# The Role of Information Theoretic Factors in the Emergence of Stem Vowel Mutation

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Vowel Quality Mutation (VQM), defined here as alternations in stem vowel quality that have their diachronic origin in anticipatory coarticulation with the vowels of former inflectional suffixes, has emerged as a pervasive phenomenon in both Northwest Germanic and the Dinka-Nuer branch of Western Nilotic. As exemplified by data from Old Icelandic in the table below, stem vowel quality alternations across paradigmatically related forms in Northwest Germanic are associated with the presence or absence of a former suffix with a high front vowel. In Dinka-Nuer, VQM is associated with the presence or absence of a former suffix with a low vowel, as exemplified by data from Agar Dinka and cognate forms from Surkum (Western Nilotic, Northern Burun branch) [4].

| Proto-Germanic [1] | | | Old Icelandic [2-3] | | | Gloss |
|---|---|---|---|---|---|---|
| *d**au**ð-az | ~ | *d**au**ð-**j**anã | d**au**ð-r | ~ | d**ey**ð-a | 'dead' ~ 'kill' |
| *f**ō**t-s | ~ | *f**ō**t-**i**z | f**ō**t-r | ~ | f**ø̄**t-r | 'foot'.NOM.SG ~ PL |

| Surkum [4] | | | Agar Dinka [4] | | | Gloss |
|---|---|---|---|---|---|---|
| r**í**m | ~ | r**í**m-**á**t̪ | r**í**m | ~ | rj**ɛ́ɛ**m | 'blood'.PL ~ SG |
| l**ɔ́ɔ**g-ɛ̀ | ~ | l**ɔ́ɔ**g-**á** | l**ɔ̀ɔ**k | ~ | l**à̱aa**k | 'wash'.3SG ~ 1SG |

Given the cross-linguistic ubiquity of concatenative systems, vowel-to-vowel coarticulation, and the diachronic erosion of affixal material, it is not well understood why more languages do not take the evolutionary path toward VQM. On the other hand, it is also not clear why a language should take this path at all, as it results in greater typological rarity relative to its antecedent system along several parameters: non-linear fusion type [5], polyexponence of lexical and grammatical categories [6], and a large inventory of contrastive vowel qualities [7]. It is proposed here that the emergence of VQM is best understood in an evolutionary framework, where coarticulatory variation is only likely to become exploited and grammaticalized over historical time under particular information theoretic conditions.

Previous work has identified a strong relationship between the informativity of a linguistic unit in context and its degree of signal autonomy, such that more informative units are encoded in the signal with greater phonetic specificity and vice versa [8-11]. This in turn has been proposed to play a role in long-term phonological change [12-14]. It has also been shown that coarticulatory variation is associated with the informativity of both target and trigger, such that the magnitude of the trigger's coarticulatory influence is greatest when the target has low informativity and the trigger has high informativity [10]. Available evidence is presented that suggests such an asymmetry between the informativity of vocalic contrasts in stems ($V_1$) and inflectional suffixes ($V_2$) for early stages of Germanic and Western Nilotic.

The hypothesis that VQM emerges under these particular information theoretic conditions is supported by results from an agent-based simulation [13-18] designed to model how informativity shapes vocalic contrasts over iterated communicative interaction. The model allows adaptive agents to exchange phonetically detailed signals of pseudo-words comprising two ordered trajectories in F1xF2 space ($V_1$-$V_2$), and the informativity of $V_1Q$ and $V_2Q$ can be manipulated independently across trials. Covariance between the two vowels in the form of V-to-V coarticulation is introduced during each iteration, as well as a small number of $V_2$-less productions. VQM (e.g. $e_1$-$i_2$ ~ $e_1$-$a_2$ → $e_1$-$Ø_2$ ~ $ɛ_1$-$Ø_2$) emerges only during trials in which the informativity of $V_1Q$ is low, but high for $V_2Q$. Other permutations of $V_1Q$-$V_2Q$ informativity result either in stability of the original concatenative system, or loss of $V_2$ without concomitant bifurcation of $V_1Q$ (i.e. $e_1$-$i_2$ ~ $e_1$-$a_2$ → $e_1$-$Ø_2$ ~ $e_1$-$Ø_2$).

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