century. The language in the texts covers the 14th and early 15th centuries;
- Approximately 1,200 charters in Frisian from the period 1378 - 1550 and one single charter from 1329.

Evaluation of sources for linguistic interpretation

There was no independent spelling practice for Frisian during the Middle Ages. Authors of Old and Middle Frisian used existing conventions from other languages they were familiar with: Latin and later, Middle Dutch. An 'Old Frisian spelling tradition', presumed by some scholars, is the result of an ad hoc application of Latin spelling conventions. Middle Dutch spelling practices were used for Middle Frisian.

The spelling of Old and Middle Frisian was phonemic in principle. In some cases allophonic variations and phonetic details are expressed. The default interpretation of the spelling is a one-to-one match between sign and sound. This interpretation however necessitates corrections to accommodate the diverging practices of Latin and Dutch in the representation of vowel and consonant lengths.
The West Frisian charters were localised using dominant toponymic references in the texts. This toponomy method was corrected for instances where the author has been identified and his place of birth is explicitly known. This information has been used to produce detailed historical dialect maps of West Frisian.

There are more than enough reasons to assume that spelling variations in the original charters are a random sample of linguistic patterns of the time. Spelling variations are not the result of erroneous or careless spelling. With a careful eye for temporal, geographical and individual distortions of the data, token counting is a reliable and statistically beneficial way of evaluating the data. For historical analysis, tokens, preferably from original charters, have been used.

Theoretical framework
This study is in part a search for the reductionist components of language and the way they interact. The working hypothesis is that language is a deterministic, dynamic system, where structures and ‘rules’ (grammar) are the result of self-organisation. Within this framework, language is the result of interaction between the following constituent elements:

- Meaning / semantics: The outside world and the human perception of it.
- Articulation and acoustics: The entire field of biology and physics connected with the production and transmission of sounds.
- The biochemical workings of the mind which result in the way human beings perceive, store and retrieve information.

2. Reconstruction of historical developments
Vowel reduction is the main focus of this study and provides the input for the models in chapter 5. In order to understand the vowel reduction, the following related linguistic processes are investigated:

- Degemination: Old Frisian [sɛ:ta] ‘to set’ > Middle Frisian [sɛta]
- Open Syllable Lengthening: Old Frisian [dɔrə] ‘door’ > late-Old Frisian [dɔ:ɾə]
- Vowel Reduction: Middle Frisian [sɛta] > early-Modern Frisian [sɛtə]
- Vowel Harmony: Old Frisian [sɛka] ‘cases’ > late-Old Frisian [saka] (or [saka]).

Vowel Balance
As a phonetic phenomenon, Vowel Balance is ubiquitous in Germanic languages, in some varieties achieving phonological status. Vowel Balance phenomena in
unstressed syllables are indirect indicators of quantity in preceding root syllables. Vowel Balance effects are found in the reduction of an unstressed /a/ > /ə/ and in syncope and apocope of the Old Frisian /ə/.

Degemination

Old Frisian has a phonetic opposition between short and long consonants. Information on consonant length can be obtained from Vowel Balance effects and spelling practices, for example. The combined evidence suggests a rapid loss of long consonants between ± 1420 and 1460.

Open Syllable Lengthening

The oldest stage of Open Syllable Lengthening is the lengthening of /a/, /ɔ/, /i/ and /u/, when the subsequent unstressed syllable was not an /a/. This lengthening took place at the beginning of the 14th century. Lengthening of /ɛ/ was only a marginal feature at the time of the apocope of final /ə/, in the middle of the 15th century.

On the whole, both word-final /a/, for example in Old Frisian dorą ‘doors’, and protected Old Frisian /a/, for example in Old Frisian bītalad ‘paid’, prevented Open Syllable Lengthening. Lengthening of /ɛ/, /a/ and /ɔ/ in open syllables, when followed by an unstressed /a/, took place in the 15th century and was limited to the south-west of Fryslân. Yet even here, it was not everywhere, neither did it always occur. Lengthening before an unstressed /a/ produced a half-long vowel. In the north-east, (half-) shortening of long vowels before unstressed /a/: kâpad <kaeppit> ‘bought’, fôtan <fotten> ‘feet’ is found occasionally.

Vowel Reduction

The protected unstressed /a/ was reduced to an [ə] in the first half of the 15th century. Reduction is earlier when the preceding root is long (< 1430), compared to when the root is short (< 1470). This is the Vowel Balance effect. In word-interior position, as in abbate ‘abbot’ and sunnandi ‘Sunday’, the /a/ is more resistant to reduction in the north-east than in the south-west. Word-final /a/ remains unaltered until ± 1490. There is a Vowel Balance effect with later transition to [ə] after short roots. The transition from [a] > [ə] is later in the south than in the north.

Syncope of /ə/ in unstressed syllables was a gradual process in Frisian, stretching from the 12th to the 16th century. Syncope of /ə/ could be delayed or even prohibited by factors such as a short root quantity, a position near the end of the word, voice of adjacent consonants, and wellformedness constraints. Apocope of word-final /ə/ was controlled by (at least) three factors: Vowel Balance, voice of adjacent consonants, and morphological patterns (/ə/ as a case ending). Apocope
A.P. Versloot: *Mechanisms of Language Change*

of /ɒ/ covers the period from the middle of the 14th century to the late 15th century.

**Vowel Harmony**
West Frisian shows several types of both forward and backward Vowel Harmony. Vowel Harmony appears in Old, Middle and early-Modern Frisian. The Vowel Harmony type of a-mutation is found in West Frisian words such as *wėia* <wassa> ("to be") or *dėgan* <dagen> 'days (nom./acc.).' This type is reflected in the spelling of the early 15th century but gradually disappears after 1460. In most instances, the phonetic manifestation of Vowel Harmony is reversed in late-Middle Frisian. For example, early-Modern Frisian *wėse*, is not *wasse*.

### 3. Phonological Interpretation

Most scholars assume that Old and Middle Frisian had only one unstressed phoneme /ə/, written <e, a, i, u>. This assumption is based on a simplified interpretation and ignores diachronic, etymological and positionally defined patterns in the distribution of spelling variations.

Many of the spelling variations match diachronic or dialectal phonetic or allophonic patterns and are therefore not a 'free, random variation'. Historically motivated spellings for a single phoneme /ə/ can be excluded. Spelling by convention (spelling rules) does not match the observed gradual quantitative patterns. Spelling reflects phonetic and allophonic variation in the language. The spelling <i> is a variant of <e> as an unstressed vowel /ə/. The alternation of <e> and <i> reflects the phonetic nature of /ə/ as a rather fronted vowel.

Frisian maintains a vowel opposition in unstressed syllables in protected position until the early 16th century. The existence of two different phonemes in protected, unstressed position is supported by the developments of syncope and Vowel Harmony. The phonological opposition also functions when /a/ is realised as [a]. The realisation of historical /a/ by <a>/[a] is too weak and cannot account for its strict separation from historical /ə/ in the diachronic development of the 15th century. It is suggested that underlying /a/ in the 15th century did not find its expression in the phonetic quality [a], but in a contrasting tone contour on the whole word. In word-final position, the phonological opposition between /a/ and /ə/ is lost by the middle of the 15th century. The prototypical realisations of both phonemes, [a] and [ə], become the optional realisation for the new phoneme.

### 4. Tone contours
Typological parallels for phenomena such as Vowel Balance, Vowel Harmony and the limited application of Open Syllable Lengthening are widely attested in Scandinavian dialects, all of which are from within the zone which has two
contrasting tone contours (Accent I and II) and a relatively late pitch peak on Accent I and II (Level Stress). This suggests a similar accentuation for late mediaeval Frisian.

In Proto-Old Frisian a tone contour originally stretched over the entire length of every polysyllabic word (as was the case with Old Nordic). After the reduction of other full vowels in unstressed position in Old West Frisian to /\(a\)/, the non-root vowel /\(a\)/ was marked with the originally redundant tone contour. This additional tone contour is probably the reason for the large qualitative and quantitative impact an /\(a\)/ had on its phonological surroundings.

**Quantitative impact:**
The cumulative impact of physical and perceptual cues favours the reinterpretation of the root vowel of, for example, *dore* 'door', as being long, and of *dora* 'doors', for example, as being short. The cumulative impact of physical and perceptual stress cues in for example, *môna* 'moon' can elicit a reinterpretation of the root vowel's quantity as being short when placed in additionally shortening contexts, such as the compound *mônandei* 'Monday'. The /\(a\)/ in a non-root syllable, bearing pitch accent was probably not subject to syncope or apocope, because it was *stricto sensu* not unstressed.

**Qualitative impact:**
Vowel Harmony (*a*-mutation) was probably facilitated by the effect of Level Stress. Vowel Harmony developed into a phonological template relying on the tonal contrast (15th century). As pitch is one of the stress cues, a pitch peak is a prerequisite for attracting intensity stress. Some words with /\(a\)/ in the second syllable show accent shift in Old Frisian, such as *snandei* 'Sunday' < *sunnandei*.

Given that south-western dialects show fewer features which are typologically connected with pitch peak delay, it may be assumed that peak delay was weaker here than in the north-east. The phonologisation of tone contours in the 15th century was a break with the past, where tone contours were completely predictable from the word structure. Frisian and Scandinavian dialects share this innovation, as distinct from large West-Germanic languages.

5. **Modelling language change**
In chapter 5, the observed changes in phonological and morphological grammar are modelled. Neither of the two models presented uses common grammatical objects such as 'rules' or 'constraints'.

In the first model the reduction of unstressed vowels in West Frisian between 1300 and 1550 shows a very high correlation with the reconstructed Vowel Intensity
Integrals, a quantitative acoustic measure, of the vowels under consideration. This high correlation provides evidence of a causal relationship between the Vowel Intensity Integral and the reduction process. As deterministic processes rely on causal relationships, this reconstruction supports the hypothesis of the deterministic character of at least some forms of language change.

The model shown in the Bidirectional Table relies on the reductionist components of 'articulatory convenience', 'common practice' and 'effective communication'. The shifting 'grammar', describing the choice of phonological variants for different morphological categories, which is available to speakers, is the dynamic result of the interaction between these three basic components, assuming that the language user is a probabilistic learner. This can be considered to be a form of self-organisation.

Both models support the idea of language as a deterministic, dynamic system, which offers an established framework for the understanding of change. In the concluding remarks, the concept of dynamic systems is linked to evolutionary science. The future application of evolutionary science and its methods to the study of language as a deterministic dynamic system may well produce interesting results at a later date.
Samenvatting

Mechanismen van taalverandering. Klinkerreductie in het Fries van de 15e eeuw.

Dit onderzoek gaat in op het verschijnsel taalverandering en onderzoekt hoe en waarom dat zich voordoet. Het onderzoek bouwt op een analyse van de verzwakking van onbeklemdtoonde klinkers in het Fries van de late middeleeuwen tussen ± 1300 - 1550. Een groot deel van de tekst is gewijd aan de reconstructie van feitelijk dat proces.

1. Inleiding

In hoofdstuk een wordt het historische tekstmateriaal van het Fries geanalyseerd op zijn geschiktheid voor historisch klankonderzoek. Hoofdstuk twee bevat de taalkundige feiten die uit het materiaal gedestilleerd zijn. Ze geven een gedetailleerd beeld van de Friese klankleer gedurende de periode ± 1300 - 1550. In hoofdstuk drie wordt een fonologische interpretatie van de gegevens geboden. De hypothese dat het Fries een toontaal was, wordt in hoofdstuk vier uiteengezet. Hoofdstuk vijf behandelt twee reductionistische modellen van taalverandering.

Twee bronnen zijn gebruikt om het tijdvak tussen 1300 en 1550 af te dekken:

• De codex Unia. Het manuscript is in de late 15e eeuw geschreven, maar is alleen tot ons gekomen in de vorm van een kopie van die tekst uit de 17e eeuw. De taal in de teksten gaat terug tot de tijd van de 14e en de vroege 15e eeuw;
• De ongeveer 1200 oorkonden in het Fries uit de periode 1378 - 1550 en één losse oorkonde uit 1329.

Toetsing van bronnen op geschiktheid voor taalkundige interpretaties


De Westerlauwerse Friese oorkonden zijn geplaatst in de ruimte met behulp van plaatsnamen in de teksten. Deze toponiemenmethode is aangevuld met gegevens over de afkomst van de schrijvers van de teksten voor die gevallen dat de schrijver bekend is. Met behulp van die gegevens zijn historische dialectkaarten van het Westerlauwerse Fries getekend.

Er zijn verschillende redenen om aan te nemen dat de spelling in de originele oorkonden (niet in de kopieën) een willekeurige steekproef vormen uit de taalkundige verschijnselen van die tijd. Spellingvariatie is niet het gevolg van verkeerd of onzorgvuldig spellen. Indien rekening gehouden wordt met ongelijke spreiding van de gegevens in tijd en ruimte is een telling van verschijnselen op basis van losse tokens een betrouwbare en statistisch aantrekkelijke wijze van het meten van de gegevens. Voor de historische analyse zijn bij voorkeur originele oorkonden gebruikt.

Theoretisch kader
Dit onderzoek is voor een deel een zoektocht naar reductionistische onderdelen van taal en naar de wijze waarop die op elkaar inwerken. De uitgangspositie is dat taal een deterministisch, dynamisch systeem is en dat structuren en ‘regels’ (grammatica’) het gevolg zijn van zelforganisatie in het systeem. In dit kader is taal het gevolg van wisselwerking tussen de volgende basale elementen:

- Betekenis / semantiek: de wereld om ons heen en de menselijke waarneming daarvan.
- Articulatie en akoestiek: het hele veld van biologie en natuurkunde dat betrokken is bij het voortbrengen en overbrengen van klanken.
- De biochemische werking van de hersenen die leidt tot de menselijke wijze van waarnemen, bewaren en oproepen van kennis.

2. Reconstructie van historische ontwikkelingen
Klinkerreductie is het hoofdonderwerp van dit onderzoek en leverde de gegevens voor de modellen in hoofdstuk 5. Om klinkerreductie goed te begrijpen zijn de volgende processen onderzocht:

- Vokaalbalans: Oud-Fries [bi'talad] ‘betaald’ ~ [kapad] ‘gekocht’ > laat-Oud-Fries [bi'talat] ~ [kapad]
- Degeminatie: Oud-Fries [seta] ‘zetten’ > Middel-Fries [seta]
- Rekking in open lettergroep: Oud-Fries [dor] ‘deur’ > laat-Oud-Fries [dor]
- Klinkerreductie: Middel-Fries [seta] > vroeg-Modern-Fries [seta]
- Vokaalharmonie: Oud-Fries [ska] ‘zaken’ > laat-Oud-Fries [saka] (of [saka]?).
Vokaalbalans

Degeminatie
Oud-Fries kent een fonetische tegenstelling tussen lange en korte medeklinkers. Informatie over de lengte van medeklinkers kan verkregen worden uit vokaalbalansverschijnselen en spellingsgewoonten. Het totaal van aanwijzingen wijst op een snel verlies van lange medeklinkers tussen ± 1420 en 1460.

Rekking in open lettergreep
Het oudste stadium van rekking in open lettergreep is de rekking van /a/, /ɔ/, /i/ and /u/, als de volgende onbeklemtoonde klinker niet een /a/ was. Deze rekking vond plaats aan het begin van de 14e eeuw. Rekking van /e/ is een beperkt verschijnsel in dezelfde tijd als de apocope van woordfinale /a/, in het midden van de 15e eeuw.


Klinkerreductie
De gedekte /a/ wordt verzwakt tot [ə] in de eerste helft van de 15e eeuw. Als de voorafgaande stam lang is, vindt de verzwakking eerder plaats (< 1430) dan wanneer de stam kort is (< 1470). Dit is het vokaalbalanseffect. In woordinterne positie, zoals in abbate ‘abt’ en mnnandei ‘zondag’, blijft de /a/ in het noordoosten langer bewaard dan in het zuidwesten. Een woordfinale /a/ blijft ongewijzigd tot ± 1490. Ook hier is sprake van een vokaalbalanseffect met een latere overgang naar [ɔ] na korte stamlettergrepen. De overgang van [a] > [ɔ] is in het zuiden later voltooid dan in het noorden.
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Syncope van /ə/ in onbeklemtoonde lettergrepen is een geleidelijk proces in het Fries en strekt zich uit van de 12e tot de 16e eeuw. De syncope van /ə/ wordt vertraagd of zelfs voorkomen door zaken als een korte stamlettergreepe, een positie dichtbij het einde van het woord, stemhebbende naburige medeklinkers en welgevormdheidseisen (uitspreekbaarheid). De apocope van een woordfinale /ə/ wordt bepaald door (tenminste) drie factoren: vokaalbalans, fonologische stem van naburige medeklinkers en morfologische patronen (/ə/ als uitgang). De apocope van /ə/ beslaat de periode van het midden van de 14e eeuw tot de late 15e eeuw.

Vokaalharmonie


3. Fonologische interpretatie

De meeste taalkundigen nemen aan dat het Oud- en Middel-Fries alleen de klinker /ə/ kenden in onbeklemtoonde lettergrepen, gespeld als <e, i, u>. Die aanname is terug te voeren op een versimpelde interpretatie van de feiten en negeert diachrone, etymologische en positioneel bepaalde patronen in de spellingvariatie.

Veel van de waargenomen spellingvariatie is terug te voeren op diachrone of dialectale fonetische of allofone patronen en kan zeker niet als ‘vrije’ of ‘willekeurige’ variatie bestempeld worden. Historiserende spellings voor een enkel fonem /ə/ zijn uitgesloten. Spelling volgens traditie (spellingsregels) komt niet overeen met de waargenomen graduele kwantitatieve patronen. De spelling weerspiegelt fonetische en allofone variatie in de taal. De spelling <i> is een variant van <e> als een onbeklemtoonde klinker /ə/. De wisseling van <e> en <i> weerspiegelt het fonetische karakter van /ə/ als een enigszins gesloten, voorlijke, ongeronde klinker.

Het Fries kent klinkercontrasten in onbeklemtoonde lettergrepen in gedekte positie tot in het begin van de 16e eeuw. Het bestaan van twee verschillende fonemen in gedekte, onbeklemtoonde positie wordt ondersteund door de ontwikkelingen van syncope en vokaalharmonie. De fonologische oppositie werkt ook als /ə/ als [ə] gerealiseerd wordt. De realisatie van de historische /ə/ als /ə/ in de 15e eeuw is te incidenteel om verantwoordelijke gehouden te kunnen worden voor de strikte scheidings van de historische /ə/ in het diachrone verloop. Het vermoeden wordt
geuit dat de onderliggende /a/ in de 15e eeuw niet uitgedrukt werd door de fonetische kwaliteit [a], maar in een contrasterende tooncontour op het hele woord. In woordfinale positie gaat het fonologisch contrast tussen /a/ en /o/ verloren in het midden van de 15e eeuw. De prototypische realisaties van beide fonemen, [a] and [o], worden dan optionele realisaties van het nieuwe fonem.

4. Tooncontouren
Typologische parallellen voor verschijnselen als vokalbalans, vokalharmonie en de beperkte doorvoering van de rekking in open lettergref zijn in verschillende Scandinavische dialecten voorhanden, die zich allemaal bevinden binnen het gebied waar twee verschillende tooncontouren worden onderscheiden en waar Accent I en II een relatief late toonpick hebben (level stress). Dit suggereert een soortgelijke accentuering in het laat-middeleeuwse Fries.

In het Proto-Oud-Fries strekt een toon contour zich oorspronkelijk uit over de hele lengte van ieder meerlettergrepig woord, met de piek ongeveer in het midden (net als in het Oud-Noors). Na de reductie in het Oud-Fries van alle andere volle klinkers in onbeklemtoonde positie tot /o/ behalve de /a/, wordt die /a/ als hij niet in de stam staat, gemarkeerd door de oorspronkelijk redundante tooncontour. Deze bijzondere tooncontour is de mogelijke verklaring voor de grote kwalitatieve en kwantitatieve invloed die de /a/ op zijn fonologische omgeving had.

**Kwantitatieve invloed**
De cumulatieve invloed van fysieke en perceptionele signalen suggereert een (re)interpretatie van de stamklinker in een woord als *dore* ‘deur’ als zijnde lang, en van een woord als *dora* ‘deuren’ als zijnde kort. De cumulatieve invloed van fysieke en perceptionele signalen in bijvoorbeeld *môna* ‘maan’ kan een reinterpretatie van de lengte van de stamklinker ontkennen als zijnde kort, wanneer het woord in een context staat waar het extra verkort wordt, zoals in de samenstelling *mônandei* ‘maandag’. Een /a/ die niet in de stamlettergrep staat, maar gemarkeerd is met een toonpick, wordt waarschijnlijk niet het voorwerp van syncope of apocope omdat het *stricto sensu* niet onbeklemtoond is.

**Kwalitatieve invloed**
Vokaalharmonie (a-umlaut) wordt waarschijnlijk bevorderd door level stress. Vokaalharmonie ontwikkelt zich tot een fonologische mal die gesteund wordt door het tooncontrast (15e eeuw). Een toonpick is één van de kenmerken van klemtoon en is daarom een voorwaarde om intensiteitsaccent aan te kunnen trekken. Een aantal woorden met /a/ in de tweede lettergref vertoont accentverspringing in het Oud-Fries, zoals *smegze* ‘zondag’ < *sunandei*.
Gegeven het feit dat zuidwestelijke dialecten veel minder verschijnselen vertonen die typologisch met een late toonpiek in het woord verbonden zijn, ligt de veronderstelling voor de hand dat de toonpiekverschuiving daar zwakker is dan in het noordoosten. De fonologisering van de tooncontouren in de 15e eeuw is een breuk met het verleden, waarin tooncontouren volledig voorspelbaar zijn aan de hand van de woordstructuur. Friese en Scandinavische dialecten delen die vernieuwing en onderscheiden zich daarmee van de grote Westgermanse talen.

5. Modellering van taalverandering

In hoofdstuk 5 worden de waargenomen veranderingen in de fonologische morfologische grammatika gemodelleerd. Geen van beide getoonde modellen gebruikt grammaticale noties als ‘regels’ of ‘constraints’.

Het eerste model toont een hoge correlatie tussen de gereconstrueerde integraal van de klinkerintensiteit - een kwantitatieve akoestische maat - aan de ene kant en de reductie van onbeklemtoonde klinkers in het Westerlauwerse Fries tussen 1300 and 1550 aan de andere kant. De hoge correlatie levert een aanwijzing voor een causale relatie tussen de integraal van de klinkerintensiteit en het reductieproces. Omdat deterministische processen bestaan op basis van causale relaties, ondersteunt deze reconstructie de hypothese van het deterministische karakter van ten minst bepaalde vormen van taalverandering.

Het model dat verwerkt is in de vorm van de bidirectionele tabellen is gebaseerd op de reductionistische componenten van ‘sprekgemak’, ‘gangbare praktijk’ en ‘doelmatige communicatie’. De verschuifende ‘grammatica’s’, die de keuze tussen de beschikbare fonologische varianten voor de verschillende morfologische categorieën aangeven, zijn het dynamische resultaat van de wisselwerking tussen de drie basiscomponenten, ervan uitgaande dat de taalgebruiker probabilistische leert. Dit kan beschouwd worden als een vorm van zelforganisatie.

Beide modellen ondersteunen het idee van taal als een deterministisch, dynamisch systeem, dat daarmee een uitgewerkt kader kan bieden voor het begrijpen van het fenomeen taalverandering. In de slotbeschouwing wordt een verband gelegd tussen dynamische systemen en evolutionaire wetenschappen. De toekomstige toepassing van evolutionaire wetenschappen en hun methoden op het onderzoek van taal als een deterministisch, dynamisch systeem kan in de toekomst mogelijk tot interessante uitkomsten leiden.
The language designation (West) Frisian is not included. It is the study’s main topic. The same holds for the word phonology. Old and Middle Frisian words are cited in a normalised Old West Frisian form. Examples from other languages are unmarked. Word references in chapter 5 are not exhaustive.

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Arjen Pieter Versloot was born in Schiedam, in the Netherlands, in 1965. After completing Gymnasium in 1983, he went on to study physical geography, with special emphasis on cartography, completing his Master’s degree at the University of Utrecht in 1987. It was here that, in the same year, Versloot also gained a Bachelor’s degree in German and studied aspects of Old Germanic. This led him on to his second Master’s degree in 1989, in Frisian Language and Literature, with emphasis on historical linguistics, from the University of Groningen. Study visits to the universities of Marburg (Germany, 1987), Odense (Denmark, 1989) and Reykjavik (Iceland, 1989/90) further broadened his horizons and deepened an interest in historical linguistics.


In 1993 Versloot joined the Fryske Akademie, where his tasks have included the preparation of a text edition of 19th century language material from the East Frisian island of Wangerooge, enhancing the Frisian spell checker, and transcribing dialect interviews for the Morphological and Phonological Atlas of Dutch and Frisian dialects (MAND).

Preparations for this thesis began in 2000, at a time when Versloot was working intensively on the construction and enrichment of the Frisian Language Database. This study builds on those activities. In 2006, work began in earnest on the writing of this thesis. Whilst it reinforces a long-held affinity with historical linguistics, it has also triggered a growing interest in more fundamental linguistic questions, potentially initiating a new phase in Versloot’s research.