A Multivariate Analysis of Morphological Variation in Plural Inflection in North Sea Germanic Languages

Arjen P. Versloot, University of Amsterdam
Elżbieta Adamczyk, University of Wuppertal & Adam Mickiewicz University, Poznań

Abstract
The present study explores the variation in the plural inflection of eight varieties of Frisian and English, focusing on the irregular plural formations. The aim of the study is to identify and assess the significance of the factors which contributed to the preservation and emergence of irregular plural patterns in the investigated varieties. Multivariate regression analysis, which was employed to weigh the significance of individual factors, reveals that the retention and emergence of irregular plural patterns is determined by a combination of three major factors: relative frequency, absolute frequency and salience. The factors that emerge from our analysis as being statistically relevant can be reduced to underlying cognitive processes, including the storage and retrieval of linguistic information in the human brain.

1. Introduction
The focus of the present study is on the diachronic development of irregular plural formations in the two representatives of the North Sea Germanic branch, i.e. English and Frisian.¹ These

¹ The concept of ‘(ir)regularity’ can be defined in a number of different ways, often depending on the theoretical framework adopted. It has been often associated and analysed with reference to terms such as ‘productivity’, ‘type frequency’, ‘rule based’, or ‘default’. In our study the association with type frequency is the most prominent and accordingly ‘irregular plural patterns’ can be best defined as plural patterns with a low type frequency. At the same time, we do not take any stance with respect to the theoretical implications that different definitions of ‘(ir)regularity’ may have. For a recent discussion of irregularity and its relation to the other concepts, see, e.g., Stolz et al. (2012), Gardani (2013), Strik (2015: 13-24).
irregularities are partly vestiges of once regular inflectional patterns, partly a result of more recent phonological or lexical developments. The Old Germanic languages were characterised by a wide range of plural formation patterns, inherited from the Proto-Indo-European inflectional system and subsequently reshaped in Proto-Germanic. These plural formation patterns have their source in the historical inflectional classes, originally organised on etymological grounds, i.e. according to the stem-type criterion. The existing diversity of declensional classes which can be found in individual Old Germanic languages (e.g. a-stems, s-stems, n-stems, root nouns) is reflected in a varied inventory of plural morphemes whose distribution was highly lexical in the earliest attested stage of Germanic (i.e. the pattern of inflection was not predictable from the nominative sg.) (e.g. OE dag – dagas ‘day(s)’ (a-stem), OE cynn – cynn ‘race’ (ja-stem), OE cealf – cealfru (s-stem) ‘calf/calves’, OE fōt – fēt (root noun) ‘foot, feet’). While some of them continue as the productive patterns of forming the plural in present-day English and Frisian (-es, -en), others are only sporadically retained as vestiges of the historical plurality markers. Already at the earliest stage of attestation of Germanic languages their declensional systems were undergoing a gradual process of reorganisation, induced by an interplay of phonological and morphological developments, including phonological reduction and analogical levelling. These tendencies led gradually to a confusion and merger of class-specific inflectional markers in individual Germanic languages and dialects, and contributed to a reduction in the diversity of the inherited inflectional exponents, including those marking specifically the plural (for Old English see, e.g., Kastovsky 1995, 1997, Hogg & Fulk 2011, Adamczyk 2010, 2013, 2014). With time, the distribution of plural markers tended to become increasingly phonologically- and gender-guided (as was the case with the masculine nouns in -e in Middle Dutch which became feminine, in contrast to feminine nouns ending in a consonant which became masculine (Van Loey 1976: 19, 23)), or semantically-guided (as in the case of the s-stems, representing predominantly agrarian

The emergence of the system of stem-type inflection in Old Germanic was a relatively recent development, resulting from a fairly uniform inventory of inflectional endings in Proto-Indo European (Ringe 2006: 269, 272, 279–280). Most of the phonological processes, such as mutation, gemination, monophthongisation, apocope and syncope, which had their share in the emergence of the varied set of fused inflectional endings, did not take place earlier than between 300 and 700 AD (Nielsen 2000: 289). The complex interaction between phonology and morphology eventually determined the shape and the dynamics of the changes in the nominal system, including the plural inflection. More specifically, the changes in the phonological system functioned as the catalyst of morphological restructuring, and the later process of analogical levelling must be seen as a natural response of the language users to the changing phonological constellation (Paul 1920: 198, Versloot 2008: 78, 276–294). While the paradigms of most of the nouns affiliated with minor (unproductive) classes were exposed to extensive analogical reshaping, triggered by changes in their phonological shape and resulting in transfers to other declensional types, some tended to escape this widespread tendency, retaining the historical inflectional pattern until the present-day.

As language history shows, alongside the irregularities whose origin can be sought in the historical inflection, new morphological patterns, comprising limited sets of lexical items and lexically idiosyncratic formations, tend to emerge. Both English and, in particular, the dialects of Frisian abound in such formations which, from the synchronic perspective, form new

2 For a discussion of the interaction between declensional class and gender in Germanic languages see Kürschner (2008).
inflectional irregularities (entailing, e.g., suppletion or phonological alternations). The focus of the present study is on both - the inherited and novel inflectional irregularities as attested in the diachronic and dialectal varieties of English and Frisian.

The shape of the nominal inflection as it is known now in present-day English and Frisian results from the activity of several factors of diverse nature (e.g. Kastovsky 1997; Kürschner 2008; Dammel, Kürschner & Nübling 2010). The complex interaction between them was an essential part of the mechanism underlying the restructuring of the early Germanic (plural) inflection. The aim of the present study is to identify and assess the significance of the factors which contributed to the preservation and emergence of irregular plural patterns in North Sea Germanic languages. The interplay of these conditioning factors could potentially result in three paths of development of plural forms, whereby a noun could (1) preserve the historically-developed plural form, (2) become regular, fitting into the prevailing pattern of plural formation, or (3) develop a new irregular form. The present investigation consists in two stages, including, firstly, the identification of individual irregular plural formation patterns in several dialects belonging to the North Sea Germanic group, and secondly, applying a multivariate analysis to estimate the weight of the individual factors contributing to the preservation and emergence of irregular plurals. As a substantial number of irregular patterns found in present-day varieties of Germanic can be traced back to the earlier historical stages, an investigation into the historical shape of inflection constitutes the starting point for the quantitative study.

The North Sea Germanic languages were selected as the testing ground for the analysis, since they depart from a relatively late common starting point; in other words, Old English and reconstructed Proto-Frisian of ca. 900 were (nearly) identical with respect to (relevant here) inflectional morphology until a relatively late stage of development (compare the juxtaposed paradigms of Old Frisian and Old English nominal inflection in Steller 1928: 36–45; also
The underlying tendencies which caused the (re)grouping of the plural marking patterns and whose origin is to be sought in the Old Germanic period were so persistent that even 16th century English and Frisian, having drifted apart for more than 500 years by then, show a highly similar inventory of nouns with irregular plural forms. In the subsequent 500 years, these North Sea Germanic dialects follow essentially divergent paths of development. In English, the stock of nouns with irregular plurals has been highly resilient to generalisation of the productive plurality patterns, and new nouns have been added to the group by semantic analogy only occasionally (e.g. fish, which follows the endingless neuter plural pattern despite its original affiliation with the masculine a-stems). The dialects of Frisian testify to a much greater diversity in this respect, and, accordingly, some varieties, such as West Frisian, witness a gradual reduction in the number of historical irregular plurals, occasionally “compensated” by the emergence of new irregular patterns; whereas others, such as the North Frisian dialect of Amrum and Föhr, testify to a considerable resistance to inflectional innovations. These divergent patterns need to be attributed to language-specific (or dialect-specific) circumstances which will be subjected to a closer inspection in the course of the investigation. In a broader perspective, the findings from the present research can hopefully make a contribution to the general study of the underlying mechanisms of morphological change.

The present paper is organised in the following way: Section 2 is devoted to an overview of irregular plural formations in the investigated varieties and a discussion of a range of factors potentially determining the shape of the plural forms. Section 3 focuses on methodological considerations and characteristics of the corpus used in the study: the selection of the linguistic material used for testing is accounted for, followed by a discussion of the statistical

<table>
<thead>
<tr>
<th>OE/OFris. (Riustringen) u-stem sunu</th>
<th>OE/OFris. root noun fōt</th>
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</thead>
<tbody>
<tr>
<td>N.A. sunu</td>
<td>N.A. fōt</td>
</tr>
<tr>
<td>G. suna</td>
<td>G. fōes</td>
</tr>
<tr>
<td>D. suna</td>
<td>D. OE fōt, OFris. fōte</td>
</tr>
<tr>
<td></td>
<td>D. OE fōt, OFris. fōtum</td>
</tr>
</tbody>
</table>
methodology applied in the study; also the factors which were considered crucial for the preservation and the emergence of irregular plurals are operationalised. Section 4 presents the results of the investigation, including the findings from the examination of the plural formation patterns in minor declensional classes in the earliest attested stages of English and Frisian (4.1), as well as the results of the statistical tests for various data configurations in the selected modern English and Frisian varieties, including both historical and novel irregular plural forms (4.2). The focus of Section 5 is on the theoretical implications of the findings, and finally, the argumentation is completed with a conclusion.

2. State of the art

2.1 The origin of present-day irregular plurals

The regular endings of nouns in present-day varieties of West Germanic can be traced back to the Proto-Germanic declensional classes of a-stems and n-stems. The a-stems are the source of the Modern English and Scots plural ending -(e)s, such as days < OE dagas. Likewise, the North Frisian ending -er of masculine nouns is rooted in the same declensional class, e.g. fasker ‘fish (pl.)’ < OFris. fiskar. The dominant plural ending -en in West Frisian developed from earlier -an, which was possibly a contamination of the ambiguous ending -a from the Old Frisian n-stems and the less ambiguous Middle Dutch morpheme -en from the same class (cf. Bremmer 2009: 60). Occasionally some varieties, such as the Schiermonnikoog dialect, still retain a distinct feminine inflection, being a continuation of the old feminine ē-stem patern, e.g. dare < OFris. dora ‘doors’.

The present-day irregular plurals are predominantly vestiges of historically minor and unproductive declensional types, including: i-stems, u-stems, root nouns, r-stems (kinship

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4 The class of i-stems can be viewed as unproductive only from the Anglo-Frisian perspective; the closely related
terms), s-stems and nd-stems (nomina agentis). The widespread presence of analogical
inflections in the minor paradigm, extended from the productive patterns (a-stems, ō-stems and
n-stems), can be observed already in the Old English and Old Frisian stages. As the inflections
of i-stems and nd-stems have not left any traces in modern irregular plural forms, these classes
were taken into account only in the examination of the earliest stages of attestation of English
and Frisian. The plural forms in these minor declensions were often typified by the presence of
allomorphic variation, i.e. the mutated vowels in the nominative and accusative pl.
Additionally, minor declensions are characterised by a specific quantitative profile: although
they are not very large classes, many of the nouns affiliated with them show a high (token)
frequency of occurrence/use. Some examples of such historically-defined irregular plural forms
found in Modern English, Scots and Frisian are presented in Table 1, alongside their
corresponding forms in Old English and Old Frisian.

Ingvaeonic Old Saxon testifies to a wide spread of i-stem inflections in the minor stem paradigms and to a steadily
growing productivity of this class. The historical class affiliation of nouns stays in compliance with the information
found in standard historical handbooks and dictionaries. The complete inventory of lemmas is provided in the
Appendix.
Table 1. The irregular plurals continuing the historical inflectional patterns in modern varieties of English and Frisian\(^5\)

<table>
<thead>
<tr>
<th>Historical class affiliation</th>
<th>Old English/Old Frisian</th>
<th>Mod. English, Mod. Frisian</th>
</tr>
</thead>
<tbody>
<tr>
<td>root noun</td>
<td>OE brōc : brēc ‘trousers’</td>
<td>E. breeches</td>
</tr>
<tr>
<td>root noun</td>
<td>OFris. gōs: gēs ‘goose’</td>
<td>NFris. gus – ges</td>
</tr>
<tr>
<td>root noun</td>
<td>OE lūs: līs ‘louse’</td>
<td>E. louse: lice</td>
</tr>
<tr>
<td>root noun</td>
<td>OE mūs: mīs ‘mouse’</td>
<td>E. mouse: mice</td>
</tr>
<tr>
<td>u-stem</td>
<td>OFris. lith: litha ‘limb, member’</td>
<td>WFris. lid – lea</td>
</tr>
<tr>
<td>s-stem</td>
<td>OE cild: cildru ‘child’</td>
<td>Scots child – childer</td>
</tr>
<tr>
<td>s-stem</td>
<td>OFris. clāth: clāthar ‘cloth/clothes’</td>
<td>NFris. [kleet] – kluaser</td>
</tr>
<tr>
<td>s-stem</td>
<td>OE Æg: Ægru ‘egg’</td>
<td>NFris. ai – aier</td>
</tr>
<tr>
<td>s-stem</td>
<td>OE cealf: cealfru ‘calf’</td>
<td>Scots calf – cair</td>
</tr>
<tr>
<td>s-stem</td>
<td>OE lomb: lombor ‘lamb’</td>
<td>NFris. lum – lumer</td>
</tr>
</tbody>
</table>

Being relics of the minor historical patterns, these present-day irregularities are idiosyncratic and entirely lexicalised. In Old English and Old Frisian these plural formations contained substantially more nouns than the few isolated forms found in the modern varieties (cf. root nouns with 26 lemmas in Old English vs. 6 lemmas in present-day English). As many of the nouns affiliated with the minor classes were high frequent lemmas, these minor patterns of forming the plural could still be relatively easily recognisable in the language.

Aside from irregularities which must be ascribed to an early historical development, all investigated modern varieties attest to a range of inflectional innovations whose origin must be traced back to a later stage. Analysing the inventory of historical lemmas and tracing their development to modern times allowed identifying a number of lemmas with irregular (from the present-day perspective) plural forms which did not represent a continuation of the Old English

\(^5\) The following abbreviations were used in Table 1 and 2: E.= English, EFris.= East Frisian, WFris.= West Frisian, NFris.= North Frisian, infl.= inflectional.
or Old Frisian plural formation patterns. These novel irregularities often have an indirect lineage to the minor paradigms of Old English and Old Frisian, being further modifications of the historical patterns, frequently involving mechanisms such as vocalic alternations or suppletion. Table 2 presents selected instances of such irregular plural formations, including their relation to the historical classes.

<table>
<thead>
<tr>
<th>Historical class affiliation</th>
<th>Present-day variation</th>
<th>Type of plurality marking</th>
</tr>
</thead>
<tbody>
<tr>
<td>$u$-stem</td>
<td>WFri. <em>soan</em> : <em>soannen</em> ‘son’ [o.ə] ~ [wa]</td>
<td>vowel alternation + infl. ending</td>
</tr>
<tr>
<td>$r$-stem</td>
<td>Scots <em>brother</em> : <em>brether</em></td>
<td>analogical $i$-mutation</td>
</tr>
<tr>
<td>$r$-stem</td>
<td>E. <em>brother</em> : <em>brethren</em></td>
<td>analogical $i$-mutation + new infl. ending</td>
</tr>
<tr>
<td>$r$-stem</td>
<td>E. <em>cloth</em> : <em>clothes</em> (vs. <em>cloths</em>)</td>
<td>vowel alternation + infl. ending</td>
</tr>
<tr>
<td>root noun</td>
<td>WFri. <em>foet</em> : <em>fuotten</em> ‘foot’</td>
<td>vowel alternation+ infl. ending</td>
</tr>
<tr>
<td>root noun</td>
<td>WFri. <em>man</em> : <em>manlu</em></td>
<td>partial suppletion</td>
</tr>
<tr>
<td>$a$-stem (n.)</td>
<td>WFri. <em>bern</em> : <em>bernh</em> ‘child’</td>
<td>zero ending</td>
</tr>
<tr>
<td>root noun</td>
<td>EFri. <em>ku</em> : <em>bäiste</em> ‘cow’</td>
<td>suppletion</td>
</tr>
</tbody>
</table>

Table 2. Examples of irregular plurals which do not continue the old inflectional patterns in modern varieties of English and Frisian

The new irregularities often involve a combination of the historical inflection (e.g. $i$-mutated vowel, $r$-formative) and a novel dominant (productive) ending (e.g. *child* : *children*). The emergence of these new irregular patterns was motivated by a number of circumstances and factors, to some extent, overlapping with those responsible for the retention of the historical inflectional patterns (cf. section 4.2.2).
2.2 Controlling factors

The central aim of the present study, as declared in the introduction, is to identify and estimate the significance of the factors which determined the preservation and emergence of irregular plural patterns in North Sea Germanic languages. The factors which will be examined in order to account for the attested plurality patterns were referred to in a number of earlier studies, including, among others, Tiersma (1982), Bybee (1985), Diessel (2007), Dammel, Kürschner & Nübling (2010), Carroll, Svare & Salmons (2012). It is not the intention of our study to refine or extend the list of factors explored in the mentioned studies, but rather to specify which of them have the most significant bearing on the dynamics of the inflectional system in the investigated varieties. The factors are introduced here in a largely random order and their relative importance will follow from the statistical analyses. The following determinants have been considered relevant for the development of the plurality patterns in the investigated languages:

(a) Frequency of occurrence/use. The role of frequency in morphological change has been defined as a “conserving factor”, i.e. high frequency is believed to add to the conservation of irregular morphology (Greenberg 1966, Bybee 1985, Bybee & Hopper 2001). In our cross-linguistic comparison, its impact is still far from being unambiguous and the two languages testify to divergent effects of its activity. In English, frequency of occurrence can be invoked to explain the fact that over the centuries English has hardly eliminated the limited inventory of irregular plural formations. In turn, in West Frisian frequency merely defines the chronological order of levelling of lexemes with irregular plurals, but it does not inhibit the process in the way that it does in English. Another manifestation of frequency effect is found in the multiple high frequent nouns which lose their inherited plural form and replace it by another irregularity, e.g. West Frisian man - †man > man – manlju instead of the expected regularised *mannen.
(b) *The phonological salience of plural markers.* Phonological salience is defined here in terms of acoustic weight: a Ø-ending is less salient than a vowel, which in turn is less salient than a VC-ending (Goldschneider and DeKeyser 2001: 22-23). Nouns with overt plural markers turned out to be more resistant to analogical levelling in Old English and Old Frisian than equally frequent nouns with a Ø-plural (see section 4.1).

(c) *Morpho-phonological complexity of plural marking.* The complexity hierarchy of morphological marking (Corbett et al. 2001: 212-214; Dammel & Kürschner 2008: 248-256) is amply documented in the investigated languages. The types of plural formation attested in the investigated varieties can be ordered on the scale of complexity (from high to low) as follows: (partial) lexical suppletion (East Frisian *ku – bäiste*, West Frisian *man – manlju*), consonantal root allomorphy (OE *brōc /broːkl – brēc /breːʃl*), vocalic root allomorphy (*i*-mutation), suffixation (cf. Table 1 and 2 and (b) above). While complexity may be expected to induce simplification, the investigated material indicates that it may also contribute to the retention of morphological irregularity on account of the salience of such irregular plural formations. We therefore combined the phonological salience of the ending and its morpho-phonological complexity into one ordered scale of perceptional salience (Goldschneider & DeKeyser 2001, cf. Berman 2003: 275), ranging from Ø-ending through vocalic ending, consonantal ending to root-alternation.6 Suppletion was not found in the analysed Old English and Old Frisian data and accordingly it does not appear among the independent variables in the present study.

(d) *The interaction of irregular forms with the default (productive) plural markers.* This

6 Bybee (1995) shows that root alternation is not necessarily more difficult to acquire than affixation, which may be used as an argument against the proposed scale of morpho-phonological salience. However, in the context of Germanic languages, where root vowel or consonant alternation is phonologically distinctive, morphologically unpredictable, and is rather used to distinguish different lemmas, root alternation is highly marked and comes close to suppletion. Cf. *goose – geese* vs. *boost – beast*, *mouse – mice* vs. *spouse – spice*. 

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interaction may be expressed in various ways. In English, the formation of an irregular plural in a noun such as fish is most likely triggered by a combination of phonological and semantic factors: a phonological sibilant-sibilant clash (*fish-es, *goose-s: push factor), resulting from the attachment of the regular -es ending, combined with the semantic content (i.e. animal designation) (pull factor).7 In various East and North Frisian dialects, the retention of the -er marker pertinent to the historical s-stems, was enhanced by the presence of an identical -er ending (of a different origin) in the masculine a-stems. In both cases, the interaction between the competing markers had some bearing on the introduction or retention of an irregular plural pattern.

(e) Prosody. Most of the nouns showing irregular plural forms are monosyllabic, both in English and Frisian, which implies that the syllable count may be a relevant feature. Accordingly, the number of syllables was included as one of the independent variables in the statistical analysis. Even if this factor is likely to correlate with the salience of inflectional marker in this group of nouns, this correlation cannot be generalised to all monosyllabic plurals (cf. monosyllabic plurals of the type deer or, very regular, dogs).

(f) Semantics. Many declensional classes show a clustering of semantically related items, such as the r-stems, denoting kinship terms, or the s-stems, representing predominantly agrarian vocabulary, including animals and other livestock.

(g) Gender. Gender is a factor which can potentially play a significant role in the reorganisation of any nominal system, which can be very well illustrated by the developments in the history of German. However, this factor was not considered relevant for the present study for three major reasons: (1) most of the minor classes comprised

7 The terminology seems justified given that the changes in phonology are considered to have been the primary incentive for the morphological developments. The semantics is accordingly interpreted as a secondary factor, enhancing the activity of the phonological one.
nouns of different genders, and thus no direct relation existed between a specific inflectional pattern and gender; (2) although gender played a significant role in determining the direction of analogical transfers of nouns to regular inflectional classes in the earlier stages of the development of English and Frisian, its function in the preservation of the archaic forms was very limited in these languages; 3) the limited role of gender in the later stages of Frisian and English, where no relation between gender, as far as it is still present, and the choice of a plural ending exists.

(h) *Language contact.* The contact between closely related languages may potentially work as a factor facilitating the changes in morphology. All dialects of Frisian have been exposed to extensive language contact for several centuries. West Frisian has been in direct and intense contact with Dutch which retains no irregular plurals of the type found in Old Frisian, while North and East Frisian have been in close contact with Low German and Danish, both characterised by similar irregular and multiple plural formations. Also English has been exposed to intense language contact with Celtic, Norse and French. The aspect of language contact was not included in the model for two reasons; firstly, as both languages experienced fairly intense contact situations over the centuries, it was not expected to be a distinctive feature across the analysed varieties, and secondly, the quantification of a variable as complex as language contact poses many methodological questions.

An interaction of all these factors is expected to have exerted considerable influence on the changes in the inflectional system. Given the potential statistical correlations between them, some of the observed interactions may be instances of confounders (i.e. epiphenomenal in nature), which in a combined statistical model turn out to have no impact. The following two examples illustrate the complexity of the potential interactions:
(a) Irregular plurals are the result of historical phonological developments and therefore by
definition are relatively old. The older the noun/word, the greater the likelihood that its length
was over time reduced by historical reduction processes (apocope). Both irregularity and
prosodic structure can be a result of a word’s age. This implies that if we find a correlation
between irregularity and prosodic structure, it may be a confounder effect of age of the
noun/word, which is itself not tested as a factor for irregularity. A typical example are the strong
verbs in Germanic, continuing the PIE verb formation patterns, whose preterite and participle
forms are shorter and more irregular than their corresponding forms in the younger and regular
weak verbs, e.g. *drink – drank vs. blink – blinked*.

(b) The effect of the influence of semantics is often difficult to distinguish from frequency
effects. For instance, a number of nouns denoting body parts are used predominantly in the
plural (e.g. *feet, teeth*). Given the fact that absolute and relative frequencies of occurrence of
forms have a direct impact on the development and preservation of irregularity, these nouns,
which are more often used in the plural, tend to retain the irregular plural pattern. Accordingly,
it is not semantics itself that generates irregularity, but the frequency effects that come with it.
In other words, semantics induces high token frequency of these plural forms and high
frequency serves as a factor conserving the irregular pattern.

The estimation of the exact role that the individual factors play in the preservation of
irregular plural patterns poses some difficulties due to such methodological pitfalls as the
existence of confounder factors. This fact certainly needs to be taken into consideration both
when designing the statistical procedures and when interpreting the findings.
3. Methodology and Database

3.1 Corpus data

The examination of plurality patterns and the evaluation of conditioning factors was carried out in the present study for English, Scots and a number of varieties of Frisian, at different stages of their development. Accordingly, the investigation covered Old and Modern (standard) English, Early Modern and Modern Scots, and six varieties of Frisian, representing East, West and North Frisian. Scots was included in the study as a variety of English owing to the fact that, in contrast to many existing varieties of English, it shows some inflectional peculiarities, including the inherited archaisms. The basis for the investigation of the Old English material was the data from the Dictionary of Old English (electronic corpus) (Healey 2004), covering the period between the 7th and 11th c. The information about present-day English comes from the Oxford English Dictionary (1989) and the frequency figures for Modern English were based on the British National Corpus (BNC) (2007). The data for Early Modern and Modern Scots come from the Dictionary of the Scots Language, comprising two major historical dictionaries of the Scots language (available at http://www.dsl.ac.uk/), and were supplemented by the information from a printed edition of the Concise Scots Dictionary (Robinson 1987). The analysis of the frequency effects in Scots relied on the extrapolated frequency figures for English based on the BNC.

As regards the Frisian material, the label “Old Frisian” has been commonly applied to the Frisian attestations from the period between the 13th c. and the early 16th c. The present analysis of Old Frisian was confined to the so-called ‘classical’ period, dated between ca. 1275 - ca. 1410, and attested in 6 manuscripts. This stage of Frisian, despite its relatively young age, is compatible with the other Old Germanic languages in terms of phonological and morphological archaism (Versloot & Adamczyk 2014: §3.2). Present-day Frisian can be
essentially viewed as a group of historically related but mutually unintelligible dialects, spoken in various language islands amidst varieties of German and Dutch. These dialects are traditionally grouped into three main branches: West Frisian, used by approximately 450,000 speakers in the Dutch province Fryslân; East Frisian, spoken by maximally 1000 inhabitants of the municipality of Saterland, near Oldenburg; and North Frisian, used by ca. 4-5,000 speakers on the western coast and adjacent islands of Schleswig-Holstein. The data from 6 varieties (two from each group) were included in the study. The West Frisian sample included the standard variety which comes close to the idiom of the majority of the West Frisian speakers, and the dialect of Schiermonnikoog, a fairly archaic and dying variety with probably fewer than 100 speakers. East Frisian is represented by the dialect of Saterland, and the dialect of Wangerooge, which died out in the 20th c. and was in various respects (not with regard to the formation of the plural though) one of the most archaic varieties of Frisian. North Frisian, which itself shows a very strong dialectal differentiation, is represented by the dialect of the islands of Föhr and Amrum and by the Mooring-dialect, spoken on the coast.\(^8\) The frequency figures for modern stages of Frisian were obtainable only for West Frisian and are based on the Frisian Language Database (Versloot & Nijdam 2011). They are based on the language material from the period 1550-1800. As all the varieties are genetically, geographically and culturally closely related, we found it justified to use the robust West Frisian figures as a proxy for the frequencies in the other Frisian varieties.

3.2. Interpretative problems

As discussed in the introductory section, the presence of irregular plurals in modern varieties of English and Frisian can be attributed to both inherited archaisms and newly emerging

\(^8\) For a thorough introduction to all essential aspects of the Frisian language, including its present-day variation and history see Munske (2001).
irregularities. The inherited archaisms are not necessarily irregular from the modern perspective, which can be illustrated by the inflections of the nouns originating in the class of u-stems in the present-day dialect of Saterland. In Old Ems Frisian, from which Saterfrisian can be derived, the regular plural ending of masculine nouns in the productive vocalic stems was -ar. The ending -a, which is the historical plural ending of the u-stems, was an exception, and Old Ems Frisian witnessed an incidental analogical extension of –ar to the u-stems. For a reason which stays beyond the scope of the present study, Saterfrisian generalised the ending –e < (OFris. –a) to all nouns ending in a consonant by a synchronic phonological rule that now also applies to the historical u-stems, such as sumer ‘summer’, sun ‘son’ and winter. In consequence, the plural form sune, being a direct continuation of the archaic plural ending of the u-stems (< OFris. suna), is entirely regular from the synchronic point of view. Another example of regularisation of a once archaic inflection comes from the s-stems. In the strongly gender-based organisation of declensional classes in Old Frisian, the ending –ar, found in the neuter s-stems but characteristic of masculine a-stem nouns, was anomalous (Versloot 2014). Likewise, a modern Frisian form such as Saterfrisian lounere ‘lambs’, a historical neuter s-stem, is an irregularity in the synchronic Saterfrisian system of plural inflections, dominated by –e and –en as markers of plurality. Accordingly, it is classified in the present study as ‘preserved archaism’. However, in modern dialects of Frisian, the distribution of endings is often guided by phonological principles rather than by gender. In the dialect of Föhr and Amrum, the ending –er, originally pertinent to masculine nouns, is also commonly found in some feminine and neuter nouns. Despite the gender-based preferences for a specific inflection in this dialect, the distribution is at least partly guided by the synchronic phonological structure of the noun, and consequently –er appears in various feminine and neuter nouns in this modern dialect. That is the reason why the ending –er in nouns such as lumer ‘lambs’ and kualwer ‘calves’ is not considered to be irregular from the synchronic point of view in this dialect.
Another interpretative difficulty is posed by nouns which retain traces of the original inflection in their phonological shape, but do not show an irregular pattern synchronically. An example is West Frisian *lea* < OFris. *litha* ‘members’, showing the inherited *u*-stem ending in *-a*. The form is petrified as a *plurale tantum* with the meaning ‘body’ and is lexically detached from its original singular *lid*, meaning ‘limb, member’. The form was interpreted in the present study as a reflex of the archaic pattern and counted accordingly. Another example is the paradigm of *brek*, pl. *breken* ‘trousers’, as used in the dialect of Föhr and Amrum. The noun is regular from the synchronic point of view, but the root vowel reflects the earlier presence of *i*-mutation characteristic of the historical plural forms in root nouns, and its subsequent analogical extension to the singular. The Modern English form *breech* (rare) – *breeches* reflects exactly the same pattern, with analogical levelling of the vowel from the plural to the singular.

One of the essential methodological questions which arose at the outset of the present investigation was which forms should be interpreted as a ‘preserved archaism’. Two approaches were adopted in order to interpret the data. In one of them, the diachronic perspective was taken, and accordingly every form that continues the historical plural pattern (or reflexes of it), in compliance with the phonological rules for each specific dialect, was interpreted as a preserved archaism (e.g. Wangerooge Frisian *kiier* ‘cows’ with the preserved historical *i*-mutated vowel and an additional ending *–er*, cf. Early Modern English *kine*). In the alternative approach, only those forms that do not match the synchronic patterns of regular plural formation were considered to be preserved archaisms (cf. the examples above). As the focus of the study is on the factors facilitating the survival of historical, non-productive endings in present-day varieties of English and Frisian, examining ‘archaisms’ that coincide with synchronic, productive plural formations, was considered less relevant. Both configurations of input data were tested and it was found that the trend in the obtained results was identical. In both instances, the percentage of plural tokens relative to the total number of attested tokens for a given lemma (henceforth
‘plural percentage’, %PL) turned out to be the dominant factor.

3.3 Statistical methods

In order to investigate the range of factors which could potentially be involved in the reorganisation of the plural formation patterns in the selected Germanic languages and varieties, a multivariate analysis was employed, whereby multiple factors are quantified as independent variables and the correlation with the dependent variable, i.e. archaism or irregularity of plural inflection, is computed. The statistical tool particularly suited for the data selected for the present study is a logistic regression analysis, where the dependent variable (the phenomenon that is to be explained) is measured on a binary scale: 1 ‘yes’ or 0 ‘no’. The logistic regression model includes one or more independent variables that are believed to influence the choice of either of the two alternatives in the dependent variable. These independent variables are compared to the actually observed value of the dependent variable. Given the nature of the plural system, the test is applicable to the investigation of the development of plurality patterns: the concept of plurality in nouns is commonly expressed by one plural form; only in isolated instances do languages show multiple plural forms, which very often have different connotations or semantics. The choice of the plural marker in a language is the result of an interplay of factors which determine the likelihood that one or the other form survives or arises. In technical terms, this relation can be expressed on a binary scale, namely, a particular archaic form survives (‘yes’/1) or does not (‘no’/0), and correspondingly, a particular innovation (here inflectional irregularity) emerges (‘yes’) or does not (‘no’). The independent variables can be measured on a binary scale (e.g. semantic category: “a word denotes or does not denote an animal”), on an interval scale (e.g. “a word has one, two or three syllables”) or a ratio scale (e.g.

9 The software used for the regression model was an online calculator available at <http://statpages.org/logistic.html>. 

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“percentage of plural forms ranges from zero to one on a continuous scale”). Logistic regression is therefore suitable for analysing the survival of archaic inflectional forms or the emergence of new ones.10

In the adopted approach, every single noun in the data set in each investigated language variety provides one data item. Based on these input data, the model computes whether there is in fact a statistically significant relation between each of the supposed independent variables and the dependent variable; in other words, it tests whether an independent variable contributes to the selection of either of the two alternatives (‘yes’ or ‘no’), incorporating also the impact of other variables. It should be borne in mind that not every technically significant correlation expresses a causal relationship between the independent and dependent variable (cf. section 2.2). In some cases identified in the analysed data set, the variables turn out to be confounders of other controlling factors. Accordingly, a critical evaluation of the various factors entailed eliminating such potential statistical confounders, and identifying reductionist causal relations between independent and dependent variables in the model.

The weight of each variable is computed and expressed in the variable coefficient. The combination of the input values and their weight produces a likelihood between 0 and 1 for each item in the data set to display a given property (e.g. to be archaic or not). However, this is a probability rather than a discrete prediction: the expectation is that an item with a high probability to be archaic (> 0.5) is factually archaic, but it is not necessarily the case. It is inherent to probabilities that also an item with a low probability to be archaic can in fact be archaic. The power of a model is expressed by the so-called Odds Ratio. An Odds Ratio expresses the relative increase of chance for an event in the dependent variable. It means that for every single unit increment in the independent variable, the chance for the presence or

10 For an analysis of the actual diversity of plurality patterns, which can involve more than two different markers (e.g. Modern High German), a range of other statistical methods is available; see, e.g., Daelemans (2002).
absence of a property in the dependent variable (the odds of being ‘yes’) increases by the value of the Odds Ratio. For instance, in the statistical analysis of the level of archaism of plural forms in Frisian (section 4.2.1.1) the Odds Ratio for the semantic feature *animal* was 3.5. This implies that, all the other variables being equal, the chance to retain an archaic ending is 3.5 times bigger for a noun denoting an animal than for a noun denoting any other concept or object.

The statistical analysis procedure was started with a full inventory of potentially relevant variables (enumerated in section 3.4). After the evaluation in the logistic regression model, the variables whose contribution was not statistically significant were preselected for elimination and the variable which contributed least to the explanation was removed from the model, and the new model was evaluated again. This procedure was repeated until it reached the stage when only variables whose contribution to the variation in the dependent variable was statistically significant were left.

3.4. *Operationalising the controlling factors*

In the course of operationalising the potential controlling factors, presented in section 2.2, the following variables, discussed here in detail with reference to the Frisian and English material, were added to the model as potential independent variables.

(a) *The absolute number of plural tokens, reflecting the intensity of entrenchment of forms in memory.*\(^{11}\) For English and Scots the figures from the (synchronic) *British National Corpus* were used for this and the following variable. As no accurate frequency figures are available for all Frisian dialects, the absolute number was computed as a weighted average

\[^{11}\text{In other corpus-based studies a *corpus percentage* is occasionally used; it refers to an absolute number of tokens for a specific item (absolute token frequency) divided by the total number of tokens in the corpus. The two methods of quantifying the frequency are interchangeable and render the same results.}\]
of the Old Frisian data and the early Modern West Frisian data.\(^{12}\)

(b) **The relative plural proportion, expressing the analogical pressure of either of the two paradigm forms: singular or plural.** The phenomenon of occasional analogical extension of the plural forms to the singular in nouns with high plural proportion has been described in qualitative terms by Tiersma (1982: 835; defined as “local markedness”; cf. Haspelmath 2006). In the present study the plural proportion for Frisian was computed as the average from the Old Frisian and Early Modern West Frisian data. However, for lemmas where no plural forms were attested in Old Frisian, the plural percentage figures from the larger Early Modern West Frisian corpus were used, which was considered legitimate given that the absence of these attestations in Old Frisian is most likely to be ascribed to the limited size of the corpus rather than the underlying linguistic reality.

(c) **Salience.** The phonological salience of plural marking and the morpho-phonological complexity of the plural marking in Old English and Old Frisian were combined into one variable, ranked on a scale 0 to 1 from the least to the most salient/complex where: 0 = no explicit plural marker (pl. = sg. form); 0.33 = vocalic ending -a; 0.67 = vowel-consonant ending (OFris. –ar, OE –or, -ur); 1 = root alternation (i-mutation). The classification was based on the inflections actually attested in Old Frisian and Old English. The quantification of the salience scale was based on a conversion from a rank order to a ratio scale. The application of this procedure is supported by the Old English data in Table 3, where the percentage of innovation in the plural and salience, quantified by the same procedure, shows a correlation of 0.95.

(d) **Syllable structure.** The syllable structure was quantified by including the number of

\(^{12}\) Human perception of quantities follows a logarithmic, relative scale, rather than an absolute, linear scale (Dehaene 2003). Therefore, the logarithm of absolute token frequencies seemed most appropriate for the type of investigation undertaken in the present study.
syllables of the nom. sg. form in Old Frisian and Old English minor stems.

(e) Semantics. Three semantic variables were introduced: (1) persons, such as OFris. *mon* ‘man’, *mōder* ‘mother’; (2) animals, such as OE *lamb* ‘lamb’ or *gōs* ‘goose’, and (3) body-parts, such as OFris. *lith* ‘limb’ and *tōth* ‘tooth’. These variables were measured on a binary scale.

(f) The interaction of irregular plural forms with the default plural inflections. This aspect was not operationalised as an independent variable. As mentioned in section 2.2 (d), the interaction between irregular and default plural inflections may be manifested in two ways.

The first manifestation involves the lexical distribution of regular and irregular plural endings. This aspect was taken into account in that the historically defined plural forms which overlap with synchronically productive plural endings were not considered to be ‘archaic’ in the present study (see earlier discussion section 3.2). The second manifestation involves phonotactic complications in the concatenation of the root and inflectional ending. This aspect does not play a role in the Frisian dialects, where the regular plural endings are mostly attached depending on the phonological structure of the noun, causing no phonotactic complications. In English and Scots, the nouns *goose*, *louse* and *mouse* terminate in a sibilant and are potential targets for a sibilant-sibilant clash: *gooses, *louses, *mouses*, which might have potentially contributed to the retention of the irregular plural forms (without such a clash). However, all three plural forms are on account of their plural percentage and salience of the plural marker sufficiently identified as potentially archaic (i.e. likely to retain their historical form). Therefore, an independent contribution of the phonotactics could not be detected and this factor was eliminated from further statistical testing.
4. Results of the analyses

4.1. Results from the analysis of the historical data

The present section is devoted to a discussion of the findings from the examination of the nominal inflection in the Old English and Old Frisian material. The investigation was confined to minor (unproductive) declensional classes whose relics constitute the source of many irregularities in the plural inflection in present-day varieties of English and Frisian.

Table 3 presents a correlation between the type of inflectional marker and the percentage of innovative inflection in the plural paradigms of minor stems, juxtaposing the data from Old English and Old Frisian. The figures come from a systematic investigation of the respective corpora discussed in section 3.1. In order to account for the patterns found in the Old Frisian material, the figures for relative plural proportion were included as well. They refer to the number of plural tokens as a proportion of all tokens of the analysed lemmas.13

<table>
<thead>
<tr>
<th>declensional class</th>
<th>archaic inflectional marker(s)</th>
<th>percentage of innovation in the plural</th>
<th>archaic inflectional marker(s)</th>
<th>percentage of innovation in the plural</th>
<th>relative plural proportion</th>
</tr>
</thead>
<tbody>
<tr>
<td>OLD ENGLISH</td>
<td>OLD FRISIAN</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>r-stems</td>
<td>Ø</td>
<td>86%</td>
<td>Ø</td>
<td>85%</td>
<td>18%</td>
</tr>
<tr>
<td>i-stems</td>
<td>-e</td>
<td>70%</td>
<td>-e, Ø</td>
<td>94%</td>
<td>34%</td>
</tr>
<tr>
<td>u-stems</td>
<td>vocalic -a</td>
<td>63%</td>
<td>vocalic -a</td>
<td>71%</td>
<td>23%</td>
</tr>
<tr>
<td>s-stems</td>
<td>r-formative</td>
<td>47%</td>
<td>r-formative</td>
<td>51%</td>
<td>38%</td>
</tr>
<tr>
<td>nd-stems</td>
<td>i-mutation</td>
<td>33%</td>
<td>Ø</td>
<td>24%</td>
<td>58%</td>
</tr>
<tr>
<td>root nouns</td>
<td>i-mutation</td>
<td>8%</td>
<td>i-mutation</td>
<td>20%</td>
<td>25%</td>
</tr>
</tbody>
</table>

Table 3. The relation between the type of inflectional marker and the percentage of innovative inflections in the plural paradigms of Old English and Old Frisian minor classes

13 The grey scale applied to the cells referring to the inflectional markers reflects the quantification of the salience scale as discussed in sections 2.2 and 3.4. Accordingly, light grey colour corresponds to markers of low salience, while the dark grey colour refers to the more salient ones.
The data from the two investigated languages show largely parallel patterns with respect to analogical restructuring of the plural paradigms of minor stems. The scale and dynamics of the reorganisation process in individual declensional classes is comparable in the two languages, being slightly more advanced in Old Frisian (which could be expected given the attestation dates of the two sister languages). Some more significant differences emerge with respect to the relation between the amount of innovation and salience of inflectional markers in individual classes. This refers in particular to the class of *nd*-stems, where, in contrast to Old English, the plural is not characterised by any inflectional exponent in Old Frisian, and the root nouns, which although in both languages marked by the *i*-mutated vowel in the plural, show a divergent pattern of restructuring. The Old English data attest to a very strong correlation between the salience of the plural marker and the amount of innovation in the plural paradigm; namely, the less salient exponents, such as vocalic endings or zero markers, are much more prone to analogical levelling than the more salient ones, such as *i*-mutation or *r*-formative. Accordingly, while the amount of analogical inflection in the *r*-stems, where the plural has no inflectional exponent, reaches 86 percent, in the root nouns, marked by *i*-mutated vowel in the plural, the analogical pattern is found only in 8 percent of forms.\(^\text{14}\)

A more independent role of the plural proportion is found in Old Frisian, where the correlation between salience and innovation percentage is not as straightforward. The general pattern found in the analysed data is largely the same as in Old English, with two clear exceptions, namely, the resistance of the plural forms of the *nd*-stems to analogical levelling.

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14 Additionally, apart from the direct correlation between the salience of inflectional markers and the innovation percentage, also the relative plural proportion (%PL) turns out to contribute to the final outcome, as was confirmed in a logistic regression model. In order not to overload the paper with technicalities, we decided not to include the technical description of the results of statistical testing in this section. The major implications are sufficiently illustrated in Table 3.
and the relatively high percentage of analogical inflections in the root noun paradigm. As regards the latter class, the attested pattern can be explained by the fact that, in contrast to Old English, *i*-mutation was not consistently present in the Old Frisian root noun plural paradigm. In fact, with respect to salience of inflectional markers, this class is a hybrid in Old Frisian in that it comprises both nouns which never showed mutated vowel in the paradigm and those which displayed it more systematically.\textsuperscript{15} The absence of a mutated vowel as a salient marker of plurality would explain the relatively high percentage of innovation in the plural paradigm.

In order to account for the lack of a direct correlation between the percentage of innovation and salience in the *nd*-stems, the relative plural proportion was invoked as a second controlling factor and its significance was tested in a logistic regression analysis. The combination of relative plural proportion and salience of inflectional markers in a logistic regression model offers a very powerful prediction of the actual developments: the low salience of the plural forms in the *nd*-stems is compensated by their relatively high frequency of occurrence in the plural. Consequently, the spread of analogical endings in the plural paradigm is limited by the high token frequency of the plural forms, which works as a factor conserving the historical pattern of inflection, inhibiting the dissemination of analogical endings. The two controlling factors, i.e. the salience of the inflectional marker and relative plural proportion, are strongly interwoven in the mechanism of the reorganisation (or formation) of plurality patterns and this relation will be further elaborated on in section 4.2.

\textsuperscript{15} There is a substantial difference between Old English and Old Frisian in the application of *i*-mutation in the nominative/accusative plural of root nouns. Old English essentially attests to mutated forms in all investigated nouns. Old Frisian lacks *i*-mutation in nouns such as *burg*, *bōk* and *turf*. Plural forms of ‘mouse’ and ‘louse’ are not attested in Old Frisian; in North Frisian, where a range of mutated plural forms is preserved, these nouns show endingless plural forms without *i*-mutation. Also the attestation of an endingless plural form *mus* in 15\textsuperscript{th} c. West Frisian implies that the lack of *i*-mutation may have been an original feature in various root nouns. Likewise, Old Frisian *nd*-stems lack *i*-mutation in the plural paradigm, e.g. *fiand* ‘fiend’ – nominative/accusative plural *fiand*, cf. OE *fēond* – *fiend*. 
4.2. Results from the statistical analyses

The present section is devoted to a discussion of the findings from the analyses of the preserved archaisms (4.2.1) and new inflectional irregularities (4.2.2). It must be observed that the investigation of the preserved archaisms was confined to only those forms which do not much synchronic, productive formations.

4.2.1 Archaisms

4.2.1.1 Frisian

The logistic regression analysis was applied first to the Frisian data, beginning with a model including all the mentioned variables, i.e. plural percentage (%PL), absolute number of plural tokens (logarithm), salience, three semantic categories (animals, body-parts, persons) and syllable structure. The syllable structure and the semantic aspect of person turned out to be absolute (categorical) in their predictions and therefore technically not suitable for the logistic regression analysis. These factors will be discussed separately. Accordingly, the second version of the logistic regression model contains only the following variables: plural percentage, absolute number of plural tokens, salience and semantics, including animals and body-parts. Subsequently, the model was tested again and variables that did not contribute significantly to the result were stepwise eliminated (beginning with the least significant one). This procedure was repeated until the model contained only those independent variables that make a significant contribution to the observed variation in the dependent variable, i.e. the retention of archaic plural forms. Table 4 presents the descriptives of the final model.
The logistic regression model for the archaic plural forms in 6 Frisian varieties contains technically three significant, independent variables: plural percentage, animals and body-parts. The Odds Ratios show that the plural percentage is by far the most relevant one, with a value of 282, against 3.5 and 5.3 for the two semantic variables of animals and body-parts, respectively. The impact of the %PL turns out to be more than 50 times bigger than of the most influential semantic variable. The evaluation of the relation between semantics and %PL shows that they are strongly interdependent. The average %PL for nouns belonging to the categories of animals and body-parts is 0.59, for the other nouns in the test-set the average %PL is only 0.22. This contrast is significant in a T-test (p < 0.001), which means that nouns designating...
body-parts (e.g. eyes, legs, hands) or animals are relatively more often used in the plural than any other nouns. Given the fact that plural percentage is already the strongest independent variable in its own right, we conclude that the effect of semantics is, in fact, a confounder of the plural percentage effect.

The syllable structure could potentially be considered a factor contributing to the retention of archaic plural forms. However, as all nouns retaining archaic plural forms are monosyllabic, the effect of syllable structure is categorical and, therefore, this factor could not be included into the model as an independent variable. Moreover, syllable structure and plural percentage correlate strongly: the average %PL in disyllabic nouns in the data set equals 0.09 and corresponds to 0.44 in monosyllabic nouns, which implies that the seeming importance of syllable structure is a confounder effect of the relative plural proportion.\textsuperscript{16} The third semantic category considered in the model was person. Its effect was likewise categorical, namely, no items denoting a person retained their historical irregular plural form (although quite a few developed new irregular plurals). Accordingly, as a factor contributing to the preservation of archaic forms, this variable was meaningless. At the same time, this fact does not imply that factors such as syllable structure or semantics could not develop their own dynamics (cf. the discussion in section 5).

A factor that was expected to have some impact, given the strong correlations with innovation in Old English and Old Frisian, is the salience of the inflectional marker. Its

\textsuperscript{16} In general, there is a tendency for frequent words to be shorter. Short and high frequent articles (the, a) and prepositions (on, in, at, of) are typical examples of this effect. However, the lemma frequency of the disyllabic nouns, including high frequent items, such as ‘son’ (OFris. sune) and ‘mother’ (OFris. mōdor), is on average, in fact, higher than that of the monosyllabic items in the test set. It may have been the high lemma frequency that contributed to the fact that, e.g., kinship terms retained their distinct, non-default inflectional pattern in Old English; and, at the same time, it was their low incidence in the plural that caused the loss of their irregular plural marking in modern varieties.
correlation with %PL equals 0.46 ($r = 0.46^{17}$). A T-test comparing the plural percentages for nouns with a low salience to nouns with a high salience shows that the two groups differ significantly: items with a low salience have on average a lower plural percentage (average %PL = 0.23) than items with a high salience (average %PL = 0.55). In the earlier versions of the model, which included the semantic variables as well, salience was excluded at an early stage of the elimination process of non-significant variables, as its contribution was not statistically significant. Given that the contribution of semantics may be considered a confounder effect of plural percentage, we tested an alternative version of the model which excluded semantics and included only two variables, namely, plural percentage and salience. In this model, plural percentage is still by far the most influential variable (O.R. = 322), while salience shows an Odds Ratio of 4 and is marginally significant ($p = 0.055$). Table 5 shows a) the correlation between the salience of inflectional markers and the retention of archaic plural forms in Frisian dialects, and b) the correlation between the plural percentage and the retention of archaic plural forms. As can be observed, the proportion of archaic forms increases with every step on the salience scale and with a higher level of plural proportion.\textsuperscript{18}

<table>
<thead>
<tr>
<th>salience</th>
<th>% archaic forms</th>
<th>%PL</th>
<th>% archaic forms</th>
</tr>
</thead>
<tbody>
<tr>
<td>-Ø</td>
<td>6%</td>
<td>&lt; 0.25</td>
<td>0%</td>
</tr>
<tr>
<td>-a</td>
<td>17%</td>
<td>0.25-0.5</td>
<td>14%</td>
</tr>
<tr>
<td>-ar</td>
<td>30%</td>
<td>0.5-0.75</td>
<td>39%</td>
</tr>
<tr>
<td>i-mutation</td>
<td>41%</td>
<td>&gt; 0.75</td>
<td>67%</td>
</tr>
</tbody>
</table>

Table 5. The impact of salience and %PL on the proportion of archaic plural forms

The relatively low contribution of salience to the logistic regression model is due to the fact

\textsuperscript{17} ‘r’ refers to the \textit{Pearson product-moment correlation coefficient} and is a measure for the correlation between two variables: 0 means no correlation, -1 or +1 means a total correlation. Two independent variables with $r < 0.7$ are generally considered to be acceptable in a regression model, without causing confounder effects.

\textsuperscript{18} For all relevant examples see the Appendix.
that even for the highest value on the salience scale, still the majority of forms are not archaic. For the variable plural percentage the increase of predictive power is clearly sharper: the amount of archaic inflection increases from 0% for the lemmas with %PL lower than 25% to 67% for the lemmas with %PL higher than 75%. To sum up, salience turns out to have some intrinsic overlap with plural percentage and it seems to have had only a limited contribution to the preservation of irregular, archaic plural forms in Frisian.

Altogether, it can be concluded that plural percentage contributed most substantially to the preservation of archaic, irregular plural forms in the Frisian varieties: when the plural is frequent, the form is simply better remembered. Items with a low plural frequency – and a low frequency in general – tend to adhere to the productive patterns of plural formation, because their plural form has too little ‘critical mass’ to be remembered separately. This plurality effect is most tangible in the two items with the highest plural percentage: ‘clothes’ (0.92) and ‘limb’ (0.84). In both cases, the plural form detached from the singular and became a separate lemma with a plural tantum meaning: ‘clothing’ and ‘body’, respectively. In the dialect of Föhr-Amrum the noun brek shows a similar plural-to-singular transition as English breeches, with further semantic parallels in Modern English trousers and Icelandic buxur (pl.) ‘idem’.

4.2.1.2 English and Scots

The data for English and Scots were examined in a similar way, using the same investigative procedures. The following variables were included in the first version of the model: absolute plural frequency (logarithm), plural percentage, salience and semantics. As both semantic categories of animals and body-parts had a positive impact on the preservation of archaic forms

19 In a model with plural percentage as the only independent variable, the Odds Ratio equals even 581, including also the frequency effects that ‘leaked away’ to the semantic variables or salience in the former versions of the model.
in the Frisian data set, they were combined here into one binary variable. The syllable structure was excluded for the same reason as in the analysis of the Frisian data, namely, all preserved archaic irregular forms are monosyllabic, and the effect of this variable was hence categorical and technically not applicable in a logistic regression model. Just as in Frisian, there is a strong tendency for both – nouns belonging to the mentioned semantic categories and monosyllabic nouns – to show relatively high values for plural percentage. For both variables, i.e. semantics and syllable structure, this bias towards high values is statistically significant in a T-test (\(p < 0.001\)). This means that one can expect an overlap in the effect of the variables semantics and syllable structure with plural percentage in the model, which indeed led to their elimination from the model as making no significant contribution.

The final version of the regression model for English and Scots, just as for Frisian, is much simpler in that it contains fewer variables than the initial version of the model which included all potential independent variables. In the case of English and Scots, there are two significant, independent variables, namely, the relative plural percentage and salience, both with very high Odds Ratios (%PL: \(OR = 2157\), salience: \(OR = 1325\)). The correlation (r) between the two variables is 0.49, which is almost identical to the result in the Frisian data set. The explanation for the high impact of salience in English and Scots is that, apart from *child(e)r(en)* and Scots *caur* ‘calves’, only root nouns with *i*-mutated vowel as a marker of plurality (the most salient plural marker) have been preserved as irregular plurals (at least in this data set containing lemmas originally affiliated with historical minor classes). Nouns with less salient plural markers in Old English (-Ø and -a) have consistently developed an innovative and mostly regular plural ending in Modern English and Scots. Such a strong contrast in the development of nouns with low and high salient markers of plurality produces a high Odds Ratio in the logistic regression analysis. The likelihood of preserving an archaic plural form as computed by the logistic regression model, with plural percentage and salience as independent
variables, is presented in Figure 1.

As can be observed, the points in the graph referring to individual nouns follow the so-called S-curve. The steep slope of the curve is an expression of the strong predictive power of the model. The model predicts namely that nouns with a salient plural marker and a high plural percentage are more likely to retain their historically-defined plural marking than the nouns not characterised by these properties. Strong as the predictive power of the model is, it is not absolute, as can be seen in the case of the two nouns, ‘cow’ and ‘furrow’, which, according to the prediction of the model, have a high likelihood to retain their archaic plural forms, yet in reality they show regular plural inflection. The plural form of ‘cow’, however, shows archaic traces in Scots and some English dialects (e.g. Cumbria, North Yorkshire): *kine*. The word *furrow*, in turn, violates the monosyllabicity constraint in its modern form (*furrow* < *furh*), which is a factor that seems to have had a categorical effect.
To conclude, the archaic plurals in English and Scots are the result of the conserving effect of high plural proportions and the high salience of the plural marker, i.e. predominantly i-mutation of the root vowel. Just as it was the case in Frisian, English and Scots testify to the lexicalisation of a plural form, where the plural percentage reaches 85%, i.e. in the ‘plurale tantum’ lemma: *breeches. The salience turns out to be a much more prominent factor in English and Scots than in Frisian, which is indicative of the fact that the phonological reduction of endings (apocope) has been more advanced in English and Scots than in Frisian. In contrast, the root alternation induced by historical i-mutation was not affected by reduction processes and was therefore a resistant plurality marker. Not without significance is also the fact the i-mutation process was more widespread and consistent in Old English than in Old Frisian (cf. footnote 15).

4.2.2 New irregularities
In section 2.1., Table 2, new inflectional irregularities present in modern English and Frisian were introduced, discussed and contrasted with the preserved archaisms. They referred only to irregularities within the inventory of lemmas affiliated with the minor classes. These new inflectional irregularities may range from minor phonological allomorphy, such as in English clothes ‘clothing’ vs. regular cloths, to far-reaching lexical innovations, such as Saterfrisian suppletive bäiste as a plural to ku ‘cow’. The second stage of the present investigation consisted in an examination of these new irregularities, and accordingly the data set included only non-archaic forms, i.e. those which were either regular or irregular, but did not constitute a historical irregularity. The Old Frisian word *gōs, plural gēs ‘goose’ may serve as an example of the divergent development of the plural form in modern dialects, which necessitates a different interpretation of forms in individual varieties. More specifically, in the evaluation of archaisms, the Föhr-Amrum Frisian plural form of gus: ges was counted as an archaic feature, while
Wangerooge Frisian *goos*, pl. *gooz* (with voiced final consonant from earlier *gooze*) was considered non-archaic. In the investigation of new irregularities, the Föhr-Amrum form was discarded from the calculations (being an inherited irregularity), while the Wangerooge form was now counted as a ‘new irregularity’ (*goos* or *goosen* would be the expected regular form in this dialect). In the dialect of Schiermonnikoog, the noun has a regular plural form of the feminine inflection (complying with the inflectional pattern in this specific dialect): *goze*. This form is counted as ‘regular’, both in the study of archaisms in section 4.2.1 and in the investigation of new irregularities.

As present-day English and Scots display too few new irregularities in the analysed set of lemmas to make an interesting statistical case, the present investigation was confined only to the data from the varieties of Modern Frisian. This does not imply that such irregularities are entirely non-existent in English or Scots, e.g. *clothes* is found alongside regular *cloths, brethren* alongside regular *brothers* (Scot. *brether*) (cf. also Scots *treen* ‘trees’, *breer* ‘eyebrows’). The following variables were included in the first version of the model: absolute number of plural forms (#PL), plural percentage, three semantic variables (animals, body-parts, persons), salience and the syllable structure. After repeated elimination of the least significant variable, the total model emerged as significant (p < 0.001) with two variables, each also individually significant (p < 0.001): #PL with an Odds Ratio of 38.6, and the semantic factor of animals with an Odds Ratio of 11.0. As was concluded in the previous sections, the impact of the semantic factor is probably a confounder of plural percentage. When applied to the variable *animals*, a T-test reveals a significantly (p < 0.001) higher plural percentage in the nouns denoting animals (0.59) than in the other nouns (0.31). We therefore tested a new version of the model which excluded semantics. Salience did not make a statistically significant contribution this time, which was only expected as the impact of the salience of historical endings on the irregularities which developed at the later stage is rather unlikely. The final version of the model
without semantics contained the plural percentage (%PL) and the absolute number of plural tokens (#PL) as independent variables. The complete results of the statistical model are presented in Table 6.20

<table>
<thead>
<tr>
<th>Descriptives:</th>
</tr>
</thead>
<tbody>
<tr>
<td>The data set contains 142 relevant instances from 31 lemmas from 6 dialects: 92 instances show Y = 0 (regular ending); 50 instances show Y = 1 (innovative irregular ending):</td>
</tr>
<tr>
<td>Variable</td>
</tr>
<tr>
<td>%PL</td>
</tr>
<tr>
<td>#PL</td>
</tr>
<tr>
<td>Overall Model Fit:</td>
</tr>
<tr>
<td>Chi Square= 21.3248; df=2; p= 0.0000</td>
</tr>
</tbody>
</table>

| Coefficients and Standard Errors: |
| Variable | Coeff. | StdErr | p |
| %PL       | 1.8971 | 0.8597 | 0.0273 |
| #PL       | 2.2897 | 0.7932 | 0.0039 |
| Intercept | -2.5124 | |

| Odds Ratios and 95% Confidence Intervals: |
| Variable | O.R. | Low | High |
| %PL       | 6.6668 | 1.2363 | 35.9516 |
| #PL       | 9.8721 | 2.0855 | 46.7310 |

Table 6. Descriptives of the logistic regression model for innovative irregular plural forms in six Frisian varieties

The absolute number of plural tokens and the plural percentage contributed significantly to the development of new irregular forms. The effect of plural percentage was already noticeable in the analysis of the archaisms: learning irregular plural forms and storing them in memory alongside the ‘unmarked’ singular forms requires a substantial proportion of plural occurrences of a lemma; otherwise the analogical pressure will oust any irregular form.

The absolute number of plural tokens works in a somewhat different way. High frequency items are more easily and quickly retrieved, processed and hence undergo stronger

20 For the explanation of the abbreviations used in the table see Table 4.
articulatory reduction, which, precisely due to the high frequency of occurrence, is more acceptable for the listener as these high frequent items are more easily recognised (Ernestus 2000, Diessel 2007: 114). Many of the new irregularities involve phonology-driven innovations, such as the West Frisian and Saterfrisian instances of shortening of the root vowel luus [lu:s] ‘louse’, pl. luze [luza] ‘lice’ (Saterfrisian) (word-isochrony effect). Such articulatory reduction effects tend to come with high absolute frequency of a form.

Figure 2 illustrates the emergence of new irregularities in the investigated varieties of Modern Frisian as determined by frequency, both absolute and relative. The token frequency (#PL) is plotted on the X-axis and plural percentage (%PL) on the Y-axis. The white circles refer to lemmas which have new irregular plural forms in less than 50% of the relevant forms from the 6 investigated Frisian dialects. The black dots refer to lemmas which have new irregular plural forms in more than 50% of the relevant forms.

As the data indicate, there is a clear division in the distribution of lemmas in the data set: 19 lemmas (marked in the graph with a white circle) developed new irregular plural forms in 40% or less of all the relevant forms in the 6 dialects (disregarding the archaisms). In the remaining
12 items, 66% or more of the relevant forms developed a new irregularity in the plural. The lemmas with many new irregularities are clustered in the upper-right corner of the graph, while the lemmas with a preference for regular plurals are found in the lower-left corner. This shows that the combined effects of token frequency and plural percentage contributes to the emergence (especially token frequency) and entrenchment (especially plural percentage) of new irregular plural forms.

4.2.3 Syncronic complexity of plural formations

The complexity of the plural formation system results from the combined effect of the historically-defined (inherited) irregularities and the newly emerging ones. All the syncronically irregular plural forms can be considered complex from the perspective of language learner in that they require much more processing than the regular plural forms. In Figure 3, the percentage of preserved archaisms is plotted against the overall percentage of forms which are irregular from the synchronic perspective and thus contribute to the complexity of the morphological system, being either inherited or new irregularities.21

21 The abbreviations used in Figure 3 refer to the following varieties of Frisian: F-A= Föhr-Amrum, Moor= Mooring Frisian, W= Wangerooge Frisian, WF= West Frisian, Sat= Saterland Frisian, Sch= Schiermonnikiog Frisian.
Figure 3. The complexity of the inflectional system reflecting the cumulative effect of preserved and novel irregularities. The X-axis shows the percentage of preserved archaisms, irregular from the synchronic point of view; the Y-axis shows the percentage of irregular plural forms, including both archaisms and new irregularities. The low value of $r^2 = 0.06$ illustrates the lack of correlation between the two percentages.\(^{22}\)

A striking feature of the distribution in Figure 3 is an evident lack of correlation between the overall proportion of irregularity (Y axis) and the proportion of archaic forms (X axis) found in the investigated material. One might expect that the preservation of many archaic plural forms will contribute to the overall proportion of irregularities in a language, reflecting some higher level of complexity of the morphological system. However, the graph illustrates that – at least within the investigated subset of lemmas – there is no correlation between the proportion of preserved archaisms and the total number of irregular forms. In other words, irrespective of the level of preserved archaisms, all investigated varieties, both the Frisian and the English ones, have a similar level of synchronically irregular plural forms, ranging roughly between 30 and 50 percent. This level of irregularity resembles a ‘natural’ balance between regular and irregular

\(^{22}\) The relatively low percentage of overall irregularity (Y-axis) for the Föhr-Amrum dialect is a result of the choice to interpret the plurals in -er in the historical s-stems as regular; otherwise the level of irregularity would reach 34%.
forms: when archaic irregularities are not preserved, new irregularities develop to ‘fill the gaps’, i.e. to maintain the equilibrium.23

So far in the study, the new irregular plural forms were not split into further categories with regard to their complexity or salience. A closer look at the data suffices to observe that some of the new irregularities are a result of phonological changes, such as shortening of the vowel in the plural (e.g. West Frisian laam – lammen ‘lamb(s)’), others show rare, new plural inflections (e.g. English brethren, being a combination of analogical i-mutation and the once productive -en marker), or are instances of lexical innovations (e.g. Mooring Frisian moon – kjarls ‘man - men’). In most cases, the newly emerging irregularities are phonology-based. This complies with the earlier observation that the absolute number of plural tokens was a statistically significant factor in the model: a high absolute frequency facilitates both the development and lexicalisation of allegro-speech phenomena. In other words, the advance of phonology-induced change is enhanced by high absolute frequency.

5. Discussion: frequency and semantics

The evaluation of controlling factors evoked in earlier studies and explored in detail in section 4 reveals that few of them are actually relevant for the morphological phenomena investigated in the present study, i.e. the preservation of archaic forms as irregular plural formations and the emergence of new irregular plural forms. Some of the presumed factors have no relevance whatsoever for the investigated developments (e.g. the absolute frequency for the preservation

23 A (unpublished) parallel study of irregular plural formations in Scandinavian languages rendered very similar results and testifies to parallel patterns: of 7 varieties of North Germanic (Icelandic, Faroese, New-Norwegian, Norwegian Bokmål, Swedish, Elfdalian and Danish), Elfdalian exhibited the lowest level of archaisms, while being a language with a very complicated plural morphology, with many inflectional sub-patterns instigated by synchronic phonological phenomena, such as vowel harmony, vowel balance and level stress (Åkerberg 2012).
of archaisms); others seemed to be confounders, especially the semantic variables and the syllable structure.

The findings of the present study have some more theoretical implications, allowing some insight into the way language actually works: how it is learned, stored and retrieved. The factors of prime importance for the mechanism of morphological change are the absolute number of plural tokens (#PL), the plural percentage (%PL) and salience. All three are involved in the strength of the cognitive representation of plural forms. The number of plural tokens is a proxy for the entrenchment of the form in memory, which is shown to have consequences for the accuracy of articulation (e.g. Ernestus 2000, Diessel 2007). The plural percentage expresses the strength of the form relative to other related morphological forms with the same meaning. The access to a plural form that is not deduced from the (mostly more frequent) singular by default plural endings is easier when the form is relatively frequent and hence more often activated (cf. Haspelmath 2008: 60-63). This stays in compliance with the observation that any knowledge or skill that is regularly activated is less easily forgotten (the case of strong verb forms can serve as another example (Lieberman et al. 2007)). In both manifestations of frequency, the strength of the representation in memory enables easier processing. Finally, salience of the plural marker is an expression of the qualitative strength of the entrenchment in memory. Just as with every other feature that a human mind remembers, whether a picture or an event, remarkable, outstanding features are more easily remembered, especially when they are relatively rare (which is the case with the more salient plural markers). Another factor which may have some additional bearing on the entrenchment of the forms is related to acoustic salience (which is incorporated in the presented salience-scale) and, more specifically, the fact that the acoustically more salient endings are less easily reduced and overheard. In conclusion,

24 See Goldschneider & DeKeyser (2001: 36) for a discussion of various aspects of salience and their relevance in language acquisition.
all factors that emerge from our analysis as being statistically relevant can be directly reduced to underlying cognitive processes, without the necessity to employ any abstract set of linguistic constructs or formalisations.

An intriguing role in the mechanism of retention and emergence of irregular plurals is played by semantics, which turned out to have a statistically significant contribution to the archaisms in all investigated varieties and to the emergence of new irregularities in Frisian. An aspect which poses a problem for the interpretation of the data is that the contribution of semantics does not seem to be consistent. Namely, while for the preservation of archaisms two semantic categories were relevant in the model (i.e. *animals* and *body-parts*), for the emergence of new irregularities only the category *animals* was meaningful and thus constituted a part of the final version of the model. It is not directly transparent why one semantic category would have some substantial effect in one context but not in the other. The high correlation between these semantic categories and the plural percentage (%PL) implies that the former can be significant, because the nouns in these categories denote concepts that often appear in the plural. The conclusion reached so far on the basis of the results from the conducted statistical tests was that the semantic variables are confounders of the frequency profiles of the nouns. It does not mean, however, that semantics cannot be a factor determining the shape of the plural inflection. An example may be the small group of English endingless plurals denoting animals, which contains not only historically-determined nouns, such as *deer* and *sheep* (deriving from neuter *a*-stems), but also a number of newly acquired items, affiliated originally with other declensional classes, e.g. *fish* or *moose* (e.g. Ekwall 1975: 92). This brings the concept of analogy into play: the extension of the new plurality pattern in the two nouns mentioned above is a result of analogical association. Analogy involves the activation of any type of knowledge in the brain as an effect of any similarity between two entities (Fertig 2013: 12). Given the nature of the human language as an abstract system of signs, composed of the *signifiant* (form)
and signifié (meaning), as defined by Saussure (1916), this similarity can be found either in the form (ranging from phonetics to syntactic structures) or in the meaning. Activation of one form means automatic co-activation of all items in all categories of which this form is a member (see Skousen (1989) for a model-wise implementation of this concept). In the present study, we observed a correlation between high plural percentages, semantic category of nouns denoting animals or body parts, and archaic endings (irrespective of the causal relation between them). Originally (in Old English/Frisian) there was no particular association between the irregular plurals and lemmas from specific semantic categories (i.e. body parts and animals). However, the specific semantic profile of some of these lemmas and the high plural percentages resulting from it created a relative overrepresentation of these semantic categories among the surviving irregular plurals. The consequence of the strong association of irregular plurals and specific semantic categories is that every time a specific irregular (archaic or new) plural form is produced, these semantic categories (body parts and animals) are co-activated in the brain. In other words, an activation relation is established between the (irregular) plural formation and the semantic category. Even if the original causal direction runs from frequency profile to semantics, analogical association works in a way that this relation, once it emerges, can also be activated in the reverse direction. Consequently, non-default (unproductive or irregular) plural formations can obtain a (limited) productivity based on the semantic features of lexical items, as in the case of English endingless plurals denoting animals (sheep, deer, etc.). This course of development seems to have had a very limited application in Frisian, because most of the new irregular formations denoting animals in Frisian dialects are of a phonological nature, involving shortening of long vowels in the plural (word-isochrony). Two examples representing the mechanism of analogy-driven-by-semantics are found in the Wangerooge dialect: (1) plural form of ‘cow’, kiier (OFris. kī), with the -er-ending extended by analogy to other nouns denoting cattle, such as laumer ‘lambs’, kalver ‘calves’, where the ending is archaic, and (2)
schaiper ‘sheep (pl.)’ (not in the lemma set of the present study), where the -er-ending is likewise innovative, replacing an endingless Old Frisian form (cf. English sheep).

Finally, the divergent patterns of the preservation and emergence of plural irregularities in the varieties of English and Frisian can be attributed to a range of interacting factors, the most significant of them being phonology-related. They include the different dynamics of phonological developments (especially reduction process), which have been more advanced in English than in Frisian, and the different scope of implementation of i-mutation, which was a much more regular and consistent process in early English than early Frisian. The disparate patterns found across the Frisian varieties can be ascribed largely to the contact situation, which differed substantially for individual dialects. Accordingly, while West Frisian dialects tended toward greater regularisation of the inflectional system under the influence of Dutch, the geographical and thus linguistic isolation of North Frisian varieties allowed them to retain considerable morphological diversity, including the preservation of many inherited plural irregularities. Other factors, such as the size of the linguistic communities or the socio-economic situation (e.g. the isolation of the North Frisian and East Frisian relic areas) must have had further bearing on the attested linguistic patterns. This non-linguistic conditioning of the morphological changes, much as it can be revealing about the linguistic landscape in individual varieties, stays beyond the scope of the present study.

6. Conclusions

The examination of old and new irregular plural forms in the investigated varieties of English and Frisian allows us to conclude that the developments affecting the plural inflection are guided largely by the frequency profiles of individual lemmas and their paradigm forms (in this study the plural form). The absolute and relative frequencies of occurrence of a specific paradigm form are the best predictors for the survival or development of irregular forms (from
the synchronic point of view) in the consecutive generations of language learners. The identified frequency effects can be directly linked to cognitive aspects of storage and retrieval of linguistic information in the human brain. The same holds true for the aspect of salience, which emerged as particularly relevant for the explanation of the irregularities continuing historical inflections. The findings of the present study indicate that semantics may have a substantial bearing on the frequency patterns, but it is frequency that determines the chance of a given plural form/pattern to survive or emerge. This does not preclude the possibility that analogical levelling based on secondary activation of semantic features can lead to new irregularities.

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