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 /o/ in all (unstressed) positions and /u/ in the dative plural ending -um only. The /o/ had a fairly fronted unrounded realisation, something close to an [ɛ] or an [ɨ] 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 bitalita: <bitalat>, than in the corresponding form of the long-rooted verb kâpia: <kaepit>. However, it never grew into the consistently applied morphological contrast of /at/ versus /at/. Also, the ‘Seesaw’ Vowel Harmony, for example <bitellet> versus <bittellet> 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’ <wassen> from Old Frisian wesane.

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 /ä/-/a/, but this has not been investigated or tested by modelling. For example, the gerund of ‘to be’ was phonetically [va=o=n] or [va=s=on], where the late pitch peak marked the Vowel Harmony template and prevented syncope of the [a].

The a-mutation template was gradually lost after 1460. Even without Vowel Harmony, the pitch accent in the gerund <wessen> [væs=on] marked the contrast with the past participle <wessen> [vés=on]. 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 [a] before (some) lengthening could take place, as can be seen with the word <naema> *[næ.ma] ‘name’ from OFO I-307 (1481) or <boeda> *[bœ.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.¹⁶³

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 (§ 5.1). The functional load of the vowels could cause a non-linear tendency, as illustrated in § 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 habbe/ habba case (§ 5.2.3) and the seke/ seka/ seken case (§ 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. § 1.2.5 and 1.4).

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 § 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,

¹⁶³ Testing with the Bidirectional Table from § 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.
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 structuralist 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’ produces the continuously changing mini-grammars which describe the choice between the different endings of the verb habba and the noun 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 grammar, appear as the result of self-organisation of the system. 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:

---

164 Cf. § 1.4 for references to Chomsky e.a. concerning these items.

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 Faculty of Language Broad. 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[arrow].” (Hauser, Chomsky & Fitch 2002, 1574; italics by this author).
A.P. Versloot: *Mechanisms of Language Change*

- 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.

---

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* ‘you (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 endurable 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;
a clarification of Hauser, Chomsky & Fitch 2002, already being explicitly evolutionary). Pinker, himself an explicit generativist\textsuperscript{168}, acknowledges the importance of evolution in the growth of human language ability (Pinker 1994, 243).\textsuperscript{169} Also, to understand language change and language diversification, Pinker refers to evolutionary processes (idem, 241-242): “Differences among languages, like differences among species, are the effects of three processes acting over long spans of time. [...] variation - mutation, [...] heridity, [...] isolation [...]”.

What may be new in this presentation of the data is that it attempts to extend the evolutionary process to how grammar evolves in speech communities, as well as to the individuals who make up these communities. It is acknowledged that the sum of all physical and mental abilities used in the production and perception of language constitute a human-specific language ability (cf. the broad Faculty of Language (FLB) in Chomsky & Fitch 2002, 1570). The opinion of empiricists, who argue there is no need to assume any inborn grammatical structures, is also considered a valid one. The null-hypothesis presented here for future research is that the observed linguistic structures are the result of self-organisation following on from the interaction of basic components of acoustics, general cognitive abilities / memory formation and the desire to express real-world events (semantics). Grammar (structures and patterns in human language utterances) has no explanatory power by itself, but should be the object of a reductionistic analysis, or at least always be deducible from its basis components.\textsuperscript{170} These grammatical

\begin{flushright}
\textsuperscript{168} 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 [...].”
\end{flushright}

\begin{flushright}
\textsuperscript{169} “[...] evolution, having made the basic computational units of language innate, [...]”
\end{flushright}

\begin{flushright}
\textsuperscript{170} The opposite direction of causality is claimed by Jackendoff & Pinker (2005, 213): “[...] the existence of phonological rules that ease articulation,[... ]” (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.”
\end{flushright}

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.  

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.

---

171 There remains a clear difference with generative grammar in any form, cf.: “[faculty of ] L[anguage] N[arrow] takes a finite set of elements and yields a potentially infinite array of discrete expressions.” (Hauser, Chomsky & Fitch 2002, 1571); or Pinker & Jackendoff (2005, 210) about phonology: “Speech segments are drawn from a finite repertoire of phonemes, each defined by a set of 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).