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On the interplay of salience, absolute frequency and proportional frequency in West Frisian plural morphology

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Abstract The earlier declensional classes of Old Frisian had gradually been worn down towards the close of the Middle Ages, leaving only incidental lexical vestiges. One of these vestiges is a set of 15 nouns, which still show archaic, but synchronically irregular, plural forms in the early 17th century. We traced their development throughout the following centuries. Only eight of them preserve their 17th century plural form in the written language until the 20th century and even fewer are intact in present-day spoken Frisian. Statistical analyses were performed to find out which factors correlate with retention. It turns out that the absolute and proportional frequencies of the plural form, as well as the salience of the ending, contribute in almost equal proportions to the retention of the plural form. The diachronic regularisation of the studied lexical items can to a large extent be predicted from these 3 variables.

1 Introduction

The present article investigates the question of which factors correlate with the retention of irregular plurals in West Frisian between 1600 and 2000. It is well-known that absolute frequency is a factor promoting the conservation of various linguistic phenomena, especially those involving irregularity (Bybee 2007:10–11 and others). The relevance of proportional frequency was pointed out, though not quantified, in Tiersma (1982). The proportional frequency of a plural form is the percentage of plural occurrences where the total number of plural and singular occurrences of that

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Table 1 Examples of nominal plurals in OF belonging to various declensional classes

Declensional class	Singular	Plural	Gloss
masculine *a*-stem	*dei*	*deg**ar***	'day'
neuter *a*-stem	*skēp*	*skēp-*	'sheep'
feminine *ō*-stem	*bāne*	*bān**a***	'bean'
feminine *i*-stem	*dēd*	*dēd**e***	'deed'
neuter *u*-stem	*lith*	*lith**a***	'limb
neuter *s*-stems	*klāth*	*klāth**ar***	'clothe'
masculine *r*-stems	*brōther*	*brōther-*	'brother'
feminine root noun	*kū*	*kī*	'cow'

form is 100%. Salience of the plural (as compared to the singular) was argued to be relevant to the retention of irregular plurals in eight modern varieties of Frisian and English, together with absolute and proportional frequency (Versloot and Adamczyk 2018). Salience may be informally defined as the degree of acoustic prominence of a form, see Sect. 4 for more discussion. It is expected that the same factors that support the retention of archaic forms cross-variationally are also diachronically active within one language. In accordance with this, the present article investigates the question whether the three factors mentioned here (absolute frequency, proportional frequency and salience) are relevant to the retention of archaic, irregular plural nouns in Modern West Frisian (short: Frisian, unless further distinction is required).[1]

The plural morphology of Old Frisian (OF) nouns depended on the declensional class which they belong to. Each class has a set of specific endings for case and number. Table 1 is a list of examples illustrating the plurals of various declensional classes in Old Frisian (e.g. Bremmer 2009:60ff). All forms cited involve the nominative/accusative form. Old Frisian nouns (unlike pronouns) almost always show conflation of the nominative and accusative cases. The nominative/accusative form is generally the most frequent one in the case paradigm. After the erosion of the case system, this form normally provides the basis for subsequent developments.[2] The focus of this article will be on number marking, which, unlike case, still exists in Modern Frisian nouns.

This system was already heavily eroded in late Old Frisian and it was gone by 1600. Our data set consists of all irregular plurals which have roots in Old Frisian and which have been attested in the period between 1600 and 2000 ($N = 15$). This category of plurals is referred to as 'archaic plurals'. They are given below in (1). A star before an archaic form indicates that the irregular plural, though attested after 1600, became obsolete before the 20th century. Constructed regular plurals based on

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[1]Frisian consists of a group of genetically related West Germanic varieties, spoken in parts of the Netherlands and Germany. The largest speech community, ca. 450,000 speakers, is found in the Dutch province *Fryslân*. This article focusses on the dominant variety spoken there, internationally known as West Frisian. West Frisian is not intelligible with the varieties in Germany. Old Frisian is its direct ancestor and is attested between ca. 1250 and 1400.

[2]E.g., the paradigm of 'cow' in the plural was Old Frisian nom./acc. *kī*, gen. *kūna*, dat. **kūum*. The Modern Frisian plural form continues the former nom.acc. form. Exceptions are for example found in words that appear more frequently in prepositional phrases, such as 'street', which is Modern Frisian *strjitte* < OFris. *strēta* (dat.sg.), while the nom.acc.sg. *strēte* would give **striet*.

the singular have been given for comparison in brackets. A star before such a form means that it is not or very rarely heard nowadays.[3]

(1)   15 ARCHAIC IRREGULAR PLURALS ATTESTED BETWEEN 1600 AND 2000 IN WEST FRISIAN.

a) Retention of the OF feminine plural ending (historical ō-stems):

bean – beane	[bɪˑən]–[bɪˑənə]	'bean'	(beanen)
eart – earte	[ɪˑət] – [jɛtə]	'pea'	(earten)

b) Retention of the OF endingless neuter plural form (historical *a*-stems, only *man* was a root-noun):

bern – bern	[bɛn]	'child'	(*bernen)
skiep – skiep	[skiˑəp]	'sheep';	(skieppen)
dier	[diˑər]	'animal'	(dieren)
hynzer	[hĩˑzər]	'horse'	(hynzers → hynders)
ding	[dɪŋ]	'thing'	(dingen)
man	[mɔn]	'man'[4]	(mannen)
skip	[skɪp]	'ship'[5]	(skippen)

c) Retention of incidental OF root alternations based on historical phonological changes that interfered with the historically regular masculine *a*-stem suffix *-an* (*lith* was a neuter *u*-stem, plural in *-a*):

dei – dagen	[dai] – [daːɣən]	'day'	(deien)
wei – wegen	[vai] – [veːɣən]	'way'	(weien)
skoech – skuon	[skuːx] – [skwon]	'shoe'	(→ skoen – skuonnen)
lid – lea	[lɪt] – [lɪˑə]	'limb / member'[6]	(lidden/leden)

d) Remnants of the OF root nouns with *i*-mutation:

ko – kij	[koˑw] – [kɛˑi]	'cow'	(kowen/kûien)
goes – gies	[guˑəs] – [giˑəs]	'goose'	(guozzen)

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[3]The regular plural is expressed in Frisian after 1600 by the endings *-en* and *-s*, which show a largely phonologically defined complementary distribution (see Tiersma 1999:49–52 for an overview of plural formation).

[4]The classification of 'man' is problematic. Old Frisian had *i*-mutation in the nominative and accusative plural in combination with a general rounding of *a* before *n*. The outcome was a sg-pl pair [mɔn]-[mæn]. In the eastern part of the West Frisian and in East Frisian, this appears as <mon>-<man>, in the western part as <man>-<man> in the 14th century. Each form had its own development, not to mention the deviant forms found in the marginal dialects of Hylpen and Skiermuontseach. This complex is definitely worth a closer examination. The present investigation restricts itself to the form found in (the three major dialects of) West Frisian.

[5]The word *skip* shows an alternation in stem vowel between [ɪ] and [iː], which has historical reasons but did not match a clear cut singular – plural contrast (Versloot 2008:177–178).

[6]Tiersma (1999) doesn't mention *lid – lea*, because it is no longer a semantically coherent sg-pl pair in contemporary Frisian. The originally plural form *lea* was reanalysed as an isolated lexical item with the singular meaning 'body' in Modern Frisian and with a regularly formed plural *leaen* 'bodies'. The singular *lid* 'limb, member' developed new plural forms, regular *lidden* [lɪdən] and irregular *leden* [leːdən]. The

Factor	Abbreviation
The salience of the plural as compared to the singular	SAL
The proportion of plurals as compared to the singular	%PL
Absolute frequency of plural forms	#PL

Table 2 Factors correlating with retention of irregular plurals

The four groups taken together yield a total of 15 archaic irregular plurals attested in the early 17th century, after which most of them went out of use. The data have been taken from the corpus Early Modern Frisian (Versloot and Nijdam 2011). These nouns constitute the data set which is used here to discover which factors promote retention, that is, resilience to innovation. Newly created irregulars were not taken into account, but Sect. 6 briefly discusses the question of the creation of new irregularities.

Most of these irregular plural forms have regular side forms in the current spoken language, some of which are also accepted in the written language. The plural of *skiep* 'sheep' is widely realised as the regularised form *skieppen* [skjɪpən] (Goeman et al. 2003: see *schapen*); the oldest attestation of the regular form is from 1736. Alongside the irregular plurals *dagen* 'days' and *wegen* 'ways', one can also hear the regular forms *deien* and *weien*, the latter more frequently than the former (Goeman et al. 2003: see *dagen*, *wegen*); the regular forms are already attested as early as the 18th century. An innovative more regular pair *skoen – skuonnen* [skuˑən] – [skwonɳ] 'shoe(s)' is already attested in the 19th century and nowadays widespread in the spoken language. Competition between plural allomorphs is usually restricted to two forms, an irregular one and a regular one. Only *bern* (sg & pl) 'child, children' has so far been completely unaffected by regularisation. This might be related to the fact that *bern* is the most frequent archaic irregular plural. In addition, as an anonymous reviewer suggests, it might also be related to the fact that it matches an output-oriented plural schema ending in [_n] in the sense of Bybee (e.g., 2007:103), in contrast to the irregulars *kij* 'cows' and *skiep* 'sheep', but we didn't test this factor statistically.

Some irregular plurals appear solely in the spoken language with a specific regional distribution. *Beane* 'beans' and *earte* 'peas' constitute an instance of this. They are nowadays only found among older speakers in the north-eastern part of the language area (Hof et al. 2001:5, 34; Goeman et al. 2003: see *bonen*). The plural *kûien* [kujən] foar *kij* 'cows' is a Dutch loan with a very limited dialectal spread.

Table 2 shows which factors have been found to provide a substantial contribution to predicting the cross-variational level of retention of archaic plural forms in varieties of Frisian and English.

These factors support the retention of archaic forms cross-variationally (Versloot and Adamczyk 2018). Hence we expect that they are also diachronically active within one language. Thus the present article focusses on archaic, irregular plural nouns in Modern West Frisian only, and, on the diachronic order of their regularisation. We hypothesize that the greater the number of linguistic varieties in which a plural form

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latter form is borrowed from Dutch, as is clear from the lengthened vowel, which is characteristic of a small group of irregular plurals in Dutch which do not otherwise occur in Frisian.

survives, the longer it will by and large survive in one specific variety, in this case, in West Frisian.

The data set of this study and the one of Versloot and Adamczyk (2018) have an overlap of 4 items only for West Frisian. The reason is that the starting point of Versloot and Adamczyk (2018) is the stock of Old Frisian and Old English words in a set of minor declensional classes. In contrast, the starting point of the present investigation is the set of all synchronically irregular nominal plurals of archaic origin in the early 17th century, involving those that were members of larger declensional classes in Old Frisian, such as *bern* 'child' and *skiep* 'sheep'.

The outline of this study is as follows: Our main attention will be directed to the statistical analysis of the factors that were mentioned earlier: salience, proportional frequency and absolute frequency. Section 2 deals with methodological issues. Section 3 presents the results of the statistical analysis. Sections 4–6 discusses the results and their implications, dealing successively with salience (Sect. 4), with absolute and proportional plural frequency (Sect. 5) and with the causal interrelatedness of these factors and the role they play in the retention of old irregular plurals. This causal interrelatedness involves the perspective of the speaker, where frequency is relevant for routinisation, and the perspective of the hearer, where frequency is relevant for predictability.

2 Methodology

This study takes as its starting point the nouns which are attested with archaic plural forms in the early 17th century. Each word has been traced back through the centuries, from the 17th till the 20th. Information comes from Early Modern Frisian text corpora and from various dialect surveys (Versloot and Nijdam 2011).[7] The subcorpora 'Middle Frisian' and 'Dialects before 1800' comprise all known 17th and 18th century texts in Frisian, and they have been fully tagged and lemmatised. The process of replacement by regularisation is a gradual one and can take more than a century, sometimes even two or three.

The rate of regularisation has been quantified in the following way: A distinction is made between archaic plurals and regular plurals (cf. the previous section). Every word can score two points for each century. If a noun is solely attested with an archaic plural in a given century, it scores two points for 'archaic' and zero for 'regular'. If a noun is attested only with regular endings, the two points go to 'regular', and, if both archaic and regular forms are attested in one century (irrespective of their proportions), both 'archaic' and 'regular' receive one point. The score for the rate of regularisation will also be referred to as the level of archaism.

The method outlined above may seem somewhat crude, but every quantification used here is necessarily an approximation. The corpus data give us an impression of the shifts in time, but the exact years and amounts of the attestations have a clear

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[7]The most important incorporated dialect surveys from the 19th century are: Aardrijkskundig Genootschap 1879 en 1895 (KNAG 1879), (Siebs 1889). See for a full overview: http://194.171.192.245:8020/tdbport/resources/help/dial.E.html. More 20th century recent material is found in Goeman et al. (2003).

component of chance due to historical accidence. The number of attested tokens all depend on the incidence of sources attested in the corpus, although the corpus of Frisian before 1800 contains *every* known piece of text written in Frisian.[8]

Three examples are given of scoring the rate of regularisation (level of archaism):

(1) The word *bern* 'child' is attested exclusively with an archaic plural form *bern* in the entire period of four centuries. It therefore has a score of 'archaic' = 8, 'regular' = 0.

(2) The word *dier* 'animal' was first attested with a regular *-en* ending in the early 18th century. The archaic endingless plural form was no longer attested in the 19th century and afterwards. The lemma receives the full two points 'archaic' from the 17th century, one point from the 18th, while the other one goes to 'regular', just as the 2×2 points from the 19th and 20th century. This yields a final score of 'archaic' = 3, 'regular' = 5.

(3) The word *bean* is attested with both the archaic plural *beane* and the regular form *bean(n)en* [bɪˈənən]/[bjɛnən] already since the 17th century and this variation was still present in the 20th century. 'Archaic' and 'regular' therefore share the points and each has a score of 4.

The word *hoars* 'horse' (category b) was excluded from the data set. It is only attested once in the plural, in the 17th century. The word was obsolete in the 18th century and afterwards. Hence it was not included in the statistical data.

The word *lea* 'body' received a score of 8 for archaism. The form *lea* survived into the 20th century, but—as mentioned under (1c—fn. 6)—it was morphologically and lexically detached from its original singular *lid*. This is part of a series of processes that take place in instances with plural percentages over 80%. Such a high proportional percentage can lead to lexical split (in the case of *lea*; as an example from English one can mention *clothes*, next to regular *cloths*) or markedness reversal, such as the present day singular forms *beane, earte* 'bean, pea' with the plurals *bean-nen, earten*, instead of the archaic paradigm sg-pl: *bean, eart – beane, earte*. There is no lexical split in the lemmas *bean(e)* and *eart(e)*. We considered the lexical split of *lea* as an extreme form of 'preservation through frequency' and scored it thus.[9] Six independent variables were tested in the statistical model.

1. *The absolute frequency of a plural form, abbreviated as #PL.*
   Because the human mind is sensitive to relative amounts, rather than to absolute, the logarithm of the absolute number of plural tokens was taken (Dehaene 2003). The average of the #PL of the 15 lemmas in the test-set is 5.9, in the total corpus of Early Modern Frisian, consistig of 10350 lemmas, it is 0.3. The 15 words belong

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[8]For a couple of words, the data are too scarce in one or more centuries to compute percentages of innovative forms. We computed average percentages of innovation over the four centuries, taken the averages per century divided by four for eleven items. The correlation between these percentages and the scores that we applied is 0.96 ($r^2 = 0.92$). This supports in our view the reliability of our scoring method. It moreover enables us the use of a logistic regression analysis, which is a favourable technique for binary data (here: archaic vs. innovative).

[9]In the case of *earte* there is something that comes close to such a split, namely the specific meaning of '(green) pea soup' for the archaic plural form (*griene*) *earte*. We presented a paper 'A dynamic Systems Approach to Morphological Irregularity' (A.P. Versloot, E.E. Adamczyk and E. Hoekstra) dealing with the issue of non-linear effects in morphogical irregularities at the 39th Annual Conference of the German Linguistic Society in Saarbrücken (March 9th, 2017).

to the top 1.5% of the lemmas in terms of absolute frequency (#PL). The fifteen values in our dataset are normally distributed.[10]

2. *The proportional frequency of a plural form, abbreviated as %PL.*
   The proportional frequency of a plural form is a proportional measure, more specifically, it is the percentage of plurals where the total number of plural and singular forms is 100%. The average of the %PL of the 15 lemmas in the test-set is 0.54, in the total corpus of 10350 lemmas 0.15. The 15 words belong to the top 15% of the lemmas in terms of proportional frequency (%PL). The values are normally distributed.[11]

3. *Salience, abbreviated as SAL.*
   Salience was quantified on a scale 0 to 1 as a variable that could have 4 values (see for a discussion of this scale in Sect. 4):

   0   no ending
   0.33   vocalic ending
   0.66   consonantal ending (not in this test-set), being the default *-en* and *-s* endings
   1   root alternation, either in the vocalism (*goes – gies*) or the consonantism (*wei – wegen*).

   The values for the salience of the 15 lemmas in the data set are not normally distributed, because most items have either a zero-ending (value 0) or root alternation, which counts as the most salient ending (value 1). There are only two items (*bean, eart*) with the irregular plural suffix *-e*.

4. Syllable: There is one disyllabic word: *hynzer* 'horse'.

5. Gender: The feature of 'gender' was considered but it showed an excessive overlap with Salience ($r = -0.75$), which makes it a confounder of Salience.

6. Semantics: There are six words denoting animals in the list.

The data were statistically analysed in two ways:

- The diachronic data were analysed with a logistic regression analysis, using salience, proportional frequency and absolute frequency and the other three mentioned variables as potential independent variables.[12] Three variables (4, 5 and 6) turned out to be not significant. After these had been eliminated, the final logistic regression model contained three independent variables: #PL, %PL and Salience (SAL);

- The level of archaism (the score for the rate of regularisation) in the aforementioned cross-linguistic study was compared to the diachronic developments in West Frisian (only 4 overlapping lemmas).

The results of the statistical analysis are discussed in Sect. 3 below.

3 Results of the analysis

A logistic regression analysis was performed of the diachronic scores of the 15 Frisian words: *bean, bern, dei, dier, ding, eart, goes, hynzer, ko, lid-lea, man, skiep, skip,*

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[10] $p = 0.895$ in an Anderson-Darling normality test: http://www.xuru.org/st/DS.asp.

[11] $p = 0.355$ in an Anderson-Darling normality test: http://www.xuru.org/st/DS.asp.

[12] For statistical tools, see http://statpages.org/logistic.html.

Fig. 1 The archaism and 'strength' of the 15 nouns, based on their combined values from #PL, %PL and SAL, using the coefficient values from Table 7 (on the X-axis) and the observed (black dots) and predicted (grey dots) archaism score. The X-axis renders the 'strength', the Y-axis the level of archaism, either predicted or acutally observed. The black dots are based on the observed levels of archaism. The smaller grey dots show the ideal positions if the statistical model had a 100% accuracy. The grey dots and the corresponding black one are always found in one exact vertical line.
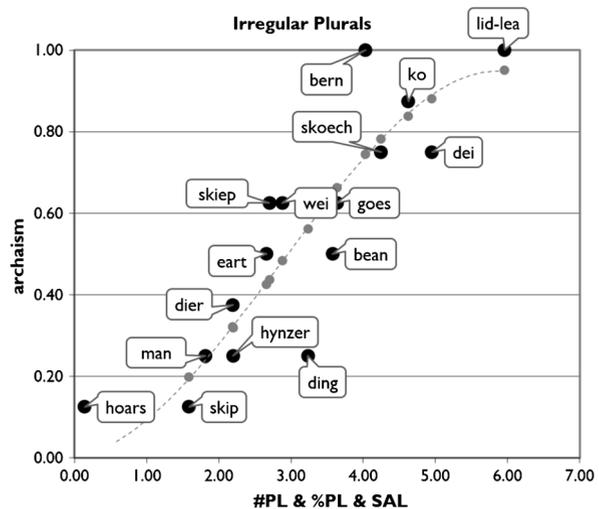
skoech, wei. The full descriptive details of the model are given in Table 7 in the Appendix to this paper. A combined 'strength', or 'resistance against regularisation' can be computed from the three independent variables #PL, %PL and SAL together, using the coefficients from Table 7, which can be compared with the actually observed level of archaism. Figure 1 offers a visualisation of the results of the logistic regression analysis.

The logistic regression model links a prediction about the archaism score to the 'strength'. This prediction is shown with grey dots in the figure. It is compared to the actually attested level of archaism score, which is shown by the black dots. The prediction and the actual value for one noun are thus to be found in one vertical line, pin-pointed by the 'strength'. For some words, the prediction and observed level of archaism are very close, such as for *man*, *ko* or *skoech*. Others show larger deviations, such as *ding* and *bern*. Such strong deviations can be a sign that something is incorrect in the input data or rather, that the real course of events is slightly more complex than instantiated in the data set.[13]

The word *hoars* 'horse' was not included in the statistical data set, because it didn't regularise, but rather disappeared and was replaced by another lemma, i.c. *hynzer*. Still, a level of archaism can be computed, using the absolute and relative frequency features from the 17th century, as well as its salience, applying the model parameter settings from Table 7. It was plotted in Fig. 1. The lemma turns out to have a low score on all three variables, which is in line with its ultimate demise. It must have

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[13]The word *ding* may reflect that it is was partly reshaped by Dutch interference. The oldest sources in the 16th century show *ting* < OF *thing*. The borrowing from Dutch may have triggered the Dutch plural ending *-en*, even when *ding* (pl.) is attested as well, and led to a lower level of archaism than expected by the word's frequency profile.

been a noun with high frequency in earlier times, just as *ko* and *dier*, before it was ousted by *hynzer*.[14]

The impact of the three variables is roughly comparable, with coefficient values between 2.0 and 2.6 and Odds Ratios between 7.6 and 13.2. The three variables are technically entirely unrelated: the correlation (r) between each of them never exceeds ($\pm$)0.17. In terms of correlation between the independent variables and the dependent variable, SAL is the best predictor ($r = 0.63$, for the other two $r < 0.35$), but this value is probably distorted by the fact that SAL is not normally distributed. Moreover, it should be kept in mind that within the entire corpus, there is a strong correlation between both #PL and %PL on the one hand and the retention of archaic forms on the other, because the 15 nouns' values belong to the top frequencies in the corpus with respect to #PL and %PL-values.

Altogether, the variable values being as they are, the correlation (r) between the predicted level of archaism and the observed level is 0.86; the explained variance (r^2) is 0.74. This means that the three variables #PL, %PL and SAL taken together explain 74% of the observed variation in the degree of resilience which the 15 words studied here display between 1600 and 2000. This may be considered to be a strong predictive value.

4 Salience

Salience is operationalised in the literature in two ways:

– salience through acoustic prominence also known as perceptual salience, i.e. the number and quality of phones (Goldschneider and DeKeyser 2001:22–23);
– salience in terms of iconicity and complexity (e.g. Corbett et al. 2001; Dammel and Kürschner 2008).

The null form or zero ending is treated differently under the two approaches. Under the iconic approach, the zero-ending is a non-iconic ending. Hence, it is viewed, at least in the context of the Germanic languages, as being more salient (defined in terms of iconic complexity) than the default plural suffixes. Under the acoustic approach, the null form is the least salient ending (defined in terms of acoustic prominence). Below we will argue that the acoustic approach makes better predictions than the iconic approach.

In Corbett et al. (2001) zero plurals are interpreted as being more complex than the regular suffixes. Corbett's approach to the irregularity of endings matches the one used in Dammel and Kürschner (2008:251) where endingless plurals are interpreted as 'more complex' because "zero marking violates one-function-one-form", a basic principle of iconicity (Dammel and Kürschner 2008:248). Following the principles of *Iconicity of quantity* and *Iconicity of complexity*, plurals are expected to be more overtly expressed than singulars (Haspelmath 2008a:2).

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[14]The word is still found as *ho's* in the Frisian dialect of the Island Skylge (Terschelling), where it is attested both with the archaic endingless plural as well as with the regular plural *ho'zen* (Knop 1954). This dialect is no longer part of the Frisian linguistic continuum and its evidence is not considered in this study.

Table 3 Length and absolute frequency of the forms of nominal endings (representing case and number) in the Old Frisian Old Skeltariucht (Steller 1926; Sytsema 2012)

Ending	Frequency	Log (Freq)	Length (salience)
ø	456	8.8	0.00
e	329	8.4	1.00
a	276	8.1	1.00
es	81	6.3	2.00
um	64	6.0	2.00
an	52	5.7	2.00
ena	8	3.0	3.00

We adopted an absolute interpretation of the salience of the zero ending in Sect. 2, not an iconic one. This can be underpinned by considering the correlation between salience scales and frequency. The longer a word is, the more salient it is. Conversely, loss of salience involves shortening. It is already known since Zipf (1935) that word length generally shows an inverse correlation with absolute frequency. This applies not only to words in general, but also to inflectional endings. The following table presents the sheer forms of the nominal endings used to represent all case and number combinations, taken from the late 13th century Old Frisian text of the Old *Skeltariucht* (Steller 1926; Sytsema 2012). It shows that there is a correlation between absolute frequency and salience, where length of the ending in phonemes is used as a proxy for its salience.

As the values for frequency involve large numbers, they are standardly scaled down by a logarithmic transformation. This yields values which have been given in the column Log(Freq), that is, the logarithm of the frequency. Length just counts the number of phonemes of the ending. Length has been used as a proxy for salience. This means that the higher the value for the length of the ending is, the more salient it is.

The correlation between the logarithm of the token frequency (for all lemmas together) and the salience of the ending is strong and significant: $r = -0.95$ ($p < 0.01$). It provides support for the claim that the zero ending is the least salient one.

Phoneme length gives us an acoustic interpretation of salience in terms of length, but it does not distinguish between two different phonemes, such as -*a* and -*e*. Nevertheless, we wouldn't want to say that -*a* and -*e* are equally salient in terms of acoustic prominence. Absolute length measures acoustic prominence, but so do formant frequencies. The absolute length in Table 3 can be refined with a purely acoustic interpretation in terms of phonetic formant frequencies, according to which -*e* is in its turn less salient than -*a* (see for historical evidence for this interpretation Versloot 2008:258–275).

This provides the following building blocks for an over-arching salience scale: various ways of expressing the plural can be ranked in terms of salience. The over-arching morpho-phonological salience scale stretches from the lowest form of salience, the lack of any plural marking, over various suffix forms to the most out-

	Declensional class	Archaic inflectional marker(s)	Percentage of innovation in the plural
Table 4 The relevance of the morpho-phonological Salience scale for the process of analogical levelling of endings in Old English. Table taken from Versloot and Adamczyk ([2018](#))	r-stems	Ø	82%
	i-stems	vocalic *-e*	80%
	u-stems	vocalic *-a*	71%
	s-stems	*r*-formative	36%
	nd-stems	*i*-mutation	9%
	root nouns	*i*-mutation	6%

standing, irregular and complex form.[15] The highest place on the salience scale is taken by nouns with root alternations, such as *goes – gies* or *dei – dagen*.

This salience scale, based on acoustic prominence, testifies to a reverse correlation between the salience of the ending, on the one hand, and the inclination to introduce regular endings. This can be illustrated with data from Old English, illustrating the following correlation: the more salient an irregularity is, the less it will be subject to change, that is, to innovation or regularisation. This correlation is illustrated in Table 4.

The archaic inflectional markers have been ordered in rows depending on their salience, where increased salience is graphically represented by increased shading. The first row contains the least salient marker, the last row contains the most salient marker. As the degree of salience goes up, the percentage of change in the plural goes down. The correlation in Table 4 is nearly perfect ($r^2 = 0.91$, $p < 0.01$; the salience of the plural markers was projected on a scale 0–1 with equal intervals), providing support for the claim that the zero marker is the least salient one, and thus most prone to change because of its low relative salience (salience as compared to the singular). The *i*-mutation as a form of root alternation is very salient, and thus least prone to change. The fact that zero plurals are most prone to change in Table 4 demonstrates that salience of endings correlates with an absolute interpretation of the zero ending, i.e. as non-salient. The results in Tables 3 and 4 disconfirm the claim that zero endings are complex, hence salient.

The most important difference between the studies like Corbett et al. ([2001](#)) and Haspelmath ([2008a](#), [2008b](#)) and this one is that while here the concept of salience is believed to contribute as an independent variable to the preservation of irregular endings, in the other studies the emergence or preservation of irregularities is considered as the dependent variable, controlled by frequency factors. What is potentially at stake here is a positive feedback loop: frequency (in any form) contributes to the emergence and preservation in the language of non-iconic, irregular morphological forms, which in their turn become an independent factor in their own survival.

Haspelmath argues that the differences in expression may have the effect of iconicity, but are not its result. In his argumentation, it is the proportional frequency of the plural in relation to the singular, that causes these differences, because the higher fre-

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[15]In view of the iconicity principle (Wurzel [1989](#)), which requires one form for one meaning and hence one root allomorph for one lexeme, nouns with root alternations can be considered the most complex ones (see also Dammel and Kürschner [2008](#): 250).

quency will lead to higher predictability and hence to a shorter form, guided by the economy principle (Haspelmath 2008a:5). Our results support Haspelmath's claim that proportional frequency is an important factor. This is particularly illustrated by items such as *beane* 'beans' and *earte* 'peas', which survive because of their high proportional frequency. However, our results indicate, in addition, that absolute frequency and salience are important factors in their own right, as well, as is illustrated by items such as *man* 'men', which has a high absolute frequency, and *wegen* 'ways', which is very salient. These examples are discussed in more detail in Sect. 5 below.

5 Proportional and absolute frequency corresponding to speaker routinisation and hearer predictability

The variables in the statistical model all three provide a statistically significant contribution to the retention of the nouns with an irregular plural form. Independent support for the relevance of proportional frequency has been given in Tiersma (1982) and Haspelmath (2008a, 2008b), among others. The interaction between the three factors can be illustrated with a couple of examples.

- The word *eart* has a low salience of its plural marker (vocalic schwa -*e*) and is the noun with the lowest #PL-frequency. But it is its high proportional frequency of the plural of 0.84 that helps it to survive.
- The word *man* didn't have a salient plural form and it is so frequent in the singular, that its %PL is rather low (0.12). But its absolute frequency, also in the plural is fairly high and that makes that it survived in some dialects with an archaic plural form into the early 18$^{\text{th}}$ century and in fixed idioms even up till today (*trije man* 'three people'). In other contexts, the plural was not simply regularised, but a new, irregular plural was developed: *manlju* [mɔ̃:λə], all facilitated by a high absolute plural frequency.
- The noun *wei*, plural *wegen*, has a low absolute and proportional frequency of the plural, but it has a high salience. The low absolute frequency is a relative characterisation, namely within this set of words.

The statistical analysis made it clear that the three variables are independent of each other. At first blush, this result is contradictory with a conceptual causal perspective, for a high proportional frequency depends on a high absolute frequency. Let us consider some examples to make this clear. Let us make the inevitable assumption that both the singular and the plural cannot have a frequency of zero, that is, they must be attested. As a result, an absolute frequency of 2 yields a maximal proportional frequency of 1/2. An absolute frequency of 3 yields a maximal proportional frequency of 2/3, and so on. Thus the maximal proportional frequency is clearly dependent on the absolute frequency, in case the absolute frequency is low, but this dependence decreases as the absolute frequency increases. All the plurals investigated have high absolute frequencies. As noted earlier, the 15 irregular nouns belong to the top 1.5% of nouns with the highest #PL-frequencies. This explains that the proportional frequency appears to be independent of the absolute frequency, contrary to what the causal analysis suggests.

Frequencies of words are perceived and represented in the human brain. The question arises how frequencies relate to the concrete processes of language production and language interpretation. There is a debate in the literature whether the correlation, as observed in Table 4, is the result of routinisation or predictability. The former is claimed to be speaker-based, the latter hearer-based. Haspelmath clearly takes a hearer-based position:

> To be sure, routinization often co-occurs with reduction of form, because forms that are routinized for the speaker are often also predictable for the hearer. But in such cases the cause of the reduction is not the routinization, but the speaker's tendency to save energy when part of the message is predictable. [...] Thus, frequency-induced reduction is to a large extent a hearer-based phenomenon and is not due to routinization, but to predictability. (Haspelmath 2008b:59–60).

However, language is by its very definition a process of production *and* perception, and it would be surprising if one of these two aspects were irrelevant. A bidirectional approach to grammar (Boersma 2011) requires that both the hearer and the speaker-based aspects are needed: no speaker will intentionally reduce a form (or morph) because s/he assumes that it is predictable for the listener. There is a speaker-based inclination to reduce any form (articulatory ease), which is amplified by routinisation: the higher the frequency (more routine) the stronger the inclination to articulatory reduction. This reduction is acceptable in a conversation until a minimal level of successful perception by the listener. This minimal level is controlled by Haspelmath's predictability. This means that routinisation is a necessary but not sufficient requirement for successful reduction of forms. The absolute plural frequency (#PL) can be linked to the effect of routinisation for the speaker, the proportional frequency of the plural (%PL) to the effect of predictability for the hearer.

The importance of #PL for reduction is not limited to the length of the ending. Other forms of reduction processes may also lead to complexity, rather than mere shortness. An example is the implementation of *i*-mutation that forms the basis for the plural marking by root alternation, which is considered to be both irregular, complex and salient. The origin of *i*-mutation is a process of place assimilation between vowels in two adjacent syllables: in the nominative plural of the word 'goose', PGerm. *$g\bar{o}si(z)$, the -*i* caused a regressive place assimilation of the root vowel: *$g\bar{\phi}si$. This initially allophonic alternation received phonological meaning after the reduction and eventually apocope of the final vowel: Old English $g\bar{\phi}s > g\bar{e}s > $ Mod. English *geese*. Such assimilation processes are stronger in allegro speech, which comes with routinisation as a consequence of high absolute frequency. In order to be learned and remembered by following generations of speakers, the form also has to fulfil the criterion of predictability, which comes with a high proportional frequency of occurrence. It seems however, that this is a supporting but not exclusively needed requirement. High absolute frequency can also help to learn and memorize forms that are less predictable from their proportional frequency. The most resistant irregular plural form in the modern language, *bern* 'children' has a low-salient endingless plural and is particularly resistant because of its high absolute plural frequency (#PL). It is exactly this combined effect that is reflected in the fact that the 15 words with irregular plurals in early 17th century Frisian belong to the top 1.5% of words with a high #PL and the top 15% of the words with a high %PL.

Table 5 The relevance of #PL and %PL for irregular plurals with and without some form of historical phonological (reduction)process. The contrast between the averages for #PL are statistically significant in a T-test ($p = 0.05$). Note that the #PL is a logarithm of the token figures

Irregularity in the plural	Average #PL	Average %PL
With phonological change	6.21	0.52
Without phonological change	4.66	0.87
Overall	5.93	0.54

The specific relevance of both types of frequency in the emergence of irregular plural forms is clearly visible in the data set for this study (see Table 5). Most of the forms are the result of historical phonological reduction processes, which are supposed to be primarily associated with routinisation. Examples are:

gies < OF *gēs* < PFris. **gōsi* with *i*-mutation and subsequent loss of the final syllable after a heavy root syllable, an effort-of-speech related phenomenon;

dei – dagen with the pre-Old Frisian reduction in the singular *dei* < PFris. **dægə* and with 14th century vowel harmony in the plural: *dagen* < *dagan* < *degan*;

bern < **barnu*: with a pre-Old Frisian apocope of word final short -*u* after heavy syllables.

The different roles of the two types of plural frequency become apparent in the two nouns without phonological reduction in the plural: *earte* and *beane*.[16]

The plural forms *earte* and *beane* are the regular continuations of the most common Old Frisian form of plurals of feminine nouns. The forms only became 'irregular' when the grammatical category of feminine gender disappeared, not because the ending in itself underwent any special development. They purely survive because of their high %PL, which belong to the top three in the set of 15 lemmas.

This account shows that changes induced by routinisation (absolute token frequency), which are blind for any functional goal such as iconicity, may produce both highly salient (*gies*) and low salient (*bern*) plural forms. The proportional frequency of the plural (%PL), which expresses the hearer-oriented predictability effect, contributes strongly to the preservation of irregular forms, but the absolute frequency also plays a role in the memorisation of irregular and rare forms. Even when there is a causal relation between frequency and the emergence of some endings, there is no automatic correlation between the synchronic salience and either of the two frequencies within the set of irregular nouns.

6 Retention and creation of irregular forms

The retention of various Old Frisian and Old English plural forms had been charted and analysed in eight modern varieties of Frisian and English (Versloot and Adamczyk 2018). The latter study and our own both conclude that the factors relevant for irregular plurals are salience and proportional and absolute frequency. It is instructive

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[16]The plural *wegen* with a pre-Old Frisian reduction in the singular takes a somewhat intermediate position.

Table 6 Comparison of retention of archaic plural forms in the two studies

Lemma	Archaic in 6 modern Frisian dialects	Diachronic archaism score for West Frisian
mon 'man'	0.00	0.25
gōs 'goose'	0.50	0.63
kū 'cow'	0.67	0.88
lith 'limb'	0.83	1.00

to compare the set of irregular plurals which both studies rely on. The comparison of the cross-linguistic study in Versloot and Adamczyk with the present one yields four overlapping lemmas, which are presented in Table 6.

The 'archaism'-scores refer to different processes: the one of Versloot and Adamczyk is the result of the comparison of 6 Frisian varieties from the 19$^{\text{th}}$ and 20$^{\text{th}}$ century. The present study describes how long the archaic plural was still current in West Frisian, after the year 1600. Despite this difference, the same factors are at work, and, for that reason, they are expected to correlate. The correlation between the two scores is nearly perfect: $r = 0.99$, $p < 0.01$. This shows that the hypothesis is not dismissed by this comparison.

There is a difference between the two studies as far as the role of absolute frequency is concerned. Versloot and Adamczyk (2018) found that absolute frequency was particularly relevant for the creation of new, irregular forms, while proportional frequency is rather important as a conserving factor. It was investigated whether this was also true for the 15 nouns in this study. An additional Logistic Regression Model was computed with scores on present day regularity or irregularity (see Table 9 and 10 in the Appendix). The noun *man*, for example, has an irregular plural form *manlju* which is a new irregularity. The word *bean* 'bean' developed a new plural *bjennen*, with a – more widespread but not entirely predictable – type of root vowel alternation. In the model incorporating the new irregularities, proportional frequency does not make a significant contribution: the significant factor of the two types of frequency is indeed absolute frequency. Both studies thus support the conclusion that absolute frequency is more strongly associated with new irregularities, while proportional frequency is more relevant for the retention of archaic forms.

The importance of absolute frequency is in line with the earlier observations that it expresses routinisation, which leads to allegro-speech with various possibilities for phonological reduction and assimilation processes. These developments are in principle blind for the system as long as they don't affect the interpretability of the language in a negative way. It was earlier concluded that the hearer's predictability is mostly supported by proportional frequency biases, but that absolute frequency also plays a role in the successful memorisation and recognition of irregular forms.

7 Concluding remarks

Proportional frequency, absolute frequency and salience each make their own substantial contribution to the retention of irregular plural forms, as was shown in this article, and, if we may extend our view with the aid of commonly accepted linguistic

knowledge, these same factors are at play in the emergence of irregular plural forms. Consider absolute frequency first. High absolute frequency may lead to phonetic reduction through automation or routinisation, which explains that irregularity easily emerges in high frequency words. The process of *i*-mutation is in all likelihood an example of this, creating *ko – kij* 'cows'. After the demise of *i*-mutation, high absolute frequency promotes the retention of the plural against regularisation. Thus absolute frequency is a factor both promoting retention and causing new irregulars to emerge.

Proportional frequency is a concept that is less well understood than absolute frequency. Semantically, animals and vegetables are clearly examples in which the plural is likely to be proportionally frequent as compared to the singular, especially in an agricultural society. Tiersma (1982) pointed out many examples of this kind, also drawing attention to recently emerged irregulars such as pieces of clothing like *learzens* 'boots' (singular: *lears*).[17] Boots come in pairs of two, hence as a plural. Such words have an increased probability of developing an irregular plural, as they did in Frisian. Nevertheless, it is not quite clear why proportional frequency should be a factor favouring retention. Why should a plural form, that is relatively frequent as compared to the singular, have a tendency to be irregular? Tiersma (1982) relies on a process of 'reanalysis' applying to concepts in which the plural is 'unmarked' semantically with respect to the singular. According to Tiersma, this may lead to what are historically double plurals. But his account does not explain the existence of zero plurals, which are part of the same phenomenon. And in the absence of a formalisation of the process of reanalysis it is hard to evaluate his proposal.

A possible explanation for the relevance of proportional frequency runs as follows. An irregular plural is often shortened, as compared to the hypothetical regular plural. Remember that Zipf already showed that word length has a tendency to inversely correlate with absolute frequency. Normally, the regular plural is less frequent than the singular, and correspondingly, the regular plural is both longer than the singular and regular in its relation to it. This implies that regularity of plural formation itself correlates with a normal relation of proportional frequency between singular and plural. Irregular plurals may then be viewed as a marker of an abnormal (reversed) frequency relation between singular and plural. In many cases, the irregular plural is shorter than a regular plural would have been. Compare vowel change plurals like *kij* to the hypothetical regular plural **kowen* 'cows' or zero plurals like *skiep* to **skieppen* 'sheep'. Needless to say, this is a hypothesis to be investigated in future research. So, although it is intuitively clear that proportional frequency is related to semantic concepts for objects which are relatively often used in the plural (as compared to the singular), it is upon closer inspection not clear why this should be a factor promoting irregularity either with respect to retention or emergence (cf. Haspelmath 2008b, who stresses the aspect of predictability).

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[17]Tiersma (1982:834 ff) also pointed out that breaking, which often accompanies plural formation and other morphological phenomena, is sensitive to high proportional frequency. Note incidentally that breaking is also sensitive to absolute frequency (De Graaf and Tiersma 1980), which is unexpected on Tiersma's account. Breaking is the process by which a diphthong is 'broken' into a glide followed by a short vowel. For example, *beam* 'tree' /bɪ.əm/ is 'broken' in the plural to *beammen* /bjemmən/. As a process which is phonetic in origin but codified in the lexicon, it is comparable to shortening in the plural. Absolute frequency is a factor which explains to a large extent why some words are broken and others are not (see also Van der Meer 1985).

Salience is the third factor promoting retention. We provided a quantitative measure of salience and argued that salience should be viewed as acoustic prominence, which explains why it shows a correlation with word length, since word length, as measured in number of phonemes, builds up acoustic prominence. The three factors discussed here are historically interrelated in sometimes very complex ways with surprising positive or negative feedback loops. Thus, an irregular plural is more salient in case its irregular marking is longer (for example: *dagen* 'days' as compared to *dei* 'day'), but this tendency will be counteracted by a tendency to shorten words if their absolute frequency is high. Furthermore, the salience of the ending itself is the product of frequency induced processes, but once emerged, salience also contributes to the stability of a form. The salience scale applied in this study and in Versloot and Adamczyk (2018) offers a better predictor of change and stability than an iconic interpretation in terms of complexity.

Because synchronic distributions are the product of a historical development, the processes of emergence and retention are two aspects of the same mechanism, although this certainly requires further research for emergence. Our analysis is based on data from Frisian, and Versloot and Adamczyk (2018) was based on several varieties of English and Frisian, but of course, our analysis of irregular plurals should also be tested against data from other languages.

Appendix

Table 7 Descriptives of the logistic regression model for the retention of archaic plural forms in West Frisian during the last four centuries. The underlying data are presented in Table 8

Descriptives...

52 cases have $Y = 0$; 68 cases have $Y = 1$.

Variable	Avg	SD
#PL	0.4540	0.2790
%PL	0.5393	0.2393
SAL	0.4440	0.4662

Overall model fit...

Chi Square $= 29.3373$; $df = 3$; $p = 0.0000$

Coefficients and standard errors...

Variable	Coeff.	StdErr	p
#PL	2.583	0.8319	0.0019
%PL	2.362	0.9370	0.0117
SAL	2.036	0.5059	0.0001
Intercept -2.9580			

Table 7 (*Continued*)

Odds ratios and 95% confidence intervals...

Variable	O.R.	Low–high
#PL	13.2357	2.5921–67.5849
%PL	10.6159	1.6917–66.6157
SAL	7.6566	2.8405–20.6385

Avg. = average; *SD* = Standard deviation; *df* = degrees of freedom = number of independent variables

The *p-value* of the total model is less than 0.05 and therefore the model is considered to be statistically significant

Coeff. expresses the arithmetic weight factor of the variables in the total model, presented alongside the Standard Error (StdErr) and probability (*p*). The last one must be below 0.05 if it is to constitute a significant contribution to the total model

The Odds Ratio (O.R.) is defined as the increase of likelihood in the dependent variable per single unit increment. All variables are on a scale between 0 and 1. Hence the Odds Ratios express in practice the increase of likelihood from the lowest value of the variable to the highest. The #PL was rescaled to that range for this specific purpose

Table 8 Dataset underlying Table 7

	#PL(0–1)	%PL	Salience	Syll	Gender	Semantics	Innovative	Archaic
hynzer	0.38	0.52	0	1	1	1	6	2
dier	0.43	0.46	0	0	1	1	5	3
skiep	0.45	0.65	0	0	1	1	3	5
bern	1.00	0.61	0	0	1	0	0	8
skip	0.23	0.42	0	0	1	0	7	1
goes	0.06	0.61	1	0	0	1	3	5
ko	0.50	0.55	1	0	0	1	1	7
ding	0.75	0.54	0	0	1	0	6	2
man	0.59	0.12	0	0	0	0	6	2
lid-lea	0.68	0.92	1	0	1	0	0	8
skoech	0.29	0.61	1	0	0	0	2	6
eart	0.00	0.84	0.33	0	0	0	4	4
bean	0.31	0.89	0.33	0	0	0	4	4
wei	0.24	0.10	1	0	0	0	3	5
dei	0.90	0.25	1	0	0	0	2	6

Note that the #PL and the Salience have been stretched between 0 and 1, to make every independent variable ranging between 0 and 1, creating comparable Odd's Ratios

Table 9 Test set for #PL and %PL and synchronic irregularities

Singular	Dominant plural	#PL(0–1)	%PL	Regular	Irregular
bern	bern	1.00	0.61	0	2
dei	dagen	0.90	0.25	0	2
ding	dingen	0.75	0.54	2	0
lid	leden	0.68	0.92	0	2
man	manlju	0.59	0.12	0	2
ko	kij	0.50	0.55	0	2
skiep	skjippen	0.45	0.65	1	1
dier	dieren	0.43	0.46	2	0
hynzer	hynzers	0.38	0.52	2	0
bean	bjennen	0.31	0.89	1	1
skuon	skuonen	0.29	0.61	2	0
wei	wegen	0.24	0.10	0	2
skip	skippen	0.23	0.42	2	0
guos	guozzen	0.06	0.61	2	0
eart [jet]	jetten	0.00	0.84	2	0

The regular–irregular scores are given in a similar way as the archaism scores. Fully irregular (type frequency = 1) gets 2 points for 'irregular', non-dominant patterns with type frequency > 1 get one point in each column and entirely predictable plural forms receive 2 points for 'regular'

The dominant plural forms may differ for various speakers of Frisian. Some people will argue that the most common plural form for *man* is nowadays *mannen* and hence regular. That does not affect the outcome in a sense that of #PL and %PL only the former is a statistically significant predictor of the synchronic irregularity

Table 10 Descriptives of the logistic regression model for the distribution of synchronically irregular plurals in West Frisian

Descriptives...

16 cases have $Y = 0$; 14 cases have $Y = 1$.

Variable	Avg	SD
#PL	0.4540	0.2790

Overall model fit...

Chi Square = 9.6471; $df = 1$; $p = 0.0019$

Coefficients, standard errors, odds ratios, and 95% confidence limits...

Variable	Coeff.	StdErr	p	O.R.	Low–high
#PL	5.0396	1.9994	0.0117	154.4054	3.0675 7772.2509
Intercept	−2.4209	0.9908	0.0146		

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