Journal of Germanic Linguistics **35.1** (2023):69–95
doi: 10.1017/S1470542722000083

Nominal Compounds in Old English Meter and Prosody

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What is the lexicon's role in licensing the selection of phonologically-marked structures in Old English verse? Specifically, what is its role in the avoidance of certain nominal compounds in verse, even though the same compounds are used apparently freely in prose (Terasawa 1994)? Using a simulation of the Old English lexicon, we offer a statistical analysis of the poetic use of nominal compounds compared to the availability of relevant prosodic structures in the ambient language. In the process, we unify Terasawa's separate constraints and demonstrate a new way of addressing the complex interplay between Old English prosody and the structure of Old English alliterative meter. Our results endorse Terasawa's position: We find that the dispreference for nominal compounds of the XX-LX type is a general but noncategorical property of Old English. We attribute their highly restricted usage in verse to the demands of poetic diction and their incompatibility with the metrical templates that scops and scribes replicate. Additionally, while syllable weight factors into metrical organization, it does so less for stress placement, which remains morphologically grounded; this asymmetry in the ranking value of weight between poetry and prose is considered briefly in the context of the Old English monastic scribal training.

Keywords: Old English lexicon, poetic diction, Terasawa's constraints, syllable weight, stress

1. Introduction.

Compounding is a strikingly productive pattern of Germanic and Old English word formation. Compounds are universally regarded as one of the most important characteristics of Old English (OE) poetic diction. However, neither the density of recorded compounds in verse—literal or figurative (that is, *kennings*)—nor the high proportion of compound *hapax legomena* in verse match their distribution in prose texts. Moreover, only less than 1% of the surviving OE records in Cameron et al. 2018 (Dictionary of Old English; henceforth DOE) are verse texts. The sheer volume of extant nonpoetic material suggests that the number of compound forms in the prose would exceed the attestations in verse—yet quantitative evaluations of the two types of lexicons have not been attempted. In contrast, the discrepancy between the phonological structure of compounds in poetry versus those in prose has attracted significant attention and has become an important evidential source for OE metrical scholarship and accounts of OE prosodic structure. We seek to address the earlier findings in the light of new lexical data.

The different lexical choices in verse and prose were first brought to attention in an early 20th-century study by Weyhe (1905). He found that in poetry, nouns whose forms vary between #H(eavy)# or #HL(ight)# appear preferentially as monosyllables as the first member of compounds in which the second member starts with a stressed light syllable L-, followed by any syllable (X). For example, the exclusively poetic word *hild(e)* 'battle, war', appears consistently as *hild-* when followed by LX nouns, as in *hild-stapa* 'warrior', while *hilde-* is the form on record for compounds with H(X) second elements, as in *hildebord* 'battle-shield', *hilde-lēoma* 'battle-light', *hilde-dēofol* 'demon'. Taking this observation as his starting point, Terasawa (1994) conducted a meticulous survey of the use of nominal compounds (NNs) in the entire OE poetic corpus. He underscored the remarkable density of NNs in the poetic diction compared to the relatively lower rate of NNs in the prose, an a priori recognition of the great stylistic significance of these lexical choices. In addition to documenting the paucity of HX-LX compounds, he recorded dispreference for LX-LX compounds. Our main goal in this paper is to match the empirical solidity of Terasawa's findings for poetic compounds to the patterns of compounding in the entire OE lexicon.

The structure of the paper is as follows. Section 2 surveys the compound types avoided in poetry, as reported by Terasawa (1994), and provides the philological detail for identifying, counting or excluding entries from the database. Section 3 addresses the rationale for revisiting the patterns of compounding in the entire OE lexicon, presents the corpus details (doi.org/10.17605/OSF.IO/J9FY7), and describes the procedures for the statistical analysis. Section 4 covers the specifics of the analysis. The discussion in section 5 places the analysis within the linguistic and sociocultural context of the meter-prosody interface. Our concluding remarks in section 6 point to further directions of research in that area.

2. Terasawa 1994: Data and Database Overview.

2.1. Terasawa's (1994) Metrical Constraints.

Terasawa's (1994) expanded empirical database of poetic NNs makes it possible to identify two types of NNs regarded as unsuitable for placement in verse (Terasawa 1994:11–12, *passim*; 2011:7–76). The examples in 1 contain compound types avoided in the verse corpus.

(1) a. *LX-**LX**: *here-rinc* 'war man', *here-grīma* 'war mask', OK in verse versus *here-toga* 'war leader' (mostly prose)

b. *HX-**LX**: *ellen-dǣd* 'deed of valor', *ellen-mǣrþu* 'fame for valor' OK in verse versus *ellen-hete* 'fierce hatred'[1]

Terasawa referred to the consistent avoidance of these patterns in OE verse as "metrical constraints"; in subsequent OE scholarship, they are commonly known as Terasawa's Law (Hutcheson 1995, Russom 1995, Suzuki 1996, Fulk 2007, Goering 2016a). We refer to the constraints exemplified by the data in 1 as Terasawa's Constraints (TCs). Their modified version is provided below:

(2) a. TC1: Avoid compounds of the shape HX-LX
(Potentially, these undergo repair to become H-LX)

b. TC2: Avoid compounds of the shape LX-LX

[1] Rare: a single DOE attestation in *Lit* 4.3.5 25 (prose). Similarly, *hēafod-beorg* 'head protection', *hēafod-māga* 'close kinsman' OK in verse versus *hēafod-stede* 'chief place' (prose only).

Terasawa's presentation of NNs usage separates *Beowulf* from the rest of the poetic corpus, with further subdivisions of the material based on genre. The strikingly low occurrence of -LX compounds in the entire poetic corpus is initially puzzling; other compounds of that shape, while rare in verse, appear to be used freely in prose. His limited coverage of the patterns of NNs in the prose corpus (1994:60–62) overviews the distribution of the roughly synonymous words for 'leader/chieftain/commander': *here-toga* (LX-LX) versus *folc-toga* (H-LX), *here-wīsa,* and *here-tēma* (LX-HL), showing a lopsidedly more frequent use of *here-toga* in prose: *n*=161 occurrences in prose versus *n*=3 elsewhere.[2] The example of prosaic *here-toga* and poetic *folc*-toga, a brief comparison of the *Prose Boethius* versus the *Meters of Boethius* (1994:61–62), and a commentary on the preference for uninflected forms for the second element in verse, such as *ende-dæg* 'last day', *here-paþ* 'main road' versus inflected *ende-dæge(s), here-paþe(s)* common in prose and charters, leads him to the conclusion that TCs "are metrical or poetic rather than phonological" (Terasawa 1994:62–63). We believe this to be a well-reasoned inference, yet it leaves open the question of how the verse data fit within a much more inclusive picture of observed versus expected patterns of compounding in the entire lexicon. To answer that question, we look at some philological information on the data included in our analysis.

2.2. Stem Variability in the NN Data.

A key aspect of the analysis of the NNs distribution in the compounding data is the metrical treatment of sonorant-final stems subject to parasiting (anaptyxis/epenthesis) and syncope, in which the sonorant is either consonantal or syllabic. Thus, an originally monosyllabic word such as *wundor* 'wonder', Old Norse (ON) <undr> would have been subject to parasiting by the 7th century, but it can scan as mono- or disyllabic: *Beo* 920a versus *Juliana* 575b (Fulk 1992:66–91, 2007). The metrical

[2] *Here-toga* is heavily used in glosses; DOE definitions 1a, 1d, and 4. *Folc-toga*, *here wīsa*, and *here-tēma* are attested only in verse, except for a single questionable occurrence of an item spelled <hereteomie>, read also as <hereteowie>, glossing Lat. *dux* in *Ælfric's Grammar* (manuscript damaged, DOE).

treatment of such forms supports Fulk's position that the stability of etymologically monosyllabic HR, orthographic <H(V)R> stems, realized as a single H in *Beowulf* and in other early verse, is significant for the dating of the poetic corpus. Presonorant epenthesis in both HR and the much rarer LR forms was early, variable, and gradual. In some items, such as *ātor* 'poison', ON <eitr>, *meðel* 'assembly', Gothic <maþl>, this can be tested in the late verse, where rarer monosyllabic forms must be related to formulaic diction, which makes disyllabic realization of such forms in speech highly probable.

Variability in speech extends to originally disyllabic LH stems, such as *gomen* 'mirth' and *heofon* 'heaven', which are considered targets for what Terasawa (1994:27, 41 and passim) identifies as "pseudo-epenthesis." Terasawa (1994:12) isolates those variable stems, yet he ultimately keeps them as part of the argumentation for TCs on the assumption that the "opaque" linguistic situation would allow such disyllabic stems to be reanalyzed as monosyllables by analogy with etymological sonorant-final HR monosyllables, such as *wundor* 'wonder'. For these originally disyllabic items, too, variability in speech is a reasonable but challenging to test hypothesis.[3]

The syllabic count of the sonorant-final stems can be ambiguous in the verse; the whole issue has attracted much attention and conflicting opinions (see Lehmann 1968; Russom 1987; Fulk 1992, 2007; Terasawa 1994; Hutcheson 1995; Suzuki 1996; Fulk et al. 2008 inter alia). The debatable issues revolve around what counts as metrical, since orthographically, these items are mostly written as <-VR>, with the vowel letter either underdotted or not, depending on the editorial decision. Outside verse, the evidence for variable syllabicity of the sonorants in OE LVR stems such as *befer* 'beaver', *hræf(e)n* 'raven' versus *heofon*

[3] Not surprisingly, variable syllabicity for /r, l, m, n/ is a familiar feature of versification in Middle English and into the Renaissance. Compare heaven in Shakespeare's Titus *Andronicvus*, Act 4, Scene 1:

(i) Or else to *heaven* she heaves them for revenge — l. 41; monosyllabic
O *heavens*, can you hear a good man groan — l. 127; disyllabic

In metrical studies, such variability is part of the PARAPHONOLOGY, which specifies the metrically relevant syllable count in relation to the templatic preferences (Kiparsky 1977, Hayes 2009).

'heaven', *of(e)n* 'oven' is only testable in relation to lengthening of the originally short stressed vowel in later English, which is crucially dependent on the nature of the second syllable onset (Minkova & Lefkowitz 2020). If the confirmation of TCs rests on verse, the syllabic shape and count of sonorant-final stems must be treated as a metrical issue, regardless of how such sequences were realized in regular speech or in oral performance.

Terasawa (1994) also syncopates the middle syllable in a potentially and orthographically trisyllabic second member of the compound—XLX—as in *æppel-**fealu̯we*** 'apple-fallow' (*Beo* 2165a) or *hrīm**gicẹlum*** 'by rime/hoar-icicles' (*Seafarer* 17a). This is another paraphonological variable, and we followed Terasawa in excluding compounds with a trisyllabic second member from our consideration to avoid this complication.

Separating *Beowulf*, a composition identifiable as "early" on philological grounds, that is, 8th century (Fulk 1992, Fulk et al. 2008), from the rest of the corpus is justifiable. *Beowulf* is exceptional in many ways. Fulk et al. (2008:cxii) count 903 "distinct substantive compounds, of which 518 are peculiar to Beo… [their] deployment evinces considerable inventiveness and poetic skill." Remarkably, one third of the whole *Beowulf* vocabulary is compounds. This is part of the overall "considerable statistical difference between *Beowulf* and presumably later poems" (Fulk 1992:79). Terasawa (1994) identifies only *n*=13 HX-LX and *n*=9 LX-LX compounds in *Beowulf*, all of them considered doubtful on the basis of epenthesis, syncope, or alternative readings, except for *mere-faran* 'sea-farer.GEN.SG' (*Beo* 502a). The creativity with compounding and the manifest sensitivity to the importance of weight to the meter suggest that the choices are at least partly specific to the *Beowulf* poet/scribe.

For the remaining approximately 60 texts, Terasawa (1994) gives only individual lists and numbers, no totals, classifying the first elements of NNs into HX-, LX-, and H- .[4] His Appendix 3 (1994:119–123) only

[4] The material is further subdivided into *Earlier Heroic Poems, Later Heroic Poems, Elegies, Cædmon's Hymn*, and *the Cædmonian Poems, Cynewulf's Poems,* and *Later Religious Poem (Judith)* (1994:27–47). The lists in this section include H-LX compounds, where H is unrelated to syncope or pseudo-epenthesis; they are "for the purposes of comparison" only (ibid. p. 28). The

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lists NNs that do not conform to the HX-LX or LX-LX pattern, again excluding items with potential epenthesis, syncope, alternative readings. However, there is a separate list of NNs with "pseudo-epenthesis"—the abovementioned items, which are originally disyllabic, such as *gomen* 'mirth' and *heofon* 'heaven'.

Our count shows *n*=27 HX-LX items (*n*=20 with pseudo-epenthesis of the first member, that is, HX=H), and *n*=80 LX-LX items (*n*=70 with pseudo-epenthesis), including 39 instances of *heofon-cyning* 'king of heaven'. The unexpected density of this lexically specific compound is fully in line with Fulk's (2007) reference to such usages as instances of formulaic diction.[5] Occasionally, the OE scops create their own unique compounds; they are sampled in 3, where the *a* and *b* in the texts refer to the position of the verse in the alliterative line, and not to one of the Sieversian alphabetical types A–E.

(3) Compounds attested only in OE poetry

a. (*)LX-LX

æþelduguð	'holy retinue'	ChristC 1011b
beado-searu	'battle gear'	Exodus 573b
bealu-waru	'evil-doer'	Dream 79a
ealowosan	'swillers of ale'	Fortunes 49a[6]
heofoncolu	'coals of heaven'	Exodus 71a
herescipe	'campaign'	Seasons 18a

b. (*)HX-LX

æppel-bearu	'orchard'	PPs 78.2.2a

number of H-LX NNs regularly exceeds the other four types surveyed: HX-HX, HX-LX, LX-HX, LX-LX.

[5] The DOE lists ca. 45 occurrences of *heofon-cyning* 'king of heaven', of which only five are in alliterative prose. A similar observation is made for the compounds in *-bealu* 'evil, calamity'. Terasawa (1994:50–52) highlights the common use of *heofon-cyning* in religious verse against its absence from heroic and elegiac poetry, clearly a marked stylistic choice. On compounds found exclusively in the poetic records, see also Russom 2010.

[6] The etymology of *-wosa* is "obscure" (the DOE).

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cālend-cwide	'time allotment'	MSol 480a
cumbol-wiga	'banner warrior'	Jud 243b, 259b
helle-bealu	'hell-torment'	Christ C 1426a
inwitgyren	'treacherous snare'	PPs 139.5b
inwitsearo	'malice'	Beo1101a

The rare and unevenly distributed exceptions to TCs, the open questions about the syllabicity of sonorant-final stems, and the existence of specifically poetic -LX NNs invite further examination of the rationale behind the very limited use of such compounds in verse. TCs link up directly to a more general question: Do TCs constitute evidence that poetic compound formation is a systematic transfer of weight-based patterns of compounding from the general OE grammar to the poetic grammar? We now move to a previously unexplored area of inquiry: How does the avoidance of -LX NNs in verse relate quantitatively to the available lexicon?

3. NNs in the OE Lexicon: Corpus and Simulation Details.

The avoidance of -LX NNs in the verse, a prosodic frame required for metrical resolution (LX=H), has direct implications for the reconstruction of stress placement in OE, since resolution also requires stress on the light syllable. Traditional accounts (Sievers 1885a,b, 1893; Campbell 1959; Bliss 1967; Suphi 1988; Hogg 1992; Lass 1994; Hutcheson 1995; Page 2006; Minkova 2008; Fulk 2014; Russom 2017) describe OE stress as syllabic and morphologically-based. That position is not shared by all researchers: The view that resolution in the meter is evidence for a weight-based account of stress is also widespread. McCully & Hogg (1990) use resolution specifically in arguing for a weight-sensitive secondary stress; their account of primary stress is morphological. Dresher & Lahiri (1991) use metrical resolution as support for positing a moraic account of stress, similarly to Fikkert et al. (2006) and Tanaka (1991, 1992). The status of resolution as a phonological component of OE is discussed skeptically in Minkova & Stockwell 1994 and Stockwell & Minkova 1997.

Such divergent views prompt a critical examination of the association between TCs, resolution, and stress, as there are in truth many reasons why one might find TCs plausible and their existence sustainable. After all, it is striking that poets would refrain from using specific NNs when such compounds are characteristic of the vocabulary as a whole: Are they truly avoiding these structures for metrical reasons? Are they avoiding -LX elements in subordinate ictic positions only for reasons of weight or perhaps because of some other factors?

One can argue that TCs are directly linked to the weight-to-stress constraint in the general grammar, if the compounds found in the lexicon do not have the same distribution of shapes predicted by a grammar that randomly pairs first elements with second elements. We hypothesized, however, that TCs are not applicable to just the verse but to the lexicon as a whole. Thus, we asked whether these structures are avoided in the verse specifically or if there is a general avoidance of these compounds in the lexicon. To test this hypothesis, we simulated one million Old English compound lexica using Python 3 and compared the simulation results to the attested lexicon.[7]

We gathered every headword labeled "noun" in DOE that contained a hyphen and was thus marked as a compound. We then removed a variety of edge cases. In programming, an edge case typically involves input values that require special handling. Here the special handling was removal. The nouns were removed if they:

(i) were marked as hypothetical or of doubtful meaning, marked "?" (*n*=102);
(ii) had at least one Latinate member, such as *Aprelis-mōnaþ* (*n*=12);
(iii) had at least one member with the prefixes *ge-* (*n*=362), *be-* (*n*=6), or *for-* (*n*=69);
(iv) had at least one member with the suffixes *-end(e)* (*n*=111), *-nes* (*n*=270), or *-ing/-ung* (*n*=281);
(v) were a triple compound (n=61).

With the triple-membered compounds, we further included their two-membered compound member if the word was decomposable as [member$_1$ + [member$_2$ + member$_3$]] and member$_2$ began with a letter after I. This was because the DOE does not include headwords beginning

[7] Python 3, version 3.7.7., released March 10, 2020. Python Software Foundation. Available at https://www.python.org/downloads/release/python-377/.

with L and onwards, so this was an opportunity to include NNs that were otherwise unavailable (n=12). Additionally, we conducted a crosscheck of these inferred two-membered NNs with inferred NNs that begin with A–I; these NNs were found to be already in the database, thus supporting the validity of our addition.

Some entries were excluded for multiple reasons, resulting in a final dataset of 4,076 NNs with only mono- and di-syllabic members, starting from an initial corpus of 5,338. These were then coded for the phonological shape of their members (H, HH, LL, etc.). For additional philological details on the corpus, see the comments in section 2 and the preface to the supplementary material. For the corpus itself, see the supplementary material (doi.org/10.17605/OSF.IO/J9FY7).

For each simulated lexicon, we generated 4,076 words—the size of the relevant corpus. We simulated the outcome of a lexicon that combined members entirely randomly as approximated by using the relative frequency of appearances in our corpus as the probabilities of a particular shape being chosen. For example, within our simulation, the probability of the first compound member having the phonological shape H was the probability of a noun with the phonological shape H occurring as the first compound member throughout the corpus, and not the probability of an H-shaped noun occupying any position within a compound.

The code used for our simulation is available in the supplementary material. However, some slight exposition is desirable for our implementation of frequency matching and our choice for the size of our simulation. To implement frequency matching, we first tallied up all the nouns with the same phonological shape, for each shape, for both positions. Table 1 shows the results.

	First member (%)	Second member (%)
H	2,526 (62%)	2,493 (61%)
HH	672 (16.5%)	321 (08%)
HL	222 (05%)	474 (12%)
LH	295 (07%)	178 (04%)
LL	361 (09%)	610 (15%)

Table 1. NNs in the DOE.

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Functions were defined that would select a shape with faithfulness to the distribution of the corpus of 4,076 potential inputs to NNs. Thus, for the first member, we defined a function mem_1_type() that generates a number between 1 and 4,076, inclusive. If the number is ≤ 2,526, the function output is "H"; if 2,526 < number ≤ 3,420, the output is "HX"; for all other numbers, the output is "LX".[8] We defined an analogous function for the second member. In this way, we did not simulate words but rather word shapes, as the simulated words were immaterial.

The outputs of these two functions were concatenated 4,076 times, and the counts of the resultant compound shapes were tracked. This entire process was repeated 1 million times. Each simulated lexicon was kept distinct, allowing us to count the number of lexica in which there were exactly *n* of any given compound shape.

Why did we choose to simulate 1 million lexica? In statistics, according to the central limit theorem, distribution of the outputs of a random process, repeated again and again, tends toward a normal distribution as the number of repetitions approaches infinity. For our purposes, the higher the number of repetitions, the more confident we can be that we have truly captured a representative sample of random lexica, including the statistically unlikely ones. As we suspected that the extant OE compound lexicon was an unlikely one, we wanted to emphasize this point. Why not give the most accurate model feasible?[9]

4. Statistical Analysis.

The 1 million simulated lexica were imported into R. We show below probability density histograms. We can interpret the simulated lexica with respect to the OE corpus by considering that each simulated lexicon is the result of 4,076 frequency-matching simulations of the creation of a compound. Each lexicon has some number *N* of compounds of a given shape; the normalized frequency distribution of those NNs is the probability density distribution that a frequency-matching simulation will

[8] 2,526+672+222=3,420

[9] This section responds to the question of an anonymous reviewer. By the second author's opinion, the simulation implementation is reasonably optimized. Still, 1 million lexica required about 4 hours of background computation on a desktop.

contain *N* compounds of a given shape. For example, 5,478 of our simulated lexica had 460 H-HX compounds. Thus, in our simulations, the probability of there being 460 H-HX compounds is 5,478/1,000,000, or 0.5478%.

Furthermore, comparing the observed number *O* of compounds of a given shape to the density distribution tells one how likely it is that *O* was the result of a frequency-matching grammar—approximately 0.5% of frequency-matching grammars are expected to have exactly 460 H-HX compounds. Given the central limit theorem, 95% of all simulated NNs fall within ±1.96 standard deviations (SD) from the mean of *N*. Thus, *O* is not likely to have been the result of frequency-matching if *O* is >1.96 or <-1.96 SD from the mean of *N*. If O is >1.96 SD from the mean of *N*, it is likely that some factor in the grammar of OE favored the formation of compounds of this shape. If *O* is <-1.96 SD from the mean of *N*, some factor likely disfavored the formation of compounds of this shape. The mean number of simulated H-HX compounds was 492 and the SD was 21, but the observed number of H-HX compounds was 460. The observed count is -1.57 SD from the mean, so we do not have reason to believe any factors favored or disfavored H-HX compounds.

In each histogram, we have marked the observed (true, attested) number of compounds of the relevant shape with a solid red line. We have also included a dotted curve corresponding to the normal distribution that best fits the data and a dotted line corresponding to its center.

4.1. Evidence for TC1 and TC2.

For convenience, we repeat the modified version of TCs in 4 below.

(4) a. TC1: Avoid compounds of the shape HX-LX
potentially, these undergo repair to become H-LX

b. TC2: Avoid compounds of the shape LX-LX

TC1 states that compounds of the shape HX-LX are to be avoided. Thus, we ask if the number of attested HX-LX compounds is lesser than the expected number of such in a frequency-matching grammar. In figure 1, the observed count is -5.28 SD away from the mean of the simulated counts, providing evidence for TC1.

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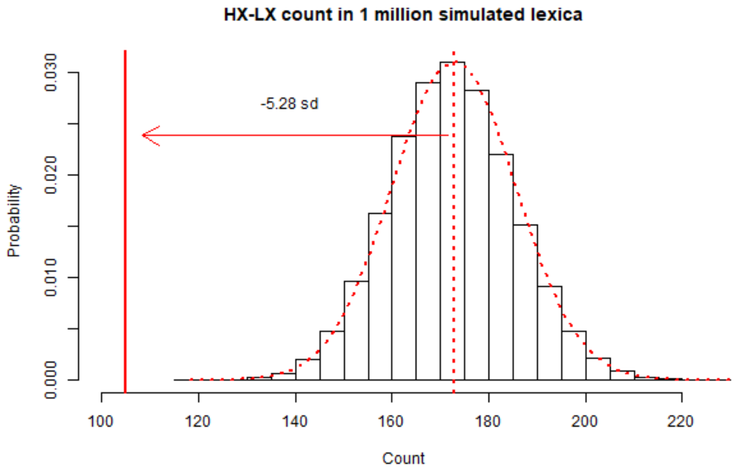

Figure 1. Probability density histogram of simulated HX-LX counts.

As shown in figure 1, the number of HX-LX compounds in the OE corpus is 105. However, given our corpus, we expect purely frequency-matching grammars not subject to any phonological constraints to contain an average of 172 HX-LX compounds with a SD of 13 compounds.[10] Accordingly, approximately 0% of frequency-matching grammars have 105 or fewer HX-LX grammars. This result thus shows that some factor disfavored HX-LX compounds, providing evidence that TC1 is observed across all of OE, not just in verse.

TC2 states that compounds of the shape LX-LX are to be avoided. Thus, we ask the same question as above, but for this shape. In figure 2, the observed count is -3.95 SD away from the mean of the simulated counts, which provides evidence for TC2.

[10] Means and standard deviations have been rounded to the closest whole number.

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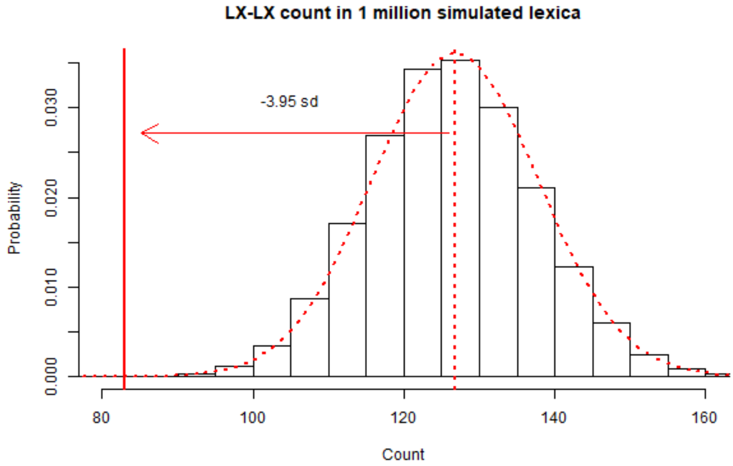

Figure 2. Probability density histogram of simulated LX-LX counts.

Figure 2 shows that our simulations predict an average of 127 LX-LX compounds with a SD of 11 compounds. We observe 83 LX-LX compounds, and approximately 0% of our simulations have 127 or fewer such compounds. TC2 as a factor in all of OE is thus also supported.

4.2. H-LX as Repair for HX-LX.

Terasawa (1994:11–12) suggests that compounds of the shape HX-LX undergo repair (through the choice of paraphoological variables due to, for example, truncation, the use of pre-epenthetic forms, and syncope; see sections 2 and 3) to become H-LX. Though he does not formulate this repair requirement as part of TCs, the issue is clearly germane. If H-LX is potentially the outcome of a repair procedure, the question arises: Given that we have found evidence that TC1 and TC2 both generally hold across OE, is H-LX a generally favored shape or is it a result of repair in the verse? Figure 3 shows that the former is the case. The observed count in figure 3 is 5.38 SD away from the mean of the simulated counts, showing that H-LX compounds are quite over-represented in the OE compound lexicon when compared to a frequency-matching grammar. Figure 3 shows that our simulations predict an average of 488 H-LX compounds with a SD of 21 compounds, but we observe 600. Approximately 100% of our simulations have 600 or fewer such compounds, showing that H-LX compounds are, in fact, statistically overrepresented across the OE lexicon.

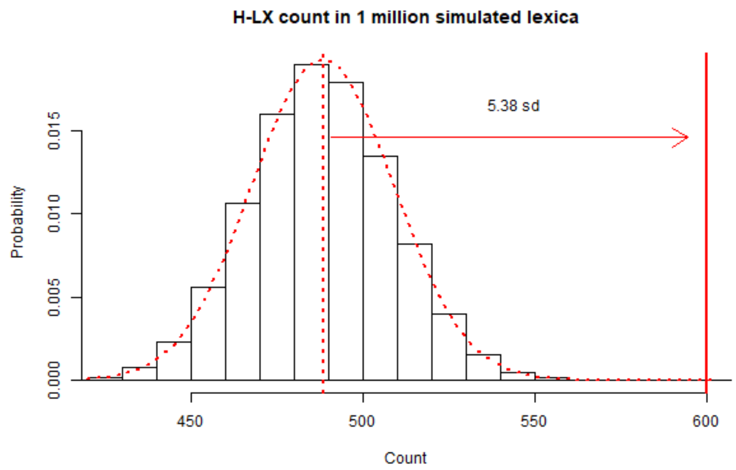

Figure 3. Probability density histogram of simulated H-LX counts.

It could be suggested that the reason that H-LX is overrepresented has something to do with the shape of the individual members. If this were so, H-LX and LX-H would be expected to behave similarly. However, our simulations show that the attested LX-H count (424) is only 1.2 SD greater than the mean, meaning that LX-H is not statistically over-represented; we do not have cause to believe that H-LX and LX-H behave similarly.

4.3 A General Constraint Against XX-LX Compounds.
Since our simulations provide evidence for both TC1 and TC2, can they be collapsed into a single general prohibition against all compounds with a disyllabic first member and an LX second? As figure 4 reveals, the answer is a resounding yes. In figure 4, the observed count is 6.7 SD away from the mean of the simulated counts, showing that XX-LX compounds are greatly underrepresented in the OE compound lexicon when compared to a frequency-matching grammar.

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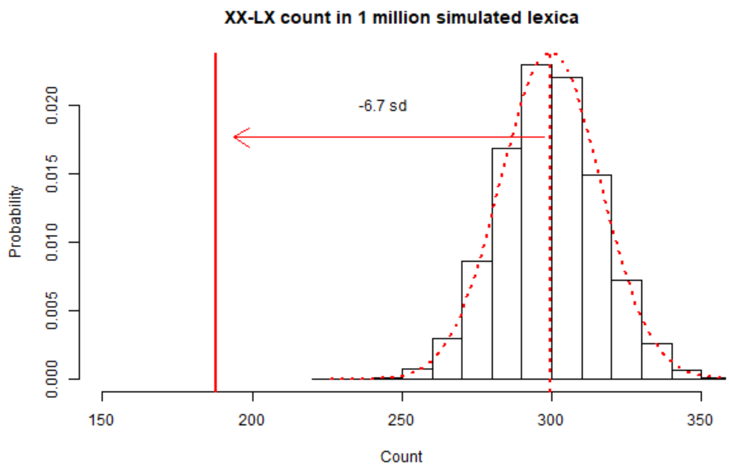

Figure 4. Probability density histogram of simulated XX-LX counts.

Our simulations predict an average of 300 XX-LX compounds with a SD of 17, but the observed count is only 188. This outcome is expected approximately 0% of the time in grammars with no generalized TCs.

Note too that the observed count is -6.7 SD from the simulated mean, a more extreme value than that for HX-LX (-5.28) and LX-LX (-3.95). This suggests that it is more parsimonious to combine TC1 and TC2, as the effect of a combined prohibition is overall greater than two separate ones: -5.28 SD means that there is less than a 1 in 100 million chance that the observed data are from a frequency-matching grammar; -6.7 SD means less than 1 in 100 billion.[11]

One might go one step further and ask if the dispreferred phonological shape is LX instead of -LX. To answer this question, we looked at the difference between HX-LX compounds, which are dispreferred, and LX-HX compounds. The idea was that if LX-HX were also dispreferred, the LX shape might indeed be the crucial point. As it turns out, LX-HX is within the predicted range. Our simulations predict a mean of 128 such compounds with a SD of 11. The observed number is

[11] A likelihood ratio test comparing two Maxent grammars, one with a single *XX-LX constraint and one with both *HX-LX and *LX-LX, came to the same conclusion with p=8E-21.

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149, which is 1.89 SD from the simulated mean. However, though 149 is within the predicted range (recall that the threshold number is 1.96), this should be taken with a grain of salt as the observed count is still greater than that found in 97% of the simulations. Regardless, it appears that LX- is different from -LX, as LX-HX is marginally preferred, while HX-LX is severely dispreferred. Recall also (section 4) that H-LX and LX-H do not behave similarly.

Based on all of these results, it is abundantly clear that the OE compound lexicon itself observes TCs. In fact, we have found that a generalized constraint against XX-LX forms explains the data even better than the separate components of TCs. We must conclude that TCs account for the general pattern of compound formation in the language, while the creation and selection of compounds in the verse is additionally circumscribed by specific poetic and formulaic diction, as well as incompatibility with acceptable metrical templates.

5. Discussion.

The statistical outcomes regarding OE NNs show that the linguistic basis of poetic compound-formation is not different from compounding in the ambient language. The modest pool of XX-LX compounds that the scops could draw on preconditions their limited use in poetry, where the restrictions are further enhanced by metrical provisos. In metrical studies, the matching of the language's vocabulary to its meter(s) is covered by the principle of FIT. However, FIT is "not an inviolable constraint that a meter must satisfy… For historical, cultural, or other reasons languages may have meters that fall short of naturally accommodating all their words" (Hanson & Kiparsky 1996:294). Compounds of the -LH shape are equally available to prose writers and poets, yet the OE scops are constrained further by the learned, inherited metrical templates that they replicate. In the most widely accepted taxonomy of metrical types in OE verse, XX-LX compounds are hard to fit. The restrictions are detailed in Terasawa (2011:76; emphases ours):

(5) a. LX-LX are avoided because they "in no way fit into Type B, are not suited to Type C…, Type D1…, or Type E… because *resolution* is quite rare before another resolvable sequence and also because *resolution* of a half-lift is very rare."

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b. HX-LX compounds are "are not suited to Type C or E. The Type A analysis is avoided because a short lift [LX] usually occurs immediately after a lift." A [HX-LX] compound "does not fit well in Type D2… where *resolution* of a half lift is very rare."

Additionally, HX-LX compounds are problematic in Type B, where they are practically unattested (Hutcheson 1995:130–131, 218). The taxonomy of verse types is, of course, based on generalizations from observed metrical patterns; this self-confirming loop does not explain the patterns themselves. This leaves the limited availability of XX-LX NNs in the language as the initial gating mechanism leading to scarcity of types accommodating such compounds in the meter.

The statements in 5 make it clear that the avoidance of XX-LX NNs is directly linked to metrical resolution. Like alliteration, resolution presents a case of selection and placement of available linguistic material, but both alliteration and resolution are verse-design conventions that follow preidentified metrical templates. Similar to the way that alliteration is systematically avoided in the final ictic syllable of the *b*-verse, XX-LX compounds can only fit particular verse types. We agree with Terasawa (1994) and Fulk (2007) that the clustering of some lexical LX items in the poetry, such as *heofon-cyning* 'king of heaven' or compounds, such as *bealu* 'evil, calamity' (see note 5) is a matter of poetic stylistic choices and formulaic diction. However, as adumbrated in section 3, accounts of stress placement in OE using resolution in verse as evidence persist in the literature. Dresher & Lahiri (1991, 2005) even borrow the metrical term resolution in their account of OE stress based on the moraic equivalence between H and LL strings.[12] If, as Terasawa (1994) proposed and our analysis of the lexicon confirmed, the severely

[12] An account of prosodic stress that prioritizes weight faces the potential problem of allowing equivalence of H, LL, and LH, which would contradict the evidence in verse, more specifically Kaluza's Law, according to which metrical resolution after an S position depends on the weight of the second syllable in LX strings. In weight-based accounts of OE stress, H and LL are associated with a prosodic foot, whereas LH has to be manipulated through consonant extrametricality or defooting. The different behavior of LL and LH structures at the right edge of some verse types thus contradict the structural equivalence of a minimally bimoraic foot H to LX.

restricted placement of XX-LX NNs in verse results from specifically metrical/poetic preferences added to already active lexical filters, this is yet another barrier to coopting resolution as evidence for weight-based stress placement in OE. The initial syllables of the first member in both LX- and HX- NN compounds must have primary stress and fill an ictus. The initial syllables of the second member of both -LX and -HX NN compounds have secondary stress and can also be ictic.

All moraic accounts acknowledge, directly or indirectly, that OE primary stress falls on the first syllable of the stem regardless of its weight, albeit cautiously (Goering 2016b), and with the caveat that verse evidence for stress is a "low diagnostic… suggestive, but not conclusive" (Bermúdez-Otero 2018).[13] Our examination of the data on NNs suggests that the link between TCs and the modeling of OE stress should be abandoned.

The statistical analysis in section 4 shows that XX-LX NNs are dispreferred in the language, which prompts two queries. First, can one identify the rationale behind the restricted formation of XX-LX NNs? Second, is there evidence that bears on the weight-to-prominence preference in the prosodic system?

As far as the first query is concerned, the dispreference for XX-LX compounds in the language—recall from section 4.3 that LX-HX is marginally preferred, while HX-LX is severely dispreferred—awaits its theoretical modeling. Though this dispreference is confirmed, there is no clear phonological reason for its existence, especially given that compounds with an LX- first member are not dispreferred. One might conjecture that primary stress is easily hosted by a syllable of any weight, but a heavier syllable is preferred for the weaker secondary stress, perhaps a compensatory reinforcement of the perceptibility of secondary stress in binominals. Such a conjecture would be in line with a well-attested difference in the treatment of identical LX nouns as phrasal

[13] Goering (2016a,b) attempts an isomorphic account of prosody and meter, yet Goering (2016a) goes further than Fulk (1992:227–233) in asserting the independence of meter and *stress*. He finds that "any role for stress as a constitutive feature of the system" is a questionable proposition (2016a:72) and concludes in his dissertation that "stress is not, as is often claimed, a core element of the metre." Note also Hutcheson's (1995:68, note 1) cautiously worded comment: "resolution does not seem to be a phonological process at all."

heads versus as second members of NNs (Terasawa 1994:10–11), which potentially mirrors the different treatment of compound stress and phrasal stress. To illustrate, in the poetic corpus, the disyllabic LX noun *gryre* 'terror', as in JDay II 8a: *þurh winda gryre* 'through the winds' terror', *Beo* 384a: *wið Grendles gryre* 'against Grendel's terror', is used as an independent ictic and alliterating item 22 times and eight times as the first member in *gryre*-HX compounds, but there are only two textually and editorially problematic instances of *gryre* as the second member in XX- compounds (Sat. 431b, 454b).

In any case, the hypothesis that weight considerations drive avoidance of a light stressed syllable in the second member of NNs faces the serious challenge of the very robust attestation of H-LX compounds both in the general lexicon and in the poetry (see note 4 and section 4 above). Note also that positing prosodic equivalence between H and LX, that is, resolution, is incompatible with the linear arrangement of H-LX versus *LX-LX and LX-HX versus *HX-LX elements in nominal compounding. Are these preferences incidental in the lexicon? Attributing the NN distributional facts to weight is, in our view, an unpromising direction of inquiry. Alternative explanations, however, surely exist.

An argument in favor of disassociating syllable weight from stress placement as well as from compound and phrasal prominence in OE does not negate the importance of weight in other parts of the phonology. OE is close to having a minimal lexical word requirement, with a caveat on pronouns' postlexical vowel reduction. Weight definitely interacts with vocalic changes throughout the period, and its importance increases in post-OE English. Focus on prosodic weight is revealing in the accounts of segmental phonological changes, such as the much-debated High Vowel Deletion in pre- to early OE (Hogg 2000, Goering 2016b), as well as a series of quantitative vowel changes (Bermúdez-Otero 1996, Fikkert et al. 2006, Minkova 2013, Goering 2016b, Minkova and Lefkowitz 2020).

Further, if one decouples stress from weight, and if potentially resolvable XX-LX items in the verse mirror the lexicon, can one dispense with resolution as a metrical device? The question has been asked repeatedly, and the positions advocating either complete rejection of resolution or unconditional across-the-board application of resolution are insightfully discussed and critiqued in Suzuki 1996:262–275 and contextualized within Germanic in Suzuki 2014. His own position "that resolution provides a principled account for an array of missing syllable sequences as unmetrical" is the dominant view in OE metrical studies, and we are fully in agreement with it. Within the parameters of metricality established for either the Sievers/Bliss system, or the four-position principle, or the word-foot theory, resolution with all its vagaries belongs in the account of OE meter. Acknowledging the importance of metrical resolution leads to the question of how this metrical device came to be applied, albeit variably, to the OE verse tradition. One line of inquiry points to the textual history of the inherited verse corpus. Most of the surviving, usually single, copies of the poems were produced after the 10th-century monastic reforms. This suggests another, admittedly tentative, discussion of resolution within the educational and cultural milieu behind the preparation of the poetic codices.

Anglo-Latin and OE verses were composed and recorded by the same people, and their familiarity with the metrical patterns and requirements, whether through direct training in versecraft or through "reading and absorption" (Steen 2008), is beyond doubt (see also Anderson 2002, Ruff 2005, Thornbury 2014). It is also significant that word division is onset-maximal in all widely used textbooks for the study of Latin, making light syllables easily identifiable. The original "doctrine" of <V-CV> adopted in scribal education referred to the written word: *In scribendo*, *in scriptura* are phrases used repeatedly by the grammarians in reference to this "rule". Under rigorous instruction, replicating the Latin prescriptive pattern was not difficult. Word division at the right edge of the manuscripts shows an unprecedented 99.9% pedantic adherence to <V. CV> (Wetzel 1981:117–118). The privileged position of Latin orthography and metrics in the curriculum would most likely impart authority and prestige to these matters. These additional considerations of the scribes' educational and cultural background lend support to our proposed separation of metrical resolution and linguistic stress. Hanson & Kiparsky (1996:294) write on choices for settings of the metrical structure parameters:

> […] whether the basis of these preferences is understood by the poets who use them or not, the choices themselves are consciously made. Particular settings may also be associated by convention with a particular style and hence subject to constraints from the tradition.

These brief references to the cultural setting of manuscript production are intended to record our hypothesis that the already scant pool of XX-LX compounds in the language and their even narrower use in verse highlights the possibility of considering resolution an adopted and conventionalized metrical constraint.[14]

6. Summary and Concluding Remarks.

Avoidance of XX-LX NNs in OE verse, also known as Terasawa's Law, has been a central point of reference in the reconstruction of OE meter and prosody. Terasawa himself (1994:62–63) interprets the paucity of second-member -LX compounds as being "less useful from the poets' point of view due to incompatibility with the Sieversian metrical types." However, the Sieversian taxonomy is descriptive, and its useful empirical adequacy with respect to the constraints on compound selection has not been statistically examined outside the poetic lexicon. Our study sought to establish if and how the poetic NN lexicon differs from the available pool of compounds recorded in the DOE. The statistical analysis shows that the low frequency of XX-LX compounds in verse is predictable if one looks at the entire lexicon.

While all the attested poetic quadrisyllabic NN compound choices are quantitatively within the expected range, the observed high rate of avoidance specifically of XX-LX compounds is cumulatively enhanced in the verse. The cumulativity is both metrically triggered due to incompatibility with pre-set frames, and it can be a matter of traditional formulaic poetic style, as concluded by Terasawa (1994; see also Fulk 1992, Russom 1995, Hutcheson 1995, Stockwell & Minkova 1997). We believe that this combination of factors sheds more light on the findings. An approach linking the general lexicon to specific metrical and stylistic requirements is consistent with the relaxation of TCs in some of the OE religious verse texts. It is likewise significant that nonobservance of *XX-LX is a feature of some compositions in Old High German, Old Saxon, and Old Norse, which deviate from the common Germanic

[14] The correspondence between metrical units and prosodic units in OE is beyond the scope of this paper, but we note that "a theory in which all the scanned entities are phonological feet [resolved moraic trochees in Hopkins] is unlikely to be tenable" (Hayes & Moore-Cantwell 2011:241, note 6).

alliterative tradition (Terasawa 1994:76–78). The observed differences in the strictness of avoidance of XX-LX NNs within the poetic corpus and across similar, but not identical, Germanic metrical traditions substantiate further the inclusion of formulaic and genre-specific lexical choices in the account of compound formation and selection in OE.

The main takeaway from the research presented here is that poetic compound formation and compounding in the language share a linguistic basis, which opens up other targets of inquiry into the meter-prosody interface. The stricter observance of the *XX-LX constraint in the poetry is directly linked to the established taxonomy of verse types. That taxonomy includes resolution (LX=H) as a central criterion, often reified as prosodic evidence, though its applicability to suprasegmental phenomena is unmotivated and untestable outside the meter; hence the importance of resolution to the whole issue of the principles of stress assignment. Exposure to resolution through instruction in Latin versification and onset-maximal syllabification as a learned scribal practice make the weight-based variability in the size of metrical lifts readily understood and applied by the poet scribes. Weight-mapping in the meter thus continues to function independently of stress, as it did in Old Norse (Ryan 2017). Such weight-mapping is not necessary for prosodic stress, though it can be relevant to segmental changes. If compound formation, stress assignment, and resolution are discrete but overlapping processes, this entails that the system can accommodate independently ranked constraints for stress and other phonological processes.

Detailed argumentation on the problematic nature of resolution—both as a learned metrical convention and in terms of its pertinence to the reconstruction of stress in OE—is beyond the scope of this paper, but the analysis of the lexicon presented in section 4 justifies a conclusion that compound formation and resolution are discrete processes. The metrical accommodation made available by resolution in some verse types and positions does not depend on, nor is it diagnostic of prosodic stress. More specifically, the metrical nature of resolution and its avoidance in specific positions and under secondary stress is confirmed by the unrestricted distribution of LX in syntactic phrases, where the prominence contour of compounds is not a factor.

Our discussion did not offer a hypothesis on the reasons for the asymmetry between LX-HX versus HX-LX compounds in the lexicon. The different rates of compounding for quadrisyllabic compounds XX-

XX and trisyllabic X-LX and LX-X compounds also remain uncharted, and it may be the case that the observed discrepancy has a semantic and/or pragmatic component. The corpus can be expanded by including adjectival and adverbial compounds. Possible further directions of inquiry include data collection and analysis of actual attestation of NNs in prose and in verse, and comparison of these data to the dictionary head-word data we have collected and analyzed, but the task of manually doing so is daunting. However, as computational methods become more and more sophisticated, it becomes ever more possible to test hypotheses that previously seemed to require inordinate effort, as our paper and Neidorf et al. 2019 show. Perhaps such an endeavor will be more tractable in the near future.

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https://doi.org/10.1017/S1470542722000083 Published online by Cambridge University Press