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THE ROLE OF PALATALIZATION IN THE LATIN SOUND CHANGE /w/ > /β/

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1. Introduction.

This article proposes that palatalization of /w/, when properly understood in typological and phonetic perspective (section 2), might be expected to have differentially promoted the fricative pronunciation [β] (later [v]) in Latin and demonstrates, on the basis of spelling variation in Vulgar Latin inscriptions, (section 3) that in word internal position the fricative pronunciation was, in fact, significantly more frequent in palatalizing than in non-palatalizing environments. The general history of the change [w] > [β], as traditionally understood, is readily described. Perhaps already in the second half of the first century AD,[1] beginning in certain lower sociolinguistic strata, the labial velar semivowel phoneme /w/ developed a bilabial fricative articulation [β] in syllable initial position. In the second century, Velius Longus described V[2] as pronounced "cum aliqua adspiratione" (K. VII, 58). Educated speakers, however, maintained the pronunciation [w] at least until the fifth century. Probably toward the end of the first century also, the bilabial voiced stop phoneme /b/ began to be fricativized to [β], at least in word medial, intervocalic position. This partial merger of /w/ and /b/ motivated the confusions in spellings, V→B and the rarer B→V, by the less educated. That the substitution V→B was more frequent than B→V is readily explained by the orthographic simplification accruing from an association of V with the vowels /u(:)/[3] and by the persistence of the occlusive allophone [b], which, at least for a considerable period, did not correspond to any sound represented by V in standard orthography. The distribution of the reflexes of Latin /b/ and /w/ in word initial, intervocalic, and post-resonant positions presents a complex picture in the various Romance

[1] On *CIL* III, 7251: *lebare* and the possibility of Grecism, see F. Sommer, *Handbuch der lateinischen Laut- und Formenlehre* (Heidelberg 1914) 163; on the Pompeian material see V. Väänänen, *Le latin vulgaire des inscriptions pompéiennes* (Helsinki 1937) 86–89.

[2] Capital letters are used to represent spellings. Phonemes are enclosed in slashes, //; phonetic transcriptions and distinctive features (for those employed here, see L. M. Hyman, *Phonology: Theory and Analysis* [New York 1975] 42–58) are enclosed in square brackets, []; vowel length is indicated by the colon, and (:) following a vowel means "either long or short." A single slash and underscore indicate the phonetic environment in which a change is discussed; e.g., /V_V means "in intervocalic position": the use of V also as a cover symbol for vowels will cause no ambiguity, since in that value it occurs only before and after the slash.

[3] Cf. W. M. Lindsay, *The Latin Language* (Oxford 1894) 49.

languages and dialects and remains a much debated problem.[4] The present study is concerned solely with the fricativization of /w/ in later Latin.

The suggestion that palatalization was an important factor promoting the intervocalic fricativization of /w/ seems to be original. None of the treatments by, *inter alios,* Schuchardt, Brambach, Corrsen, Seelmann, Stolz, Lindsay, Parodi, Grandgent, Meyer-Lübke, Sommer, Hermann, Leumann, Terracini, Väänänen, Kent, Sturtevant, Odenkirchen, Politzer, Niederman, Lausberg, Maurer, Löfstedt, Blumenthal, Pfister, Allen, or Barbarino in his monograph[5] has invoked palatalization, and recently Picard[6] has adduced Latin in his

[4] See the descriptions of, *inter alios*, R. L. Politzer, "On *b* and *v* in Latin and Romance," *Word* 8 (1952) 211–15, and P. Blumenthal, *Die Entwicklung der romanischen Labialkonsonanten* (Bonn 1972) 30–46.

[5] H. Schuchardt, *Der Vokalismus des Vulgärlateins* (Leipzig 1866–1868) I, 131–32 and III, 67–68; W. Brambach, *Die Neugestaltung der lateinischen Orthographie* (Leipzig 1868) 238; W. P. Corrsen, *Über Aussprache, Vokalismus und Betonung derlateinischen Sprache* (Leipzig 1868–70) I, 131–34 and cf. the first edition (Leipzig 1859) 61–63; E. Seelmann, *Die Aussprache des Lateins nach physiologisch-historischen Grundsätzen* Heilbronn 1885) 240ff.; F. Stolz, *Lateinische Laut- und Formenlehre* (Munich 1885) 286–88; W. M. Lindsay (above, note 3) 49–52; E. G. Parodi, "Del passagio di V in B e di certe perturbazioni delle leggi fonetiche nel latino volgar," *Romania* 27 (1898) 177–240; C. H. Grandgent, *Introduction to Vulgar Latin* (New York 1907) 133–44; W. Meyer-Lübke, *Lingüística romance* (Madrid 194) 187–88; F. Sommer (above, note 1) 163; E. Hermann, "Silbischer und unsilbischer Laut gleicher Artikulation in einer Silbe and die Aussprache der indogermanischen Halbvokale u̯ und i̯" *Nachrichten der königlichen Gesellschaft der Wissenschaften zu Göttingen*, Phil.-Hist. Klasse (1989) 100–159; M. Leumann, *Lateinische Laut- und Formenlehre* (Munich 1926) 116 and cf. the second edition (Munich 1977); B. A. Terracini, "Di che cosa fanno la storia gli storici del linguagio. Storia dei tipi *benio* e *Nerba* nel latino volgare," *Archivio Glottologico Italiano* 27 (1935) 133–52, 28 (1936) 1–31, 134–50; V. Väänänen, (above, note 1) 86–89 and *Introduction au latin vulgaire* (Paris 1967) 51–52; R. G. Kent, *The Sounds of Latin* (Baltimore 1945) 61–62; E. H. Sturtevant, *The Pronunciation of Greek and Latin* (Philadelphia 1940) 142–43; V. Pisani, *Grammatica latina storica e comparativa* (Turin 1948) 67; C. J. Odenkirchen, *The Consonantism of the Later Latin Inscriptions: A Contribution to the 'Vulgar Latin' Question* (Diss. North Carolina, Chapel Hill 1950) 53–57 and 179–86; R. L. Politzer (above, note 4); M. Niedermann, *Phonétique historique du latin* (Paris 1953) 87–89 and 110–11; H. Lausberg, *Romanische Sprachwissenschaft*, II. *Konsonantismus* (Berlin 1956) 6 and 32–36; H. Maurer, *Gramatica do Latim Vulgar* (Rio di Janeiro 1959) 35–37; B. Löfstedt, *Studien über die Sprache der langobardischen Gesetze* (Stockholm 1961) 149–59; P. Blumenthal (above, note 4); R. Pfister and F. Sommer, *Handbuch der lateinischen Laut- und Formenlehre I. Einleitung und Lautlehre* (Heidelberg 1977) 129; W. S. Allen, *Vox Latina* (Cambridge 1978) 41–42.; J. L. Barbarino, *The Evolution of the Latin /b/ - /u̯/ Merger. North Carolina Studies in the Romance Languages and Literatures*, 203 (Chapel Hill 1978); Tibiletti Bruno's review of Barbarino *(Studi Italiani di Linguistica teorica ed applicata* 9 [1980] 601–3) has remained unavailable to me.

[6] M. Picard, "On the Palatalization and Fricativization of *w*," *International Journal of American Linguistics* 53 (1987) 262–64.

argument[7] against the typological importance of palatalization in the promotion of the fricativization of /w/. Rather, it is generally assumed that [w] > [β] was always and only a strengthening process subject to the natural restriction to syllable initial position (i.e. not after *s, q* or *g*, whether /s^{w} k^{w} g^{w}/or /sw kw gw/). Such, of course, is a well attested sound change in many languages and is the distribution that the change ultimately attained, but I suggest that in the course of its implementation assimilation to an immediately following (and, to some extent, preceding) front vowel differentially promoted it in intervocalic environment and provided the basis for further generalization to other intervocalic contexts.

I have found only three treatments that give any prominence to the quality of the following vowel. The first is found in the Latin grammarians, e.g. Priscian (K III, 346. 12-4):

> omnia nomina a vi- syllaba incipiente per V scribuntur exceptis bitumine et bili (quando fel significat) et illis quae a bis adverbio componuntur, ut biceps, bipatens, bibium.

Compare Adamantii sive Martyrii *de B muta et V vocali* (K III, 168-71, 175-76). Of course, there is nothing phonological about such rules, as is clear from Adamantius' following formulation (K III, 167):

> Va syllaba praefulgens in capite nominis per V vocalem loco positam consonantis scribetur, quoniam haec apud Latinos littera plus valet quam B muta.

These descriptions are merely a means of constructing lists of lexical items according as the frequency of V or B predominates in certain environments.

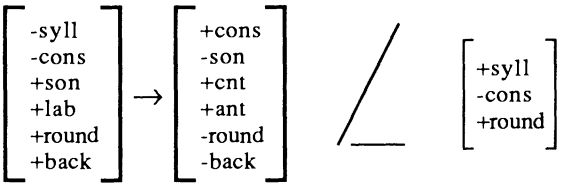
The second is that of Baehrens,[8] who, however, envisages not a palatalization process but a dissimilatory one:

> In einer anderen Gruppe hat der gleichfolgende Vokal den Lautwandel *v* > *b* veranlasst. Als in Vokabeln wie *vir* und *virgo* sich das *i* dem *v* genähert hatte und zu *y* geworden war, war die Existence des schwachen anl. *v* giwissermassen gefährdet und es wurde durch das kräftigere b ersetzt, vgl. *CIL* VI, 2723, 28062: *burgo*, 2499: *byrginio*, XIV, 1064: *Byrginius*, III, 9567: *bir[g]iniam*, V, 1796: *birginio* - VI, 3722[a], 31038: *byyris* = *viris*, XIV, 2118: *unibyria*, VI, 500, 6 a. 377): *duodecimbyr*, VIII, 2079: *biri*, X (4539), 7756: *bir*. Besonders *unibyria* zeigt, dass nicht der vorangehende Konsonant, sondern das zu *y* gewordene *i* den Lautwandel *v*> *b* verursachte.

[7] For a critique of Picard's (above, note 6) misrepresentation of established results in the typological literature and a review of the state of the question, see J. S. Justeson and L. D. Stephens, "Crosslinguistic Generalizations Concerning the Frication of *w*," to appear in the *International Journal of American Linguistics*.

[8] W. A. Baehrens, *Sprachlicher Kommentar zur vulgärlateinsichen Appendix Probi* (Halle 1922) 80–81.

Baehrens further suggests that a following /o(:)/ also promoted fricativization of /w/. While nowadays, historical linguists would avoid teleological formulation and posit a rule such as



they would only approve Baehrens' search for phonetic conditions based on natural feature classes. Furthermore, Baehrens is one of the few scholars to employ frequency data in his analysis of the change according to vocalic environment (see below).

The third is that by A.M. Devine and myself,[9] who attempted one of the first typological contextualizations of [w] > [β]. They write:

> Primary *w* >*v* word initially, intervocalically, after liquids but not after *k, g, s,* whether because it was monophonemic k^w, g^w, s^w, or because the change was subject to the phonetic restriction affecting only syllable initial *w*...The assumption of a phonetic restriction to syllable initial position for the change *w* > *v* is perfectly tenable. In some languages *w* and *v* are in complementary distribution in a manner reminiscent of this stage of vulgar Latin: in one dialect of Karen /w/ is *y* in initial position but has a semivocalic allophone after consonants (e.g. *pw, bw, tw, nw, kw, sw*)...An interesting further distinction occurs in Cavineña, *wi, we* > β*i*, β*e* (bilabial voiced fricative) but *wa* remains (**wu* is non-occurring) and in Chontal [see now Justeson[10]] where *w* has a labiodental fricative allophone before *i, e,* and in many other positions, but before *a, o, u,* ə there is free variation between *w* and *y*; there is a somewhat comparable variation in Tamil ([v] before front vowels).

In 1977 our primary concern was to show that the typological data rendered the distribution of the change [w] > [v] irrelevant as evidence for the monophonemic status of /k^w/, etc. Now I believe that the typology of the fricativization of [w] in the world's languages provides a key to the early stages of [-w-] > [-β-] in Latin, namely the saliency of a contiguous front vowel in addition to syllable initial position.

[9] A. M. Devine and L. D. Stephens, *Two Studies in Latin Phonology* (Saratoga, CA 1977) 97–98.

[10] J. S. Justeson, "**w* > *y* in Chontal (Mayan) of Tabasco and Generalizations Concerning the Palatalization of *w*," *International Journal of American Linguistics* 51 (1985) 311–27.

2. The typology of the fricativization of [w].

In a sample of 164 languages having the phoneme /w/, J. S. Justeson and I[11] found the following range of fricative allophones: beginning with [w] having audible friction, and in order of decreasing frequency voiced bilabial [β] and labiodental [v] fricatives equally commonly, next voiced labiovelar fricative [γw], then bilabial fricatives with [w] and [j] offglides, and in one case a labiodental fricative with [w] offglide. These findings are in accord with Ohala and Lorentz' generalization that "when becoming a fricative...[w] shows itself primarily as a labial, less often as a velar."[12] Ohala and Lorentz list four acoustic phonetic reasons why the fricative noise produced at the labial constriction predominates over that at the velar thus making labial fricatives the more likely outcome. We also distinguished two basic, independent factors that condition fricative allophones of /w/. 1) Initial position is clearly salient according to a predictable hierarchy: fricative allophones may occur a) utterance initially, but nowhere else, e.g. Rawang (Burma); b) word initially, but nowhere else, e.g. Javanese (Indonesia); c) syllable initially but nowhere else, e.g. Pacoh (Vietnam). Greater fricative noise is also correlated with the higher points on the hierarchy. In some cases fricative allophones may occur only after resonants. Exceptions are rare. 2) The degree of frontness of the following vowel is equally salient: if a language has fricative allophones of /w/ before back vowels, it has them before mid front vowels, and if it has them before mid front vowels, it has them before high front vowels. Some additional non-trivial examples are Amahuaca (Peru), Cayapa (Columbia), Hawaiian, Malayalam (India), Moxo (Bolivia). Furthermore the degree of fricative noise tends to be greater the more front the articulation of the following vowel; for example, in Gadsup (New Guinea) /β/ has less friction before /æ/ and /ɛ/ than /e/ and /i/, and some speakers have [w] in the former environments; see below on Tucano (Columbia). While allophones with friction at the velar position are found to be conditioned by front vowels, labial friction predominates. These results accord with Ohala and Lorentz' generalization that "when assimilating to adjacent vowels, it is the place of the labial articulation that remains unchanged; the place of lingual constriction may shift under the influence of the vowel's lingual configuration."[13] In fact [w] is more subject to palatalization than any other non-vocalic segment involving labial articulation.[14] Fifteen percent of the 164 languages in our sample show fricative allophones of /w/ only in palatalizing environments. The phonetic explanation for the palatalization is straightforward. Of the two simultaneous and (nearly) equal constrictions

[11] L. D. Stephens and J. S. Justeson, "Some Generalizations Concerning Glides," *Proceedings of the Eighth Annual Meeting of the Western Conference on Linguistics*, ed. by D.L. Malsch et al. (Edmonton 1979) 151–64.

[12] J. Ohala and J. Lorentz, "The Story of [w]: An Exercise in the Phonetic Explanation for Sound Patterns," *Report of the Phonology Laboratory*, 2 (Berkeley 1978) 133–55.

[13] Ohala and Lorentz (above, note 12) 145.

[14] D. N. S. Bhat, "A General Study of Palatalization," *Universals of Human Language I*, ed. by J. H. Greenberg et al. (Stanford 1978) 47–92.

involved in the articulation of [w], only the lingual ([+back]) is anatomically free to assimilate its place of articulation from velar to that of the adjacent vowel. This process of tongue fronting with consequent fricativization (on the association between which in palatalization processes see Bhat[15]) is exactly parallel to the palatalization seen in other velar consonants such as [k] and [g]. In fact, it is possible to consider the palatalization of Latin /w/ as the beginning of the palatalizations of other segments (e.g. /k/, /t/) which characterize Romance historical phonology. The failure of previous scholars to entertain the possibility that the Latin change [w] > [β] could, in part, have involved palatalization probably stems from three sources: 1) a tendency to classify [w] as primarily labial and to ignore its velar articulation, 2) tacit assumption that a sound change which ultimately spread to encompass all syllable initial occurrences of [w] could not have originated in and at earlier stages have been more extensively promoted by an assimilatory process, and 3) neglect of the cross-linguistic data which proves that palatalization, while not a necessary condition, frequently leads to the fricativization of [w].[16]

Justeson and I[17] cite two cases which provide excellent parallels for the sort of gradual generalization in the phonetic, chronological, and social dimensions which I wish to suggest obtained during the period of the implementation of the change in Latin. 1) in Tucano (Columbia), there is a gradient of [w] fricativization decreasing with increasing degree of backness of the following vowel: fricativization occurs most intensively before high front vowels, more lightly before mid front vowels, and not at all before back vowels. 2) Most instructively, older speakers of Tacana (Bolivia) have a biblabial fricative [β] allophone of /w/ only before front vowels, as in Cavineña (Bolivia), another member of the Tacanan family, while younger Tacana speakers are generalizing [β] to all syllable initial contexts (perhaps under the influence of Spanish). (Note that in Chama [Bolivia], another Tacanan language, factor (1) above, and not palatalization, produces the fricative allophone: /w/ in Chama has an allophone with *velar* fricative onset in initial position or under emphasis.)

3. The Latin evidence

Baehrens' observation of the evidently quite frequent substitution V→B before *i* is suggestive, and it is surprising that it has never been subjected to an adequate statistical test. Baehrens relies, however, on cases of /w/ in word initial position or in the initial position of the second elements of compounds. Perhaps it was suspected that the high frequency of words such as *vixit, vivus, vir,* etc. in inscriptions merely created the illusion of a predominance of a following *i*, whereas the rate of the substitution might be the same in the less frequent words with other vowels following /w/. This in fact turns out to be the case for word initial /w/. Using Slotty's selection of Vulgar Latin inscrip-

[15] Bhat (above, note 14).

[16] On [w] > [v] see now Justeson (above note 10): Lip retraction appears to be correlated with tongue fronting, so that [b] does not seem to be a necessary intermediate stage in every instance of [w] > [v] in languages.

[17] Stephens and Justeson (above, note 11) 157 and 161–62.

tions[18], I estimate that the rate of V→B before front vowels (including *y* < *i*) is only 4.97% (in a sample of size N = 181), whereas before back vowels it is 10.43% (N = 58). Furthermore, there is no significant correlation with /o(:)/. These results, however, cannot be extended automatically to word medial position. We need only remind ourselves that, much earlier, word initial /w/ was uniformly retained before round vowels, e.g. *voco, volo, vomo*, Old Latin *vorsum* (>*versum*), whereas it was lost before the same round vowels word medially, e.g. *deus* < *deivos*, *deorsum* < *de-vorsum* (a change which predates *vorC-* > *verC-*), *malo* < *mavolo* < *magis volo*. Both the older retention of word initial /w/ and the Vulgar Latin fricativization in word initial position are likely to reflect the well known strengthening processes characteristic of initiality as noted in section 2.

There are, however, further data available in the literature which might have stimulated research on the relevance of following front vowels in word medial position. Among the tables with which Barbarino concludes his study, are ones giving the rates of V→B before verb endings of the active *perfectum* (e.g. *renovabit* Diehls 261) and in other intervocalic positions. In the active *perfectum* /w/ is always followed by /i(:)/ or /e(:)/. In the various regions discussed, the rates for V→B are generally higher in the *perfectum* than in the other intervocalic class of environments. Barbarino's study is innocent of statistical techniques for hypothesis testing and so did not pursue this obvious fact. Subsequent exploration may have been discouraged by his assertion, "[t]he B and V spellings were examined separately in verb endings and were found to be of no major importance to the grammar."[19] I shall now demonstrate that Barbarino's own data indicates the contrary.

In Barbarino's class of intervocalic environments, the rates are based on substitutions before /a(:), /o(:)/, and /u(:)/ as well as before /i(:)/ and /e(:)/. If [-w-] < [-β] were promoted more extensively by a following front vowel, we would expect that the rate of the V→B substitution, which the sound change motivates, should be greater in a sample where the original [-w-] is followed exclusively by /i(:)/ and /e(:)/, than in a sample where the rate would be reduced by averaging in the lower rate before back vowels. Consequently, we would expect that V→B would have a higher rate in the *perfectum* of verbs than in his other intervocalic environments. This deduction is strikingly confirmed by Barbarino's data from North Africa reported in table 1.

	V→B	V→V	N
perfectum	48.31%	51.69%	89
other /V__V	23.72%	76.28%	56
	odds ratio = 3.006		
	χ^2 = 15.593		

Table 1. Rate of the substitution V→B in the perfectum *compared to the rate in other intervocalic environments including following back vowels: North Africa.*

[18] F. Slotty, *Vulgärlateinische Übungsbuch* (Berlin 1960).
[19] Barbarino (above, note 4) 26.

The odds ratio is the ratio of the odds for the spelling with B in the *perfectum*, 0.9348:1, to the odds for it in other intervocalic environments, 0.3109:1; it indicates the strength of the correlation. Thus the odds are just over three times greater in the *perfectum* than in the other environments. The value 15.593 for the chi-square statistic means that this difference is highly significant statistically; there is considerably less than one chance in a thoushand that the observed difference could arise from random factors.

A similar, statistically significant preponderance of V→B in the *perfectum* is found in the inscriptions from Rome and South Italy, reported together in table 2.

	V→B	V→V	N
perfectum	56.00%	44.00%	150
other /V__V	44.57%	55.43%	525
	odds ratio = 1.1.583		
	χ^2 = 6.113		

Table 2. Rate of the substitution V→B in the perfectum *compared to the rate in other intervocalic environments including following back vowels: Rome and South Italy.*

Although the odds ratio is somewhat smaller in table 2, the higher rate of V→B in the *perfectum* remains statistically significant. In fact, this preponderance holds true, at lower rates, when Barbarino's data for all of the regions in his study are combined, as is reported in table 3.

	V→B	V→V	N
perfectum	30.41%	69.59%	444
other /V__V	24.29%	75.71%	1165
	odds ratio = 1.361		
	χ^2 = 6.244		

Table 3. Rate of the substitution V→B in the perfectum *compared to the rate in other intervocalic environments including following back vowels: combined data from all regions.*

The foregoing tables, while suggestive, do not constitute rigorous tests of the saliency of a following front vowel in promoting [-w-] > [-β-]. For such a test, we obviously require data on the rates of V→B before front vowels and separately before back vowels. As such information has never been published, I collected it from South Italian inscriptions, utilizing precisely the same source as Barbarino, namely the collection of Diehls.[20] As a labor saving strategy, I confined my analysis to intervocalic environments other than the *perfectum*,

[20] E. Diehls, *Inscriptions latinae christianae veteres*. 3 vols. IV, *Supplementum*, ed. by J. Moreau and H. I. Marrou (Berlin 1967).

intending to supplement it with Barbarino's counts of the *perfectum*.[21] Before reporting the results, however, we must address the possible disturbing factors of analogy and, in particular, morphophonemic spelling. In some morphemes /w/ is followed by a front vowel in all inflectional and derivational forms, e.g. *civis* and *civitas*. In other morphemes /w/ is followed sometimes by a front vowel, sometimes by a back vowel, e.g. *vivi* but *viva*. In the former set, there would be no analogical basis for retaining [w] in pronunciation when it was becoming [β] nor for regularizing spelling with V other than knowledge of standard orthography. In the latter set, however, clearly related forms with [w] before back vowels could promote spellings with V. As a parallel one need only think of the earlier reintroduction of V before rounded vowels in inflectional forms such as *flavus, parvus, rivus*, etc., as well as the preservation of the phonetically motivated omission of V in extra-paradigmatic forms such as *parum*.

Consequently, I have cross-classified my classification of the morphemes containing /w/ by vocalic frontness according as the /w/ is followed 1) invariably by front vowels, 2) sometimes by front vowels, sometimes by back vowels, and 3) invariably by back vowels. I have cast the etymological net fairly widely (widely enough, e.g., to include proper names), but consistently. Now if the change [-w-] > [β] were promoted by palatalization, we would deduce immediately that the rate of V→B spellings should form a hierarchy decreasing from class 1) to class 2) to class 3). This prediction is strikingly confirmed by the inscriptional data from South Italy, as reported in Table 4.

/w/ followed by	Rate of V→B	N
1) invariable [-back]	47.87%	94
2) variable [+/-back]	19.30%	57
3) invariable [+back]	16.67%	6

$c = 0.243$
$\chi^2 = 13.564$

Table 4: Gradient of the rates of V→B reflecting the predicted hierarchy according to palatalizing environment and morpheme class: my data supplemented with Barbarino's data on the perfectum*: South Italy.*

It is obvious that the observed hierarchy is in perfect accord with the prediction. This hierarchy is highly significant statistically, as is proved by the chi-square value of 13.564. This chi-square is calculated according to Bartholomew's test[22] for qualitatively ordered gradients in proportions, and is evaluated as a function

[21] My data for this environment turns out to be rather more extensive (131 cases) than Barbarino's (92). For the test of the hypothesis in question, it is quite legitimate to combine my data with Barbarino's *perfectum* data, since, if anything, a somewhat lower proportion of *perfectum* forms could only prejudice the test *against* and not for my hypothesis.

[22] See J. Fleiss, *Statistical Methods for Rates and Proportions* (New York 1973) 100–102.

of the parameter

$$c = \sqrt{\frac{n_1 n_3}{(n_1+n_2)\ (n_2+n_3)}}$$

which takes into account the different sizes, n_1, n_2, n_3, of samples of the three morpheme classes.

There is further, very strong evidence in favor of the palatalization hypothesis. Bhat[23] has argued and R.D. Woodard and I[24] have demonstrated in a sample of 171 languages that, to the extent that high front vowels are more effectively front than mid front vowels, the former promote palatalization to a greater degree than the latter, and the latter, of course, to a greater degree than back vowels of whatever height. My data for morpheme class 1) (supplemented with the *perfectum* data from Barbarino) and class 3) manifest a perfect accord with this hierarchy of palatalizing effectiveness. The rarity of /i:/ and /e:/ in the sample preclude reliable estimation of the V→B rates before them, so that it is necessary to combine them with their short counterparts. The results are given in table 5.

Following vowel	Rate of V→B	N
/__i(:)	55.36%	56
/__e(:)	36.84%	38
/__[+back]	16.67%	6

$c = 0.0812$
$\chi^2 = 5.336$

Table 5: Gradient of the rate of V→B reflecting the hierarchy of palatalizing effectiveness of the following vowel: data as in table 4.

Again the hierarchy is in perfect accord with the prediction and is highly significant statistically. In Slotty's selection of Vulgar Latin Inscriptions we find a similar predominance of the environment before /i(:)/ (25.00%) over the environment before /e(:)/ (15.79%), although, due to the small number of cases before back vowels, there is a deviation at the final point of the hierarchy.

There is yet more evidence in favor of the palatalization hypothesis. As has long been recognized and recently afforded typological demonstration by R. D. Woodard and me[25], a preceding front vowel, particularly a high front vowel, promotes palatalization of the following segment, though not to the extent that a following front vowel does. For example, as applied to /w/, in Zoque (Mexico) a preceding /i/ or /j/ conditions the [β] allophone of /w/. When we cross-classify my data from South Italy (this time excluding Barbarino's

[23] Bhat (above, note 14).

[24] L. D. Stephens and R. D. Woodard, "The Palatalization of the Labiovelars in Greek: A Reassessment in Typological Perspective," *Indogermanische Forschungen* 91 (1986) 129–54.

[25] Stephens and Woodard (above, note 24) 141–42.

perfectum data, since he does not report on preceding vowels) and from Slotty's data for all three morpheme classes according to the presence or absence of /i(:)/ preceding the /w/, it emerges that V→B occurs in fact at a higher rate after /i(:)/ than after other vowels. The results are given in Table 6.

	V→B	V→V	N
/i (:)__	35.71%	64.29%	28
after other vowels	14.94%	85.06%	87
	odds ratio = 3.162		
	χ^2 = 5.712		

Table 6: Rate of V→B after /i (:)/ compared to the rate after other vowels: perfectum *excluded.*

As the odds ratio indicates, the odds for V→B are over three times as great if /i(:)/ precedes /w/. The chi-square value indicates that the observed difference is statistically significant. Similarly significant results are obtained when only forms from morpheme classes 1) and 3) are considered. It would be interesting to carry out this test on data from the *perfectum* as well.

To conclude: statistically controlled evaluation of phonetically and morphologically cross-classified data on the rates of the spelling substitution V→B in inscriptions from South Italy, supplemented by other material, confirms the hypothesis motivated by phonetic and typological considerations that palatalization differentially promoted the fricativization of intervocalic /w/ in Latin.[26]

[26] It may be of interest that I first formulated my hypothesis solely on the basis of a review of my own work and that of others on cross-linguistic regularities in the fricativization of [w] without consulting the Latin materials. When it became clear that this hypothesis had not been previously investigated, I collected and analyzed the Vulgar Latin data presented in section 3 as a test of the hypothesis. The present article, thus, is evidence for the heuristic value of linguistic typology for research on languages even as long and thoroughly studied as Latin.