A New Approach to the Origin of Germanic Strong Preterites

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0. ABSTRACT

- The past tense in Germanic "strong" verbs (e.g., Eng. *bite* ∼ *bit*) is usually formed through ablaut (vowel alternation), but historically continues a Proto-Indo-European (PIE) verbal formation that obligatorily displayed reduplication and accentually-conditioned ablaut.
- In Gothic, however, reduplication and ablaut appear to coexist in ***complementary distribution***.
- **Principal Question:** How does the inherited PIE category develop into the Gothic system?

1. We propose that loss of mobile accentuation in Proto-Germanic (PGmc., the intermediate stage between PIE and Gothic) made more difficult the task of acquiring an underlying Red morpheme.
2. Using Maximum Entropy learning models, we show that, once the PGmc. system is deprived of an underlying Red morpheme, it inevitably moves towards the Gothic system in which reduplication is marginal.

1. GOTHIC: DATA

Gothic "strong" verbs exhibit a diverse array of patterns in the formation of their preterite stems:

Root Shape	Class	1.sg.pres.	3.Sg.pret.	1.Pl.Pret.	Gloss
/CeRC/	I	//bejt-a// [bɛjta]	//bajt// [bajt]	//bjt-um// [bɪtom]	'bite'
	II	//kews-a// [kɪwsa]	//kaws// [kaws]	//kws-um// [kɔsom]	'choose'
	III	//bend-a// [bɪnda]	//band// [band]	//bnd-um// [bɔndom]	'bind'
/CeC/	IV	//nem-a// [nɪma]	//nam// [nam]	//ne:mum// [ne:mom]	'take'
	V	//geb-a// [gɪβa]	//gab// [gaf]	//ge:bum// [ge:βom]	'give'
/CaC/	VI	//dab-a// [daβa]	//da:b// [do:p]	//da:b-um// [do:βom]	'happen'
/CV{:,C}C/	VIIa	//hald-a// [halda]	//he-hald// [hɛhald]	//he-hald-um// [hɛhaldom]	'hold'
	VIIb	//le:t-a// [le:tan]	//le-la:t// [lɛlo:t]	//le-la:t-um// [lɛlo:tom]	'let'
	VIIc	//fla:k-a// [flo:ka]	//fe-fla:k// [fɛflo:k]	//fe-fla:k-um// [fɛflo:kom]	'bewail'

Each traditional "class" corresponds to a phonologically coherent set (cf. "Root Shapes").

- Preterites formed with reduplication all belong to "Class VII," which is comprised of all and only the roots with long vowels or with /a/ followed by two consonants.
- All other strong preterites (Class I-VI) are formed by vowel alternations.
- Therefore, reduplication and vowel alternation are in **complementary distribution**.

Question: What is the preterite morpheme?

1. If it is a (floating) vowel or vowel feature(s), then we cannot explain reduplication.
2. If it is a Red morpheme, we cannot explain the vowel alternations.

Proposal: We propose that the preterite morpheme is phonologically null, and that the various alternations result from constraints that enforce morphological contrast.

2-1. GOTHIC: ANALYSIS

There are two active *morphological contrast* constraints, demanding *phonological distinctiveness* between related stems which differ in particular morphosyntactic features.

1. Realize-Morpheme (RM; Kurisu 2001): Even though the preterite morpheme is phonologically contentless, this constraint dictates that the morphosyntactic feature preterite be expressed (at the stem level) through *some* phonological distinction relative to the present tense.
2. Anti-Ident (Crosswhite 1999): The preterite singular and preterite plural stems should also be phonologically distinct.

Which deviation from the faithful mapping (which is equivalent to the present stem) a given preterite stem displays is determined by which available faithfulness violation is least costly. From least costly to most costly (i.e. most preferred to least preferred):

1. **Back the vowel:** Class I–V pret.sg., e.g., [bajt] (violates Ident[-back]-IO)
2. **Delete the vowel:** Class I–III pret.pl., e.g., [bɪt] (violates Max-V-IO)
3. **Lengthen the vowel:** Class IV–V pret.pl. (/e/ → [e:]), e.g., [ge:bun]; Class VI pret.sg. & pret.pl. (/a/ → [a:]), e.g. [do:b], [do:bun] (violates Ident[-long]-IO)
4. **Reduplicate:** Class VII pret.sg & pl., e.g., [hɛhajt], [hɛhajtun] **(violates Integrity-IO)**

TOTAL GOTHIC RANKING: Realize-Morpheme, ⋆Superheavy, ⋆Complex, Ident[+back]-IO ≫ Integrity-IO ≫ Anti-Ident ≫ Ident[-long]-IO, Max-V-IO ≫ Ident[-back]-IO.

2-2. GOTHIC: ANALYSIS, cont.

- Class I Pret.Sg. — vowel backing, most preferred repair

/bejt, Pret.Sg/ Pres.: [bɛjt-]		RM	Max-V	Ident[-back]
a.	bɛjt	∗!		
b.	bɪt (= //bjt//)		∗!	∗
c. ☞	bajt			∗

- Class V Pret.Pl. — vowel lengthening, less preferred repair forced when backing and deletion are blocked

/geb, Pret.Pl, um/ Pres.: [gɪb-], Sg. : [gab-]		RM	⋆Complex	Anti-Ident	Ident[-long]	Max-V	Ident[-back]
a.	gɪbum	∗!					
b.	gbum		∗!			∗	∗
c.	gabum			∗!			∗
d. ☞	ge:bum				∗		

- Class VII Pret.Pl. — "reduplication" (which is merely an Integrity violation!), least preferred repair forced when all alternatives are blocked

/hajt, Pret.Pl, um/ Pres.: [hajt-], Sg.: [hɛhajt-]		RM	⋆Sphhv	Ident[+back]	Integrity	Anti-Ident	Ident[−long]	Max-V	Ident[-back]
a.	hajtum	∗!							
b.	hɪtum (= //hjtum//)			∗!				∗	
c.	hɛjtum			∗!					
d.	ho:j.tum		∗!				∗		
e. ☞	hɛhajtum				∗	∗			

3. PIE: REDUPLICATION

Reduplicated Proto-Indo-European (PIE) "Perfect":

- Gk. 3.sg.perf. [le-lóip-e] 'remains' : 3.pl.perf. [lé-lip-on]
  - < PIE *[le-lójp-e] : *[le-lip-ŕ]
- Skt. [cə-ká:r-ə] 'has made' : [cə-kr-úr]
  - < PIE *[k^{w}e-k^{w}ór-e] : *[k^{w}e-k^{w}r-ŕ]

Two prosodic rules drive vowel alternations ("ablaut"):

1. /e, o/ → Ø / _Ḿ: an underlying mid vowel is deleted before an accented morpheme
2. /é/ → [ó] / eC$_{o}$_C$_{o}$e: an accented e becomes an accented [ó] in between two unaccented [e].

Question: How does a system with obligatory reduplication (/Red/) and phonologically-motivated vowel alternations become the system seen in Gothic?

4. PROTO-GERMANIC: PROSODY

There are two aspects of the phonological system of Proto-Germanic that pose a challenge for the preservation of the PIE system.

1. The plural forms of CVC roots (which eventually comprise Class IV-V) are subject to consonant deletion:
   - **Derivation:** /Red, $g_1e_2b_3$, úm/ → (i) $g_1e_2.$-$g_1e.b_3$-*úm* → (ii) g_1e_2-$g_1.b_3$-*úm* → [g_1e:$_2$.-b_3-úm]
   - The vowel deletion between (i) and (ii) is caused by ablaut rule (1) (cf. §3);
   - The deletion of root /g_1/ between (ii) and the SR is due to OCP-Syllable (Zukoff 2014; cf. Skt. 3.pl. [pe:cúr] 'have cooked' ← /pə-pəc-úr/).
2. Change of PIE Mobile Accent > Fixed Leftmost Syllable:
   - 3.sg. PIE /ge-geb-é/ → [gegábe] > PGmc ['gegabe]
   - 3.pl. PIE /ge-geb-úm/ → [ge:búm] > PGmc ['ge:bum]
   - The retraction of the accent renders both ablaut rules opaque.

We propose that these changes made it difficult for learners to establish the presence of an underlying Red morpheme.

- ['ge:bum] gives little indication of its presence, and this seems to have affected the interpretation of the entire system.
- Without strong evidence of a Red morpheme, it is *more harmonic* to parse ['ge:bum] as instantiating an Ident[-long] violation than simulataneous violations of Ident[-long] and Max-C (and possibly also Integrity).
- The loss of the Red morpheme does not immediately trigger loss of reduplication in the entire language. It more likely occurs gradually.

5. LEARNABILITY: PREPARATION

We attempt to model the developments beginning at a stage with the following two properties:

1. Learners have failed to acquire an underlying Red morpheme; yet...
2. They are still presented with a range of "adult" forms including those which display apparent reduplication, such as Class I pl. ['bebitum] and Class V sg. ['gegabe], and those which display apparent lengthening, such as Class V pl. ['ge:bum].

Given that all forms are parsed without an underlying Red morpheme, there is no strict ranking of the constraints in 2. that can simultaneously and categorically predict both vowel lengthening in some forms (/geb, Pret.pl, un/ → ['ge:bum]) but reduplication in others (/bejt, Pret.pl, un/ → ['bebitum]).

- Because they can learn non-categorical outcomes, we employ Maximum Entropy (MaxEnt) grammars (Goldwater and Johnson 2003) to model these changes.
- Data input: 14 inputs (one for each sg. and pl. for each of the seven classes), each with between 3 and 6 candidates.
- Inputs marked as winners ("adult" forms) are reconstructed forms.
- Constraints are those used in the analysis of the Gothic system.

Here is a tableau of violations for /bejt, Pret, um/, with the "adult" form, exhibiting **both reduplication and ablaut**, indicated as the winner (thus it is given a frequency of 1, and all other candidates a frequency of 0).

/bejt, Pret.Pl, um/ Pres: [bejt-]		⋆Sphhv	OCP-σ	RM	Integrity	Ident[+back]	Ident[-long]	Max-V	Ident[-back]	⋆Pret: $\sqrt{[e]}$
a. ☞	'bebitum				1			1	1	
b. >>	'bitum							1	1	
c.	'bebejtum				1					1
d.	'bejtum			1						1
e.	'be:jtum	1					1			

Note that candidate b. (the optimal form in Gothic) harmonically bounds candidate a., the "adult" form.

6. LEARNABILITY: RESULTS

For MaxEnt models for learning constraint weights, do off-line/batch models (conjugate gradient; cf. Hayes and Wilson 2008) and on-line models (perceptron; cf. Pater 2008) perform differently?

- Off-Line Learning Tests (conjugate gradient; implemented in MaxEnt Grammar Tool) — change compatible with **learning bias** (Hayes et al 2009):
  1. No prior, zero initial weights ($\mu = 0, \sigma^2 = 10000$ for all constraints): the grammar can't choose between reduplicated ['bebitum] and non-reduplicated ['bitum]. A weight of 0 is assigned to Integrity (the constraint distinguishing those two candidates); each receives .5 probability.
  2. Non-zero initial weights, a strong prior for non-morphological constraints ($\mu = 10, \sigma^2 = 0.6$), weaker prior for morphological constraints ($\mu = 10, \sigma^2 = 100$, for RealMorph and ⋆Pret: $\sqrt{[e]}$): the learned weights predict .72 ['bitum].
  3. Likewise: singular ['bajte] takes .99 of the probability distribution; original "winner" ['bebajte] receives an insignificant portion.
- On-Line Learning Tests (perceptron; implemented in Praat v. 5.4) — change compatible with **acquisition order** (Jäger 2007):
  1. Decision strategy: `ExponentialMaximumEntropy`; `Symmetric all` update rule; `Initial plasticity`: .01
  2. Less than ∼ 6000 replications of learning (so the learner sees each datum about 6000 times, updating weights with each occurrence), the winner, when evaluated without noise, is the diachronically expected result almost everywhere. The output distributions give a categorical results (i.e. ['bitum] ≫ ['bebitum]).
  3. Beyond 6000 replications, the older "winners" like ['bebitum] begin to receive some winners; eventually, the weights converge on a solution just like the off-line model with no prior.

7. CONCLUSION

- We propose that the major trigger behind the loss of reduplication in the Germanic strong verb system was the opacity of deletion processes that created surface forms without clear reduplication, such as ['ge:bum].
- Prior to a change in the prosodic system, the deletion processes were transparent, and speakers were correctly able to derive [ge:búm] (with accented suffix) from /Red, geb, úm/. After the change, however, speakers could not reconstruct the original system, inducing change.
- MaxEnt learning models predict similar diachronic outcomes, towards the Gothic system. This is true of both batch learning and on-line learning. The selection of unreduplicated forms as winners is attributable to either **learning bias** or **acquisition order**. The grammar proposed for Gothic is a stable and learnable system.
- **Future Directions:** (1) Learning of URs (Tesar & Smolensky 2000, Pater et al. 2012) to model the failure to learn a /Red/ morpheme in Proto-Germanic; (2) Motivating initial non-zero weights, especially for Integrity.

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