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*Laryngeal enhancement in early Germanic**

Gregory K. Iverson

University of Wisconsin–Milwaukee

Joseph C. Salmons

University of Wisconsin–Madison

This paper builds on growing evidence that aspirated or fortis obstruents in languages like English and German are laryngeally marked, but that phonetic voicing in the (unmarked) unaspirated or lenis series is contextually determined. Employing the laryngeal feature set proposed by Halle & Stevens (1971), as incorporated into the ‘dimensional theory’ of laryngeal representation (Avery & Idsardi 2001, forthcoming), we develop an explicit account of this phonetic enhancement of phonological contrasts, which is widely known as ‘passive voicing’. We find that both passive voicing and inherent aspiration have been phonetic and phonological characteristics of the Germanic languages since the break-up of Indo-European, with laryngeally unmarked stops repeatedly enhanced by the gesture of [spread glottis]. A key implication of this view is that Verner’s Law was not an innovation specifically of early Germanic, but rather is an automatic (ultimately phonologised) reflex of passive voicing, itself a ‘persistent change’ rising out of the enduring ‘base of articulation’ that came to characterise Germanic.

1 Introduction

A mounting body of phonological research points to the conclusion that the voiceless aspirated or fortis series of obstruents in languages like English and German are laryngeally marked in the phonology, whereas superficial voicing in the unaspirated lenis series is phonologically inert, i.e. voicing in these languages is contextually determined rather than contrastive (Rice 1989, 1994, Rice & Avery 1989, Iverson & Salmons 1995, 1999, Avery 1996, Avery & Idsardi 2001, Honeybone 2002, among others). Employing the laryngeal feature set proposed by Halle & Stevens

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(1971) as incorporated into the ‘dimensional theory’ of laryngeal representation (Avery & Idsardi 2001, forthcoming), we develop an explicit account of this phonetic enhancement of phonological contrasts, which is known generally as ‘passive voicing’.

In the Halle & Stevens scheme, voicing is expressed via the features that define vocal fold tension, namely, [stiff (vocal folds)] and [slack (vocal folds)]. These, in turn, enable a connection to be drawn between pitch in sonorants and voicing in obstruents: [stiff] correlates with high pitch in vowels and inhibits voicing in obstruents, whereas [slack] conveys low pitch and facilitates obstruent voicing. A thread of recent work on Verner’s Law – the blocking of medial fricative voicing in Early Germanic by a preceding lexically accented syllable – exploits this familiar connection, noting the widely accepted reconstruction of Indo-European and early Germanic accent as being a lexically marked high tone (d’Alquen 1988, Ramers 1994, 1999, Page 1997, Calabrese & Halle 1998, Holsinger 2000). In contrast to the modern accentual phonetics of the daughters, the ‘musical’ or ‘pitch’ accent of earliest Germanic was thus encoded via the lexical specification of [stiff], which results in the reconstructed high tone. When spread into a following obstruent, this [stiff] property organically inhibits its voicing because the airflow or pressure drop across the glottis is not sufficient to set stiffened vocal folds into vibration in obstruents. On the ancillary assumption that passive voicing as in modern English or German has been a consistent phonological characteristic of Germanic since its very beginnings, we show here how the celebrated alternations ascribed to Verner’s Law simply would have arisen automatically, without stipulation. The surprising finding, then, is that Verner’s Law is not an independent innovation in the history of Germanic, but rather an epiphenomenon of mundane passive voicing, which just happened to get encoded into the grammar in a striking way.

In a related vein, it has generally also been assumed that the development of phonetic aspiration in the pre-Germanic or late Indo-European voiceless stops was a necessary step in order to trigger the suite of changes known as Grimm’s Law (Braune 1987, Calabrese & Halle 1998 and numerous others). Indeed, we see the early emergence of voiceless stop aspiration as instituting a new basis of articulation for the Germanic languages, one which persists to the present day. We term this pervasive innovation GERMANIC ENHANCEMENT, and consider it to be not a one-time sound change in the traditional sense, but rather the emergence of a persistent articulatory constraint that has continued to affect newly arising voiceless stops over the course of roughly 2500 years.

The paper is structured as follows. We begin by reviewing some key developments in laryngeal phonology, specifically the concept of ‘enhancement’ as based on insights from feature co-occurrences (Vaux 1998) and dimensional theory (Avery & Idsardi 2001), then turn to the place of passive voicing in this phonetic landscape. We apply this approach to a cluster of the most recalcitrant problems in historical phonology, beginning with Grimm’s Law, i.e. the phonetic changes in Indo-European stops on their

path to Germanic: IE *p = Gmc *f(<*ϕ), IE *b = Gmc *p^(h), IE *b^h = Gmc *b/β. This leads to a direct analysis of the redundant voicing of fricatives following unaccented vowels in early Germanic (Verner's Law) and of the Germanic Accent Shift, which signalled the transition from a lexically marked 'pitch' accent to a fixed initial 'stress' accent. The overarching finding is that minimally necessary assumptions about the obstruent changes from Indo-European into Germanic, along with the early origin of modern passive voicing, result in a new understanding of Verner's Law – not as specific sound change or added rule which later came to be lost, but as the fossilised cosequence of phonetic adjustments that are still operative in most of the Germanic languages.

2 Background

Recent work in laryngeal phonology shows that combinations to three privative or unary features – [voice], [spread (glottis)], [constricted (glottis)] – suffice to characterise all known phonemic laryngeal contrasts (Iverson 1983a, Lombardi 1991, 1996, Iverson & Salmons 1995, 1999, Avery 1996, all indebted to Ladefoged 1973).¹ A selection of the familiar possibilities is given in (1), where it will be noted that each system includes one laryngeally unmarked phonemic type (the first column), that two-way systems variously employ one of the three available features, three-way systems employ two, and more complex combinations are also possible to produce four-way (and even five- and six-way systems).²

- (1) *Some laryngeal contrasts employing the privative features* [voice], [spread] and [constricted] (from Iverson & Salmons 1995: 383)

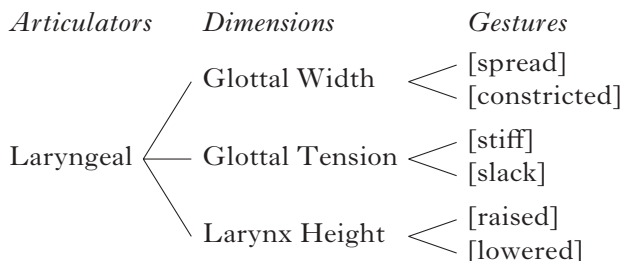
| | /p~b̥/ | /b/ | /p ^h / | /p'/ | /b ^h / |
|----------|--------|---------|-------------------|----------|-------------------|
| Hawaiian | [] | | | | |
| K'ekchi | [] | | | [constr] | |
| Spanish | [] | [voice] | | | |
| English | [] | | [spread] | | |
| Thai | [] | [voice] | [spread] | | |
| Hindi | [] | [voice] | [spread] | | [spread,voice] |

¹ The descriptive typological success of a privative feature set is strong confirmation over the less restrictive binary alternative, which admits of twice as many possibilities because it marks both positive and negatively valued features as opposed to merely the presence of a feature, absence of a feature being literally unmarked.

² A number of phonological insights emerge as well under the laryngeal privativity assumption (e.g. the English bias in assimilation in favour of the fortis series, absence of aspiration in *s*+stop clusters, devoicing of sonorants following voiceless obstruents, blocking of Grimm's Law in obstruent clusters: cf. Iverson & Salmons 1995, 1999), and the cases which have been argued to call for negative specification of the feature [voice] (Wetzels & Mascaró 2001) find a natural reinterpretation under the structural assumptions made below (as argued by Iverson & Salmons 2003a).

A persuasive variation on the privative feature theme has recently emerged in Avery & Idsardi's (2001) conception of laryngeal representation. Rather than being defined on the three privative features [voice], [spread] and [constricted], their proposals distinguish laryngeal contrasts according to the three 'dimensions' of Glottal Width, Glottal Tension and Larynx Height. These dimensions are organising constructs which subsume mutually contradictory qualities that are arrayed along the same articulatory trajectory. That is, the dimensions implicate phonetically antagonistic yet complementary 'gestures', which are essentially the same entities as the phonological features of conventional theories, except that [voice] is removed in favour of the interplay between [stiff] and [slack], as per Halle & Stevens (1971), and the dimension of Larynx Height provides for an either raised (ejective) or lowered (implosive) larynx. Structurally, the dimensions and gestures relate to each other as in (2), all implemented under the 'articulator' Laryngeal.³

(2) *Geometry of laryngeal representation in dimensional theory*
(Avery & Idsardi 2001)



Employing this system, the range of descriptive possibilities for characterising contrasts in laryngeal configurations works out to be similar to positing the three features [voice], [spread] and [constricted], since under either approach just three privative entities combine in various ways to define a given system. For example, the conventional featural systems listed in (1) would translate into dimensional representation as in (3).

(3) *The laryngeal contrasts in (1) employing the dimensions Glottal Width (GW), Glottal Tension (GT) and Larynx Height (LH)*

| | /p~b/ | /b/ | /p ^h / | /p'/ | /b ^h / |
|----------|-------|-----|-------------------|------|-------------------|
| Hawaiian | [] | | | | |
| K'ekchi | [] | | | LH | |
| Spanish | [] | GT | | | |
| English | [] | | GW | | |
| Thai | [] | GT | GW | | |
| Hindi | [] | GT | GW | | GT,GW |

³ An apparent drawback to the Halle & Stevens (1971) system of features is that the replacement of [voice] by [stiff] and [slack] raises the number of glottal phonemic

Avery & Idsardi maintain that phonemic distinctions are encoded at the dimensional level, so that only one member of an antagonistic gestural pair is used contrastively in a given system, though the other member may be invoked as a phonetic embellishment, or ‘enhancement’, of a contrast. Thus, [spread] and [constricted] form an antagonistic pair under the dimension of Glottal Width, so it is expected that only one of these will be phonologically active, as is the case in English or German (both of which contrast [spread] voiceless aspirated stops with laryngeally unmarked lenis stops). Similarly, [stiff] and [slack] constitute the complementary pair which is subordinated under Glottal Tension, hence just one of these will function phonologically in a given sub-system (as in Dutch, whose [slack] voiced stops contrast with laryngeally empty, voiceless unaspirated ones).

Whether this strict limitation on gesture co-occurrence can be maintained is still being worked out, as there may be systems that contrast obstruents along the Glottal Width dimension, thus calling for lexical distinctions between gestures. For one of these, Korean, Avery & Idsardi develop an insightful alternative that marks the aspirated series with Glottal Width (which implements the gesture [spread] by default), but analyses the phonetically tense series as phonemically geminate and only redundantly [constricted] (cf. also Ahn & Iverson 2001). Still other systems with superficial distinctions between [spread] and [constricted] obstruents may or may not be amenable to this kind of reanalysis, such as Beja, Sindhi, Swati and Zulu (cf. Ladefoged 1973, Iverson & Salmons 1995). Following the analysis of such presumably marked systems that is presented in Kehrein (2002: 75–77 and elsewhere), the Glottal Width dimension would need to implement both [spread] and [constricted] lexically, whereas in more common systems only dimensions, not gestures, are posited at the lexical or phonemic level. However, motivated alternatives do appear to be available for each of these grammars. At least some implosives can be handled without phonemic reference to the gesture [constricted], as argued by Clements (2000) and Jessen (2002). Moreover, Michael Jessen points out (personal communication) that the relevant series in Beja might be better understood as complex segments, to wit glottal stop plus plosive (cf. Ladefoged 1973), as opposed to the featural characterisation proffered in Kehrein. Whether the more restrictive interpretation of dimension-only contrast can be maintained for such systems lies beyond our immediate concerns, but one point does bear on arguments below: in the systems just discussed, the default selection is such that Glottal Width normally implicates [spread] and Glottal tension typically implicates [slack]. At the same time, [stiff] serves as the default gesture for Glottal Tension when lexically marking vowels in languages

contrast possibilities from six to nine: three combinations of the glottal tension features ([stiff], [], [slack]) co-occurring with three combinations of the glottal width features ([spread], [], [constricted]). Restrictions in the form of combinatorial exclusions that reduce this system back to six possibilities were put forward by Iverson (1983a), but these are largely obviated by the dimensional innovation in Avery & Idsardi’s proposals.

with tonal accentual systems like that of Proto-Indo-European, but this is no paradox: even though both antagonistic gestures of a dimension can be taken as default, only one of them may play this role within a given class of sounds (e.g. [slack] in obstruents, [stiff] in sonorants).⁴

The gestures [spread]/[constricted] and [stiff]/[slack] were, as already noted, originally proposed in the pioneering paper on laryngeal features by Halle & Stevens (1971). As is now common practice, [spread] is the feature associated with the voiceless laryngeal approximant /h/ and with aspiration in stops and other consonants, whereas [constricted] marks the glottal stop as well as the property of laryngealisation or glottalisation. Notably, there is no feature [voice] under this system; instead, voicing in obstruents is implemented via the gesture [slack] (or perhaps no laryngeal tension specification at all), exploiting the observation that slackened or neutral vocal folds can be set into vibration even when airflow across the glottis has been substantially impeded by a supralaryngeal obstruction. If the Glottal Tension dimension implicates [stiff], on the other hand, vocal fold vibration is inhibited unless transglottal airflow is quite substantial, as it is in sonorant articulations but not in obstruents.

Another key aspect of Avery & Idsardi's approach is phonetic 'enhancement', or overdifferentiation, of certain distinctions via the provision of a redundant dimension node to the unspecified member in a contrasting pair. One prominent dimensional enhancement is based on the findings of Vaux (1998) relative to voiceless fricatives (presaged by Rice 1994: 134–135). In Avery & Idsardi's terms, this enhancement allots the Glottal Width dimension to laryngeally unmarked fricatives whenever Glottal Width is not contrastive in the fricative system. Thus, if a language contrasts a Glottal Tension (voiced) fricative with a laryngeally unmarked (voiceless) fricative, as in Spanish or Japanese, Vaux's Law (as Avery & Idsardi call it) entails that the unmarked fricative will acquire the dimension of Glottal Width, the default gesture of which is [spread]. This generalisation takes the form of the redundancy expressed in (4).

(4) *Vaux's Law*

Laryngeally unspecified fricative → [GW] (in systems contrasting fricatives without reference to [GW])

Accordingly, the default gesture [spread] accrues to laryngeally unmarked fricatives in systems which do not otherwise mark [spread]. Following the survey of fricative phonetics laid out in Vaux (1998), this statement ensures that voiceless fricatives in 'voice' systems like Spanish or Japanese will be articulated as relatively fortis (or 'inherently aspirated') even though voiceless stops in the system are unaspirated. It has often been noted that voiceless fricatives require a substantial pulmonic airflow in order to maintain their oral turbulence, and this in turn implies

⁴ The Larynx Height dimension will not figure further into the present discussion; it implicates the antagonistic gestures [lowered] and [raised], the latter of which may be considered to be the default, ejectives being more common than implosives.

among laryngeally unspecified fricatives since the very beginnings of Germanic, as evidenced (to be argued below) by the familiar functioning of Verner's Law.

The Glottal Tension dimension is redundant in the phonological system of English, an aspiration language whose two-way laryngeal contrast among obstruents is implemented via presence *vs.* absence of the Glottal Width dimension. Among sonorants, however, 'spontaneous voicing' takes place in the manner described by Chomsky & Halle (1968) and Halle & Stevens (1971) – that is, glottal vibration ensues automatically with sufficient airflow across vocal folds which are in a neutral state of abduction, as in the case with ordinary sonorants of all types, consonants as well as vowels. These are therefore articulated as voiced rather than voiceless unless some contrary gesture intervenes, such as spreading apart or tightly constricting the vocal folds so as to inhibit their vibration. Representative redundant occurrences of the voice-implementing dimension, Glottal Tension, are portrayed among the various sonorant segments in the English words listed in (6), as provided by the redundancy in (7).

(6) *Extension of Glottal Tension into a laryngeally empty obstruent*

| | | | |
|--------------------------------|----------------|---------------------------------|---------------|
| [ɹ ʌ .b ʒ] | <i>rubber</i> | [l ʌ m .b ʒ] | <i>lumber</i> |
| | | | |
| GT GT GT | | GT GT GT GT | |
| | | | |
| [b æ dʰ .m æ n] | <i>badman</i> | [b æ tʰ .m æ n] | <i>batman</i> |
| | | | |
| GT GT GT GT | | GT GW GT GT GT | |
| | | | |
| [b ɔ lʰ .b ɔ ɪ] | <i>ballboy</i> | [b æ dʰ .b ɔ ɪ] | <i>badboy</i> |
| | | | |
| GT GT GT GT | | GT GT GT | |
| | | | |
| [b æ tʰ .b ɔ ɪ] | <i>batboy</i> | [b ε dʰ .pʰ æ n] | <i>bedpan</i> |
| | | | |
| GT GW GT GT | | GT GW GT GT | |

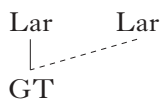
Formally, spontaneous voicing can be expressed as the phonetic introduction into laryngeally unmarked sonorants of the Glottal Tension dimension, which will result in voicing irrespective of the degree of vocal fold tension, i.e. whether associated with the gesture [slack] (lower pitch), [stiff] (higher pitch) or neither (intermediate pitch).

(7) *Spontaneous voicing*

Son
|
Lar
⋮
GT

With the Glottal Tension dimension thus phonetically present among sonorants, the phenomenon of ‘passive voicing’ in obstruents can be understood as the extension of spontaneous voicing into a neighbouring segment not already specified for a laryngeal quality. This penetration operates rightward from a segment provided with Glottal Tension to a following laryngeally empty one, which, in English (after spontaneous voicing), is any of the lenis obstruents. Accordingly, the laryngeally unspecified /b/ in *rubber* or *lumber* acquires the Glottal Tension property from the spontaneously voiced sonorant immediately preceding it. Similarly, the /d/ in *bad* [bæd], whether alone or in a phonological phrase like *bad man* [bædˈmæn], acquires the dimension of Glottal Tension from the preceding vowel. But passive voicing does not take place in the /b/ of *bad* because that initial segment is not immediately preceded by an occurrence of Glottal Tension. Voicing does not occur in the second /b/ of *batboy* [bætˈbɔɪ] either, where the syllable preceding terminates in a segment marked instead for Glottal Width, or in the /t/ of [bætˈ] (*bat*, *batboy*, *batman*), which is itself so marked. In *ballboy* [bɔɪˈbɔɪ] or even *bad boy* [bædˈbɔɪ], conversely, voicing of the second /b/ is more likely to go through based on the derived presence of Glottal Tension in the preceding segment; but voicing is inhibited in the fortis /p/ of *bedpan* [bɛdˈpʰæn] due to that segment’s inherent marking for the Glottal Width dimension.⁶ Formally, passive voicing operates as in (8), spreading the Glottal Tension dimension present in a preceding segment into a following laryngeally unspecified one.

(8) *Passive voicing (variable implementation)*



We thus can lend some precision and context to a familiar phenomenon which has been often mentioned yet, to our knowledge, not precisely defined in the phonetics literature. Kohler (1984: 162), for example, characterises the passive or contextual voicing of obstruents simply as below, consistent with the sense that this represents a kind of weakening or contamination:

Vocal fold vibration is regulated passively in Korean, as it is in English, German and Danish, to name but a few other examples. This means that the aerodynamic conditions for voicing are not actively controlled;

⁶ Michael Jessen (personal communication) regards passive voicing as ‘not very plausible’ in clusters of the /d+b/ type. The first stop here is unreleased, which yields a geminate-like character, he suggests, and there is a cross-linguistic tendency for geminates to be voiceless in view of their long period of closure. Still, in the absence of any direct phonological instruction to voice, such clusters may well show some phonetic variability with respect to this property, and the lenis /b/ of English /d+b/ (*bad boy*) in any case does not merge with fortis /p/ (*bedpan*).

voicing only continues during a stop closure as long as the articulatory context allows a pressure drop across the glottis.

Like Kohler, we understand passive voicing to consist in a lack of direct articulatory control over voicing, leaching in, as it were, from its presence in a preceding segment endowed with the Glottal Tension dimension. As the default gesture for Glottal Tension in obstruents is [slack], the result of this dimensional spread into the phonemically lenis series is typically voicing. In cases where the Glottal Tension dimension is specifically marked for the contrary gesture [stiff], however, as described below in connection with the Verner's Law phenomenon, voicing will be inhibited because stiff vocal folds do not vibrate under the low transglottal airflow conditions of an obstruent. Passive voicing on our view, then, is expressly dimensional spread, not gestural extension, so that the phonemically absent effect of phonetically stiff vocal folds in a lexically unmarked sonorant (as reflected in the higher pitch associated with English vowels under focus or sentence stress) does not impede the attribution of [slack] by default to lenis obstruents. Hence, the /b/ in *rubber* is voiced despite the stress on the preceding vowel. A lexically or phonemically marked [stiff] gesture, on the other hand, does extend along with its superordinate Glottal Tension dimension under the conditions listed in (8), and this will inhibit voicing in phonologically lenis obstruents. In sum, the organisation of physiologically complementary gestures under a single laryngeal dimension makes possible the unification of operations which spread phonemically marked gestures with those that refer to the dimensional level alone. Anchored at the steam between dimensional representation and gestural enhancement, passive voicing thus emerges not so much as a surface phonetic embellishment as a shallow phonological generalisation holding over voicing-friendly contexts.

The most accommodating of voicing-friendly environments, of course, is the intervocalic or simply intervocalic context.⁷ Obstruent voicing of just this type – for example, of German or English intervocalic lenis stops – has been documented in many phonetic studies, as reviewed by Jessen (1998: 57–58) and Cruttenden (2001). German stops in this environment range from largely voiceless to fully voiced, depending on rate and register, and the process is familiar outside of Germanic from the non-contrastive, variable voicing of intervocalic lax stops in Korean (Iverson 1983b, Jun 1994). These cross-linguistically attested patterns of partial or even full voicing in medial (specifically, intervocalic) position contrast sharply with the essentially voiceless realisation of the same lenis series in initial position. In final position in both German and Korean, of course, voicing is impossible due to the requirements of final fortition (German; Iverson 1997) or final non-release (Korean; Iverson 1989). But in English,

⁷ Whether a language whose laryngeal properties are conducive to the phenomenon actually shows passive voicing is apparently facultative, because some Glottal Width languages (English, Korean) exhibit the pattern, while others do not (Modern Icelandic).

where such constraints do not hold, even final lenis obstruents may acquire some measure of voicing from a preceding voiced segment, albeit typically less than in the medial environment.⁸ English final occlusives have also been described as fully devoiced, however – for example, by Cruttenden (2001: 161–167), with further references, who cites words like *rib*, *robe*, *bid*, *mad*, *dog*, *vague*; he further notes that ‘in initial and (especially) final positions, the voiced fricatives may be partially or almost completely devoiced’ (Cruttenden 2001: 178). In the words *leave*, *breathe*, *peas*, *rouge*, specifically, Cruttenden regards the friction as ‘typically voiceless, though the consonant remains lenis’.⁹ All of this variation is consistent with the variable, passive implementation of voicing in English rather than the occurrence of this property as an underlying, contrastive feature in the obstruent system.

We turn now to more direct consideration of the diachronic import of the theoretical and conceptual background laid out up to this point (contrast enhancement and Vaux’s Law, spontaneous voicing, passive voicing) and its relation to the cluster of sound changes that have traditionally defined the phonology of Germanic as it evolved from the Indo-European parent: the Germanic Consonant Shift, Verner’s Law and the Germanic Accent Shift.

4 Germanic Enhancement

Generations of scholars have assumed that the presence of aspiration in voiceless stops is central to how the obstruents of Germanic developed from those of Indo-European, yet this assumption has rarely been explored in depth or even made explicit. The voiceless stops of Indo-European, however, have usually been regarded as clearly unaspirated, as that is their manifestation in most of the daughters, especially those regarded as generally conservative (Greek, Indo-Iranian, Italic) but not others (Germanic or Armenian). The traditional reconstruction of Indo-European obstruents contrasts a three-way manner series of voiced aspirated (murmured) stops, simple voiced stops¹⁰ and voiceless unaspirated stops along

⁸ A typological insight into the nature of Passive Voicing comes from Holsinger (2000 and subsequent discussions and correspondence), who distinguishes between lenition processes resulting in reduction or neutralisation, on the one hand, and passive voicing, on the other, in terms of their phonemic consequences: unmarked segments may be subject to non-contrastive (phonetic) embellishments of their surface form, but no lenition process will change the contrastive features of these segments. Thus, lenition processes cannot create a phonological contrast if they affect a laryngeally unmarked segment. The environment in which lenition and passive voicing occurs is identical; the distinction, Holsinger argues, lies in the phonemic status of the targets and outputs.

⁹ As Cruttenden, Jessen and many other sources have noted, phonetic voicing of lenis obstruents is sometimes absent even in medial position, even for fricatives, which are inherently more voice-friendly than stops.

¹⁰ These are rendered as voiceless ejectives under the ‘Glottalic Hypothesis’ – cf. Gamkrelidze & Ivanov (1973), Hopper (1973) and the review in Salmons (1993).

with one laryngeally neutral, presumably voiceless fricative. In the context of dimensionality, where we extend the notion of privative description to both manner (fricatives being marked relative to stops) and laryngeal features, the scheme of representation for Indo-European obstruents is that charted and exemplified in (9).¹¹

(9) *Proto-Indo-European obstruent system*

| | | |
|------------------|--|----------------------|
| <i>oral</i> | [obs] | [obs] |
| | b ^h d ^h g ^h g ^{hw} | b d g g ^w |
| <i>laryngeal</i> | GT&GW | GT |
| | *b ^h eud ^h - ‘be aware’ | — |
| | *d ^h eub- ‘deep’ | *deuk- ‘tug’ |
| | *g ^h eng ^h - ‘go’ | *gonu- ‘knee’ |
| <i>oral</i> | [obs] | [obs, cont] |
| | p t k k ^w | s |
| <i>laryngeal</i> | [] | [] |
| | *pH ₂ tér- ‘father’ | *sed- ‘sit’ |
| | *teng- ‘think’ | |
| | *keH ₂ p- ‘grab, hold’ | |

In the speech communities destined to become Germanic, phonological developments began, we hypothesise, with the introduction of aspiration into the ancestral voiceless stops.¹² We attribute this event formally to the provision of the Glottal Width dimension (implicating the default gesture [spread]) to laryngeally unmarked stops, rather than to fricatives.¹³ We term this key innovation to the Indo-European obstruent system ‘Germanic Enhancement’, and see it as a catalyst that induced extensive

¹¹ We rely here on a traditional reconstruction of the system and draw our data from Mayrhofer (1986) and Rix (2001) for Indo-European, Bammesberger (1986, 1990) and Lehmann (1986) for Germanic. Note that we follow the Indo-Europeanist convention of using ‘H’ for the so-called laryngeals, and that we write <g>, etc. following the sources used, but otherwise leave out of the discussion the palatal occlusive series posited in many modern reconstructions, since these are lost as a distinct series in the western Indo-European languages, and so were not present in the immediate ancestor of Germanic. Moreover, their status within Indo-European is not without complications; cf. Sihler (1995: 151–155), as opposed to the view of Mayrhofer (1986: 102–106). Likewise, we do not pursue details of etymology here that are not directly pertinent to the discussion, such as the vocalism of the ‘knee’ word or the loss of laryngeals.

¹² A similar process took place in the history of Armenian, where it had similar, though less far-reaching effects. Germanic-like enhancement does not, of course, automatically or necessarily trigger restructuring of the magnitude found in Grimm’s Law.

¹³ Note that Germanic Enhancement shows similarities to and differences from Vaux’s Law: both provide laryngeal enhancement via GW, but one to stops, the other to fricatives. Their origins and motivations are likewise quite distinct.

subsequent change. Like passive voicing, moreover, Germanic Enhancement is a generalisation which persists in the phonetic systems of most modern Germanic languages, phonetically defining this family apart from its several sisters.

In effect, Germanic Enhancement provides [spread] to voiceless stops. What caused Germanic Enhancement is a matter of speculation,¹⁴ but it can be noted that there was an uncommon three-way laryngeal contrast among stops at this point (Proto-Indo-European essentially), the rather marginal phonetic distinctions among which presumably would have been receptive to such enhancement. Or perhaps Germanic Enhancement was a family-specific alternative to Vaux's Law, which itself could not be brought into play at this late stage of Indo-European (or early stage of Germanic), due to the absence of laryngeal contrasts among fricatives. That is, Vaux's Law is Glottal Width enhancement, operating to provide [spread] to fricatives only in systems in which Glottal Width is not contrastive among fricatives (per the illustrations of Avery & Idsardi 2001). Unmarked fricatives are not enhanced in English, then, because voiceless fricatives in English are already fortis (i.e. distinguished by Glottal Width, which implicates the default gesture [spread]); but as unmarked fricatives in Japanese or Spanish contrast instead with voiced ones marked for Glottal Tension (implicating [slack]), the unmarked ones come to be redundantly afforded the dimension of Glottal Width (implicating [spread]). Thus, though Indo-European /s/ (and the early Germanic fricatives – cf. below) were indeed laryngeally empty on this analysis, Vaux's Law had no effect, because Glottal Width was not contrastive in the fricative system. The parallel phonetic embellishment affecting Germanic stops is stated in (10).

(10) *Germanic Enhancement*

Laryngeally unspecified stop → [GW]

The simple yet portentous effect of this innovation on the Indo-European system of obstruents in (9) is shown in the emergent Germanic system portrayed in (11).¹⁵

¹⁴ This is not only beyond the scope of this paper, but probably unknowable. Perhaps it derives from language contact among speakers of the pre-Germanic variety of Indo-European and local substrate language(s), as a number of previous scholars have suggested. For a review of literature on this and related speculations, see discussion in Schrodtt (1974: 200–218). Certainly, in the two Continental Germanic languages that have abandoned aspiration-type systems, Netherlandic and Yiddish, contact is thought to underlie the change (cf. Iverson & Salmons 2003a: 20–21).

¹⁵ Jakobson pointed out the typological oddity of this widely accepted system contrasting voiceless, voiced and voiced aspirates in a 1957 presentation (see Jakobson 1971, and Salmons 1993 for discussion), inspiring the 'glottalic' reconstructions of Indo-European obstruents. We follow the traditional reconstruction here, but our analysis works with glottalic Indo-European as well.

(11) *Phonetic departure from Indo-European via Germanic Enhancement*

| | | | | |
|------------------|--|----------------------|---|-------------|
| <i>oral</i> | [obs] | [obs] | [obs] | [obs, cont] |
| | b ^h d ^h g ^h g ^{hw} | b d g g ^w | p t k k ^w | s |
| <i>laryngeal</i> | GT&GW | GT | ⋮ GW | [] |
| | | | [p ^h t ^h k ^h k ^{hw}] | |
| | | | *p ^h æt ^h er- | |
| | | | *t ^h eng- | |
| | | | *k ^h ap ^h - | |

From here, Grimm’s Law can be understood as a classic drag chain: the Indo-European simple voiced series devoices (loses its Glottal Tension marking), accordingly – per Germanic Enhancement – becoming aspirated through accretion of the Glottal Width dimension; and the Indo-European ‘voiced aspirates’ simplify to become plain voiced stops via loss of the now superfluous Glottal Width dimension, ultimately losing their Glottal Tension specification as well so as to emerge as the laryngeally unmarked series in later Germanic.¹⁶ These familiar subsequent changes that constitute Grimm’s Law are charted in the four stages listed in Table I, which, we conclude, were triggered by the late Indo-European innovation of Germanic Enhancement.¹⁷

| <i>stage</i> | <i>change</i> | <i>system</i> | <i>ranking</i> |
|--------------|------------------------|---------------------------------|--|
| | | b ^h b p ^h | (traditional) Indo-European after Germanic Enhancement |
| 1 | p ^h → ∅ | b ^h b ∅ | voiceless stops spirantise (‘hyper-enhancement’) |
| 2 | b → p → p ^h | b ^h p ^h ∅ | voiced stops devoice to form a new unmarked series, reimplicating Germanic Enhancement |
| 3 | b ^h → b | b p ^h ∅ | voiced aspirates simplify to voiced (lose Glottal Width) |
| 4 | b → ɸ | ɸ p ^h ∅ | Glottal Tension is removed from the obstruent system, retained only for marking lexical accent |

Table I

Likely internal chronology of Grimm’s Law as a drag-chain effect.

¹⁶ The critical parts of this analysis fit in with other chronologies as well. For instance, after the original Germanic Enhancement, imagine that the old voiced stops devoice and then the voiced aspirates deaspirate, leaving an aspirated series, an unmarked series and a voiced series. The new lenis or unmarked series could not undergo Germanic Enhancement until the spirantisation of the original voiceless series, now marked by Glottal Width, in the last stage of Grimm’s Law.

¹⁷ One apparent limitation on Germanic Enhancement is that its effects are not evident in *s*+stop clusters. That stops in these clusters were not released with

Thus Germanic Enhancement led – again, this is something that has long and commonly been attributed to the role of early Germanic aspiration – to a kind of hyper-enhancement, namely, the affrication and subsequent spirantisation of phonetically aspirated stops (not unlike later changes associated with the Second Sound Shift in High German (Davis & Iverson 1995, Davis *et al.* 1999), the remarkably similar changes now in full bloom in Liverpool English (Honeybone 2001) or the incipient affrication of aspirated stops currently underway in Danish (Fischer-Jørgensen 1980, Kohler 1984: 164).¹⁸ With spirantisation of aspiration-enhanced voiceless stops in early Germanic, the original fricative class expanded considerably (perhaps compensatorily) as the contrastive stop types reduced from the three of Indo-European to the two of Germanic. In the wake of this development, the rest of Grimm's Law follows as a straightforward reduction of unnecessary marking in the obstruent system on the part of new generations of learners having to reanalyse that system. The early Germanic obstruent system resulting from the first three of these changes (Grimm's Law *per se*) is schematised in (12).

(12) *Early Germanic obstruent system (via Grimm's Law)*

| oral | [obs] | [obs] | [obs, cont] |
|-----------|----------------------|--|------------------------|
| | b d g ^(w) | p t k ^(w) | ϕ θ x ^(w) s |
| laryngeal | GT | ⋮ | [] |
| | | GW | |
| | | [p ^h t ^h k ^{h(w)}] | |
| | *beudan | — | *fadar |
| | *deupa- | *t ^h euk ^h an | *θunk |
| | *gangan | *k ^h newam | *haf- |
| | | | *set- |

To recapitulate, this pervasive set of changes was likely triggered by the representational imbalance which Germanic Enhancement precipitated, itself a precursor to Grimm's Law under both traditional (Grimm 1826, Prokosch 1939, Braune 1987) and modern (Iverson & Salmons 1995, Calabrese & Halle 1998) interpretations. The presence of aspiration in the

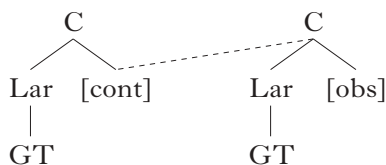
aspiration in Germanic, just as the modern equivalents are not in English, German, etc., is due to the reasons laid out in Iverson & Salmons (1995: especially 370–372); i.e. the [spread] gesture inherent in the stop is shared with the fricative and thus completed by the time of release of the stop.

¹⁸ An anonymous reviewer for this journal asks why no further hyper-enhancement of newly enhanced stops takes place after Stage 1, above. These examples indicate that further hyper-enhancements have indeed taken place. In terms of the whole structure of the obstruent system and considerations of markedness, though, such secondary developments seem to us less likely than at Stage 1: not only are there now only two stop series, rather than the relatively marked three-way distinction of Indo-European, but there exists after the first steps of Grimm's Law a fortis fricative series, leaving no obvious gap for hyper-enhanced stops to migrate into.

ancestral voiceless stops is widely understood to have been a necessary condition in order to trigger the spirantisation aspect of Grimm's Law, chiefly for phonetic reasons associated with the shorter duration of the closure phase of heavily aspirated stops, which are prone to the weakening effect of spirantisation because their briefer closures are more likely to be incomplete (cf. Iverson & Salmons 1995 for elaboration). Germanic Enhancement thus emerges as the phonetic innovation that made Grimm's Law possible, for with spirantisation come the (drag) chain-shift effects of demurmuring and devoicing that make this the most celebrated of all known sound changes.

With respect to the Indo-European voiced aspirates, finally, we hypothesise that Grimm's Law *per se* effected just deaspiration, not immediate loss of their occlusion in postvocalic contexts as well: the fricative allophones, we infer, came about due to subsequent, Spanish-like 'passive spirantisation'. This sequencing is necessary in order to recognise the voicing of fricatives *per* Verner's Law in early Germanic as a non-neutralising enhancement, as will be reviewed presently; but it also makes for a simpler set of changes in the implementation of the Grimm's Law package, since fricativisation affects all and only the Indo-European voiceless stops, not some of the voiced aspirated ones as well. Following on the heels of Grimm's Law, passive spirantisation of the Germanic voiced stops then has the further, critical effect of inducing Vaux's Law, because spirantisation creates inherently voiced fricatives which contrast with the medial voiceless fricatives in Germanic, i.e. those that escaped voicing via Verner's Law due to preceding accent. Indeed, this is the mechanism by which Glottal Width comes into the Germanic fricative system: post-vocalic spirantisation of /b d g/ creates the contrast that is necessary in order to enable Vaux's Law to come into play, which in turn enhances the class of voiceless fricatives with the dimension of Glottal Width at this still early stage of Germanic.¹⁹ Passive spirantisation, specifically, extends the a [continuant] property of a spontaneously voiced (sonorant) segment into following obstruent that is marked for Glottal Tension, as schematised in (13).

(13) *Passive spirantisation*



¹⁹ These and similar processes continue to unfold over the history of the Germanic daughters. As noted already, the High German Consonant Shift and the contemporary affrication of aspirated stops in some varieties of Danish resemble parts of Grimm's Law, while Old English fricatives move in another direction, losing laryngeal specification and thus falling prey once again to passive voicing. Honeybone

This Spanish-like weakening of occlusion in Early Germanic voiced stops – themselves laryngeally Spanish-like by virtue of their Glottal Tension marking inherited from Indo-European – bears importantly on the functioning and later phonologising of Verner’s Law, to which we now turn.

5 Verner’s Law and lexical accent

We pursue here the idea that Verner’s Law was not a rule- or constraint-like phenomenon associated specifically with early Germanic, but rather is an ordinary reflex of passive voicing as described in §2.²⁰ That is, Verner’s Law *per se* was no law at all, but is rather just a phonologised realisation of the same kind of contextual voicing as characterises most modern Germanic languages. One key to this interpretation is that the lexical accent in Indo-European was presumably encoded as a laryngeal specification on the vowel which bore the accent.²¹ In the feature model worked out by Halle & Stevens (1971), stiffness of the vocal folds associates with higher pitch in sonorants, and this, under present assumptions, means that the Glottal Tension dimension (in association with the gesture [stiff]) was the marker of lexical accent in Indo-European.²² The default gesture for a specification of Glottal Tension is [slack] in phonemically voiced obstruents, but the higher pitch of lexically accented vowels reconstructed

(ms) shows how Old English initial fricative voicing (in *this*, etc.) can be captured in a framework very much like the one developed here.

²⁰ This was first proposed by Holsinger *et al.* (2000), and draws in various places on other works of Dave Holsinger, as indicated above.

²¹ We underscore again that accent in Indo-European was a lexically marked high tone, not ‘dynamic stress’ in the metrical or relational sense. This is the common view, with only minor variations, throughout the specialist literature (Halle 1997 and earlier work, for instance), and it has been codified in the handbooks on stress/ accent (Hayes 1995: 297) as well as Indo-European generally (Beekes 1995: 148). *Pace* Halle (1997: especially 309–310), syllables not marked as accented are simply understood to be unmarked, while attested reflex tonal contrasts – H *vs.* L, with various patterns of spreading – are later innovations in some of the daughters.

²² Until a recent set of works on Verner’s Law (d’Alquen 1988, Noyer 1992, Ramers 1994, 1999, Page 1997, Holsinger 2000), researchers had failed to establish a natural articulatory connection between voicing and accent to underpin Verner’s original insight into the law that bears his name. Following on Halle & Stevens (1971), these modern works pointed out that high pitch and voicelessness are directly related by the mechanisms of articulation, in that a specification of [stiff vocal folds], used to encode high pitch, is antithetical to voicing and thus can inhibit it in a following segment, such as in laryngeally unspecified post-tonic fricatives. This phonetic connection represents obvious progress toward capturing the spirit of Verner in modern terms, but defining the phonological and particularly the featural connection has remained problematic. As reviewed in detail by Holsinger (2000), these works are forced to invoke complex arrays of features and unmotivated delinkings, difficulties resulting in no small part from the machinery of phonological theories of the 1980s and 1990s. A major advantage of dimensional theory as employed in this article is of course that it sanctions precisely the right kind of connection between tone and phonetic voicing.

for Indo-European and early Germanic could not convey the default [slack] value property; instead, lexically accented vowels were marked explicitly for the gesture [stiff] in order to express the phonemic status of high tone. Accordingly, the Glottal Tension dimension came to play a compound phonological role in early Germanic, marking both the class of phonemically voiced stops (phonetically implemented as [slack]) and lexically accented vowels (marked as [stiff]). In addition, as described previously, the Glottal Tension dimension serves as the carrier of redundant or spontaneous voicing among sonorant segments, which in turn is a trigger for passive voicing in laryngeally unspecified obstruents. At this early stage of Germanic, interestingly, when the language employed the system of contrasts in (12), the laryngeally unspecified obstruents were all fricatives – precisely the segments subject to Verner’s Law, or, as we shall maintain instead, to passive voicing as defined in (8).

The consequences of redundant voicing operating at the point in Germanic when the accent was still lexical and the obstruent system shown in (12) had just emerged from the effects of Grimm’s Law are schematised in (14).

(14) *Verner’s Law effects via passive voicing*

| | | |
|----------------------------|-----------------------|-----------------------|
| [b r ó: . θ a r] | [f a . θ á r] | <i>Early Germanic</i> |
| | | |
| GT GT GT GT GT | GT GT GT | (dimensions) |
| [stiff] | [stiff] | (marked gestures) |

The Glottal Tension dimension is inherent in the /b/ of /bró:θar/ ‘brother’, as Germanic at this early stage was still a ‘voice’ language, but Glottal Tension also accrues to laryngeally unmarked sonorants by virtue of spontaneous voicing (indicated by a vertical dashed line; see (7)). In obstruents, the default gesture for Glottal Tension is [slack], hence those so marked are thoroughly voiced; in sonorants, which are voiced in any case, the default gesture is either [slack] or neutral ([]), depending on whether the phonetic pitch is relatively low or mid. Thus, gestures are not marked phonologically in segments of these types, as their value is deducible from context. But in lexically accented vowels, as in the /ó:/ of /bró:θár/ or the second /á/ of /faθár/ ‘father’, the gesture [stiff] is marked in order to convey the phonemic status of high tone. Passive voicing (indicated by a slanted dashed line) then operates to extend to Glottal Tension dimension from both lexically accented and unaccented vowels: in the former case, a [stiff] specification is carried along, whereas in the latter there is no gestural content present, the property of [slack] being provided by default to laryngeally unmarked obstruents (here, fricatives) that take on a phonologically empty Glottal Tension dimension. As stiffness of the vocal folds inhibits their vibration under the low transglottal airflow conditions of obstruent articulations, the /θ/ in /bró:θar/ remains voiceless ([bró:θar]) despite its acquired Glottal Tension dimension, whereas the

/θ/ in /faθár/ voices ([faðár]) by virtue of the superficial [slack] quality that accrues to it by default. In short, voicing does not take place in the inter-voiced fricative of /bró:θar/ because the lexical pitch accent is marked by the gesture [stiff], which, when extended under Glottal Tension into a following laryngeally empty obstruent, inhibits its voicing. But the medial fricative in /faθár/ does voice passively because the supplied Glottal Tension dimension implicates [slack], not [stiff], as the unmarked gesture.

There are thus now two phonetically identical types of voiced fricatives. On the one hand, there are inherently [slack], passively spirantised fricative allophones of the voiced stop phonemes which are marked for Glottal Tension and so implemented with the consonantal enhancement gesture [slack], as in the [ð] of [bjúðan]</biúdan/ (Gothic *biudan* 'to bid, offer'). On the other hand, there are inherently continuant, passively voiced [slack] fricatives, as in the [ð] of [faðár]</faθár/ (Gothic *fadar*). These differently sourced voiced fricatives contrast with basically voiceless, now fortis fricatives in medial environments, as in [bró:θar] (Gothic *brōþar*), which themselves came to be enhanced with the dimension of Glottal Width because of the triggering of Vaux's Law (see (4)) in consequence of the medial contrasts ensuing from passive spirantisation (see (13)). The structural effect of the newly applicable Vaux's Law on the Germanic obstruent system is shown in (15).

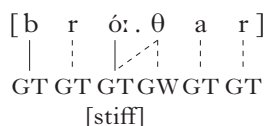
(15) *Structural effect of Vaux's Law in Germanic*
(following passive spirantiation)

| | | | |
|------------------|----------------------|---|------------------------|
| <i>oral</i> | [obs] | [obs] | [obs, cont] |
| | b d g ^(w) | p ^h t ^h k ^{h(w)} | φ θ x ^(w) s |
| <i>laryngeal</i> | GT | ⋮ | ⋮ |
| | | GW | GW |
| | | (Germanic Enhancement) | (Vaux's Law) |

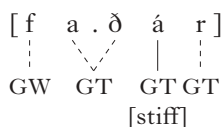
Some representative consequences of spontaneous voicing, passive spirantisation, Vaux's Law and passive voicing operating in the early Germanic obstruent system are exemplified in (16). Note that at this point the Glottal Width dimension accrues to voiceless fricatives (via Vaux's Law) as well as to stops (via Germanic Enhancement).

(16) *Summary of key early Germanic obstruent processes*
(spontaneous voicing, passive spirantisation, Vaux's Law, passive voicing)

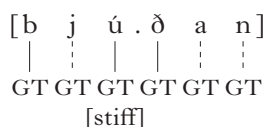
- a. /bró:θar/: effects of spontaneous voicing ([bró:θar]), Vaux's Law ([bró:θar]), (vacuous) passive voicing ([bró:θar])



- b. /faθár/: effects of spontaneous voicing ([faðár]), Vaux's Law ([faðár]), passive voicing ([faðár])



- c. /biúdan/: effects of spontaneous voicing ([bjúðan]), passive spirantisation ([bjúðan])



Voiceless fricatives are thus fortis due to the effect of Vaux's Law, though there is no contrast between those which acquire [stiff] from a preceding lexically accented vowel via the rightward extension of Glottal Tension ([θ] in [bró:θar]) and those which do not ([f] in [faðár]). We assume with Halle & Stevens (1971; see also Iverson 1983a, Kingston & Diehl 1994) that fortis voiceless obstruents marked by a spread glottis are enhanced generally with vocal fold stiffness, so that, superficially, fortis fricatives that do not follow accented vowels are articulated in the same manner as those that do. Once the Germanic voiceless fricatives became enhanced with Glottal Width ([spread]) via Vaux's Law, however, the contrastive role of the Glottal Tension dimension in the system would have come into question. Due to Germanic Enhancement, the dimension of Glottal Width was already in place among the voiceless stops, but because the voiced series inherited from Indo-European voiced aspirates was still represented with Glottal Tension, post-continuant fricatives were now being over-distinguished from each other: occurrence of Glottal Tension (either inherent or passive) implicating [slack] in the voiced fricatives squared off against the occurrence of Glottal Width (enhancement via Vaux's Law) in the voiceless fricatives. By way of further redundancy – and this is Verner's observation (1875) – the medial voiceless fricatives were always preceded by accented vowels, whereas after unaccented vowels fricatives were always voiced. A phonologically more parsimonious way to achieve these same phonetic results thus suddenly presented itself

once Vaux's Law had become operative, and that was to interpret the invariant presence of Glottal Width in both fortis fricatives and stops as a lexical rather than a derived laryngeal dimension. This made specification of Glottal Tension unnecessary in the obstruent system since, under privative assumptions, only one dimension is needed in order to keep voiceless or aspirated segments distinct from voiced ones, and voicing itself still derives passively in the case of inherently continuant fricatives. Moreover, the presence of preceding accent was no longer the sole determiner of voicelessness (or inhibitor of voicing) among medial fricatives, either, because a fortis quality was being imposed by the dimension of Glottal Width via Vaux's Law. At this juncture, the phonemic marking of voicing through specification of Glottal Tension was just no longer functional: the salient distinguishing laryngeal property in obstruents overall had become the fortis articulation associated with Glottal Width. In sum, the underlying presence of the Glottal Tension dimension had been rendered largely superfluous in the obstruent system by myriad phonetic changes ensuing from the interactions of Germanic Enhancement, Grimm's Law, passive voicing, passive spirantisation and Vaux's Law.

Finally, when the specification of lexical accent was abandoned in favour of a relational or metrical determination of stress (the late Germanic stress-retraction phenomenon, i.e. its fixing on root-initial syllables), the voicing effects of Verner's Law came to be phonologised through a restructuring of the obstruents: the Glottal Width dimension ascribed to obstruents takes over from Glottal Tension the role of inhibiting passive voicing in fricatives in what are now laryngeally unspecified vowels.²³ The voiced fricative reflexes attributed to Verner's Law were made voiced in this later stage of Germanic (indeed, still today) by the same mechanism as affected them at an earlier stage of the language, *viz.* passive voicing, as defined in (8). In present terms, the phenomenon became elevated to the status of 'law' when its inhibition could be attributed to the fricative-internal specification of Glottal Width in place of the lexical marking of Glottal Tension on a preceding accented vowel. Verner's Law is thus less about the voicing of fricatives in Germanic, which was mundane passive voicing, than it is about the complementary failure (as Verner himself put it) of post-tonic fricatives to voice – first because of the blocking effect of lexically specified [stiff] in vowels, then because of the dimensional Glottal Width in fricatives that derives from the validation of Vaux's Law via passive spirantisation.

The ensuing phonological marginalisation of the Glottal Tension dimension resulted in its removal from the system of contrasts altogether: Glottal Tension was no longer functional in the accentual system, and passive voicing was now being interrupted in (previously post-accent)

²³ As Richard Page reminds us, this picture fits well with a gradual unfolding of the Germanic Accent Shift. Earlier works on the topic have proposed that Germanic gave up pitch accent in favour of dynamic stress, with that stress only later becoming fixed on initial syllables. See d'Alquen (1988) for details and further references.

fricatives by the inhibiting effect of Glottal Width. This in turn led to the late Germanic system summarised in (17), which is also that of modern English or German in all laryngeally relevant respects (though each of these languages underwent subsequent obstruent system changes as well).

(17) *Late Germanic obstruent system after delexicalisation of accent*

| <i>oral</i> | [obs] | [obs, cont] | [obs] | [obs, cont] |
|------------------|----------------------|------------------------|---|------------------------|
| | b d g ^(w) | β ð ɣ ^(w) z | p ^h t ^h k ^{h(w)} | ϕ θ x ^(w) s |
| <i>laryngeal</i> | [] | [] | GW | GW |

Phonemic results of restructuring the Glottal Tension dimension out of both the accentual and obstruent systems in late Germanic are exemplified in the phonological representations in (18a), and the corresponding dimensionally complete forms are given in (18b).

(18) *Laryngeal representations in late Germanic*

a. *Phonemic representations*

| | | | | | | | | | | | | | | | | |
|----|---|----|----|---|----|----|---|---|----|----|----|---|---|---|---|----|
| /b | r | o: | θ | a | r/ | /f | a | d | a | r/ | /b | j | u | d | a | n/ |
| | | | | | | | | | | | | | | | | |
| | | | GW | | | | | | GW | | | | | | | |

b. *Dimensional representations*

| | | | | | | | | | | | | | | | | |
|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|---|----|
| [b | r | ó: | θ | a | r] | [f | á | ð | a | r] | [b | j | ú | ð | a | n] |
| | | | | | | | | | | | | | | | | |
| GT | GT | GW | GT | GT | | GW | GT | GT | GT | | GT | GT | GT | GT | | |

The conventional interpretation of these developments holds that loss of Glottal Tension from the underlying obstruent system occurred only after accent had been delexicalised, presumably via removal of Glottal Tension from the vocalic system upon the emergence of predictable stress. But an equally plausible and perhaps more explanatory account is that changes within the obstruent system led to the demise of Glottal Tension first among consonants, then, with its utility in the grammar sharply lessened, to its elimination from the vocalic system as well. Halle (1997) argues that the default locus of accentuation in Indo-European is word-initial, so that removal of lexically marked accent would automatically result in the observed Germanic pattern.²⁴ Accordingly, a crucial step toward removal of lexical accent may well have been the antecedent set of

²⁴ Here we follow Halle (1997), who builds on a long literature on Indo-European accent, including work touching on the question of why so many daughters developed initial accent, especially Kiparsky (1973) and Kiparsky & Halle (1977). For a related discussion with a focus on external considerations, see Salmons (1992). While the Germanic Accent Shift effected changes in realisation (high tone *vs.* a duration- and intensity-oriented stress system), as laid out above, the focus here is on the position of the accent within the word (lexically determined *vs.* predictable).

laryngeal changes that took place in the system of obstruent phonemes. The emergence of initial stress in Germanic thus no longer needs to be viewed as the trigger for phonologisation of the output of Verner's Law – instead, it is possible, perhaps likely, that 'stress retraction' was a consequence rather than a cause of the restructuring of the Germanic laryngeal system. Reduced from an active phonological instruction to a commonplace phonetic occurrence, Verner's Law on this view is just a side-effect in the series of phonological developments leading to removal of dimensional Glottal Tension from the phonology of early Germanic.²⁵

Let us turn now to the phonetics of accent and the Accent Shift. The traditional term 'Accent Shift' is perhaps a misnomer for the prosodic changes between Indo-European and the attested Germanic languages, given that it suggests a mere change in the locus of word accent, *viz.* from the mobile accent of IE to the basically fixed root-initial stress of attested Germanic. The Germanic 'Accent Shift' in fact reflects a profound change in the nature of accent itself.²⁶ 'Accent' before the shift was marked by a high tone on the relevant sonorant; with the shift, it became the kind of dynamic word stress found in the contemporary Germanic daughters, marked primarily by intensity and duration, with pitch playing a merely secondary role. While the phonetic properties of accent at both stages are relatively well agreed on, this has profound implications for the laryngeal phonology of Germanic as it developed during this period.

At the earlier historical stage when high tone identified an accented syllable, we have argued, it was the gesture [stiff] that marked that high tone and, at the same time, inhibited phonetic voicing in a following fricative. Löfqvist *et al.* (1989) present a situation that is the mirror image of this effect. They show that an increase in cricothyroid muscle activity in voiceless obstruents not only enhances the phonetic voicelessness of the consonant in question in their study, but spreads into the following vowel,

²⁵ Much has been made, since Verner himself, of possible connections of the medial voicing of Verner's Law to Germanic fricative voicing in final and even initial position. We follow here Emeneau's (1989) view that initial fricative voicing in the history of English was a weakening associated with particular syntactic categories and leave aside the matter of final fricatives, where analogy and later changes have profoundly obscured the early Germanic situation (cf. Roberge 1983). See Honeybone (ms) for details, as well as Holsinger (2001) for a treatment of these matters in terms of prosodic edges. Similarly, there is a residual trend toward Verner-esque effects visible in the modern Germanic languages, in familiar alternations like *execute* ~ *executive* or German *Hannóver* ~ *Hannóveraner*, where the highlighted fricative in the second member of each pair is voiced following a stressless syllable, but voiceless in post-tonic position in the first member of each pair. These reminiscences are not general, however – /s/ is voiceless in both *message* and *massage* – and would be described in our terms as lenition via the lexically specific loss of Glottal Width in certain configurations (cf. also the idiosyncratic fricative weakening in irregular plurals like *wives*). Voicing then proceeds passively, as elsewhere in the language. (As an anonymous reader reminds us, the fricative weakening in plurals of the *wives* type has spread analogically in some varieties of English.)

²⁶ We are indebted to Michael Jessen for detailed comments leading us to the views of the differential phonetic effects of accentual types developed in the following paragraphs.

too, as measured by the increase in its fundamental frequency (F0). While such influence from obstruents on vowels is thus experimentally attested, the Halle & Stevens model predicts that there should be a laryngeal influence from vowels on obstruents as well, a prediction which some earlier work had questioned, *viz.* Anderson (1978). Our analysis of the Verner's Law effect, Michael Jessen points out, provides just the complement predicted in the Halle & Stevens system but argued by Anderson to be impossible, because on that analysis the inhibition of Verner's Law came about via extension of the Glottal Tension dimension dominating the gesture [stiff] from a lexically marked vowel into a following obstruent. Indeed, that same extension of Glottal Tension, when not dominating [stiff], is known as 'passive voicing', and is the historical root of Verner's Law itself.

After the 'Accent Shift' in late Germanic, however, lexical tone transmuted over to a metrical system of stress, phonetically very close to what is attested in most of the modern daughters, such as English, German and Dutch. The sharply diminished role of tone is confirmed by recent experimental work in phonetics showing that the attested Germanic daughters realise word stress overwhelmingly in terms of duration and high-frequency intensity (or 'spectral balance' rather than amplitude); cf. Sluijter (1995) for Dutch and English, Claßen *et al.* (1998) for German. With regard to pitch, Sluijter finds that, together with overall intensity, it overwhelmingly serves to mark what is often called 'accent', namely sentence-level stress or focus, rather than word stress. This suggests directly that [stiff] plays no central role in post-Accent Shift Germanic word stress. In short, the notion that modern accentual systems of the type found in Dutch, English or German should show Verner-like effects on neighbouring vowels would indeed be, as Michael Jessen (personal communication) has put it, 'a challenge to phonetic reality'.

This, in a nutshell, accounts for why Verner's Law is the rarity that it appears to be: the influence of accented vowels on fricatives was dependent on the pre-Germanic accentual system (where the gesture [stiff] was employed to mark high tone on lexically accented sonorants). Caught up in the profound restructuring underway in the laryngeal phonology of the fricative and overall obstruent system, the transitory pattern happened to leave its unique footprint due to these changes, but the overall picture is one of persistence in the articulatory base of Germanic laryngeal phonology, a topic to which we now turn.

6 Germanic Enhancement as persistent change

Germanic Enhancement, a seemingly superficial embellishment, opens the door to a view of sound change which is at once phonetic and phonological, yet one which distinguishes the respective roles of phonetics and phonology in a perhaps surprising way. We consider briefly how pressure toward change in a particular direction can come into a grammar and persist over many generations, surviving pervasive and systematic segmental

changes. Germanic Enhancement was not a one-time modification of voiceless stops, but rather, we think, introduced a new basis of articulation for the language to the effect that voiceless stops come to be produced as aspirated whenever they can be, whenever they arise, from whatever source.²⁷ As traditional views have long had it, the voiceless stops of Indo-European became enhanced in just this way on their spirantisation path into Germanic. But these new fricatives, laryngeally unmarked and thus subject to the Passive Voicing effects known as Verner's Law, were lenis, not fortis, because only stops, not fricatives, were subject to Germanic Enhancement. The late Indo-European fortis stops therefore did not 'lose their aspiration' upon spirantising in Germanic; rather, the generalisation associating aspiration with them in the first place was no longer relevant because this class of segments had left its domain. At the same time, moving beyond traditional views, this development is intimately connected to the reason why the new voiceless stops (*viz.* the devoiced Indo-European voiced series) acquired aspiration anew. This was due to the same overarching principle that provided aspiration to the Indo-European voiceless series and which constrains the articulation of English, German, Danish and Swedish to the present day.

Though this approach helps to contextualise and motivate Grimm's Law and to tie it more tightly to other developments in Germanic, from traditionally assumed inputs to the internal ordering of the changes posited, we are no longer talking about sound change in a mechanistic, Neogrammarian sense – this is change of a persistent, systemic sort. Whereas sound changes generally happen and then are, in some sense, done with (as implied by the familiar notion of the 'lifecycle of sound change', see Iverson & Salmons 2003b), the proclivity towards aspiration of voiceless stops has remained in most Germanic languages since Germanic Enhancement came to define the beginning of that family. To propose a type of sound change that inheres in a family over generations (indeed, over millennia) raises important questions. For example, first, what does it mean for a 'persistent change' to enter a grammar; how and why does this happen? Second, are there other well-established patterns of change which reflect similarly persistent phonetic tendencies with similarly profound phonological consequences? Full answers to these questions await future work, but some preliminary suggestions are in order even at this point.

²⁷ This notion is hardly new, in some sense. While similar kinds of chronic diachronic propensities have been recognised in the study of historical phonology before (e.g. Lass 1997: 117–118), the modern and theoretically oriented accounts we know of are strikingly different from the one sketched out here. Shortly after writing the above passage, though, we discovered that three-quarters of a century ago van Haeringen had discussed the loss of initial *h* in some Dutch dialects, an indirectly related topic in Germanic laryngeal phonological history, in almost identical terms: 'Hier hebben we niet zozeer een klankovergang, die in een bepaalde periode voltrokken is, als wel een blijvende phonetische habitus' [We do not have here so much a sound change which was completed in a particular period, but rather more likely an enduring phonetic habit – our translation] (1934: 109).

To the first question, it has been argued in phonetics since at least Rush (1827) that speakers of particular languages and dialects can have ‘articulatory settings’ or a certain ‘voice quality’, general phonetic characteristics that pervade the varieties in question. In a classic description of ‘voice quality’, for example, Abercrombie (1967: 92–93) discusses elements that are under the active control of the speaker, which

originate in various muscular tensions which are maintained by a speaker the whole time he is talking, and which keep certain of the organs of speech adjusted in a way which is not their relaxed position of rest. These adjustments give a kind of general ‘set’ or configuration of the vocal tract, which inevitably affects the quality of sound which issues from it. (Though acquired by learning, the habit of such muscular tensions can, once acquired, be so deeply rooted as to seem as much an unalterable part of a person as his anatomical characteristics.)

We suggest simply that such settings can persist not only across generations – that is, they can be acquired by learners in the speech community – but that they can also survive significant segmental changes and phonological reorganisations. It is possible, in other words, to maintain a stable ‘articulatory set’ at a phonetic level in the face of phonological changes in the same component of the sound system. We see the original introduction of Germanic Enhancement as a change in the articulatory setting of Germanic speakers, one which triggered a set of reorganisations that continues today.²⁸ And while Grimm’s Law lies too far in the past to exemplify this in detail and beyond any doubt, one of the more recent dominos can provide that evidence, the ‘Second Sound Shift’ from High German dialects. There, affrication of the old aspirated stops left a lack of aspirated stops in southern dialects. In a straightforward drag chain, the so-called *Medienverschiebung* (shift of voiced stops) created new aspirated or fortis stops to fill this gap (see Davis & Iverson 1995, Davis *et al.* 1999 for details) in accordance with Germanic Enhancement. The Second Sound Shift demonstrates, then, not only a close (if ultimately incomplete) parallel to Grimm’s Law, but also the fresh application of Germanic Enhancement to previously laryngeally unmarked stops after further (aspiration-driven) changes have removed the old set of aspirated stops. That this indeed remains a vital and ongoing tendency across Germanic is borne out not only by that shift, but also the changes in progress in some dialects of Danish or Liverpool English (both referred to above).

The link of Germanic Enhancement to ‘voice quality’ and ‘articulatory set’ is yet closer than just described, though, in a critical way: such phonetic settings are often illustrated with ‘laryngeal tension’ (see also Laver 1994: 416–420). The laryngeal features and behaviours discussed throughout this paper tie in directly to questions of Abercrombie’s ‘muscular

²⁸ See also Buccini (1992: 350–381) for arguments regarding ‘base of articulation’ in language change, especially for the transfer of such phenomena under language contact.

tension'; indeed, another research tradition treats the Germanic obstruent system in terms of a feature [tense] and/or the closely related [fortis] (see Kohler 1984, Jessen 1998, among many others) rather than in terms of the relevant state of the glottis, as we do.

To the second question, we actually find surprisingly close parallels to Germanic Enhancement in recent work on vocalic chain shifts. Treating a variety of shifts, with most of his case studies coming from the history of various Germanic languages, Labov (1994) uses the feature [\pm peripheral] – basically, closeness to the edge of the vowel – space to capture what many previous scholars have regarded as a tense *vs.* lax distinction in vowel systems. For example, Labov posits a 'Vowel Shift Principle': 'in chain shifts, peripheral vowels become less open and non-peripheral vowels become more open' (1994: 262). Vowels which have the property [peripheral], closely related to the muscular tension described in work on articulatory settings, have repeatedly and consistently moved in the same diachronic trajectories over centuries, whatever their source.²⁹ The consonantal shifts in Germanic are also most easily seen as chains, with Germanic Enhancement triggering one of the most systematic and dramatic reorganisations of consonant systems known in historical phonology. The principle of Germanic Enhancement, then, might be thought of as a parallel for consonantal chain shifts to the principles of chain shifting proposed by Labov (1994: 601–602, and earlier discussions).³⁰

7 Summary and conclusions

This article is aimed at advancing our understanding of language change, basic sound structure and the phonological system of early Germanic in several ways. First, we identify the principle of Germanic Enhancement, perhaps the defining phonetic and phonological characteristic of the Germanic languages. Persistent aspiration of voiceless stops is structurally akin, and historically linked, to Vaux's insights into the enhancement of voiceless fricatives with the dimension of Glottal Width. The initiation of Germanic Enhancement, providing Glottal Width instead to voiceless stops, becomes the critical moment in Germanic, setting the family off and charting the future course of its obstruent chain shifts and related changes. The view developed here thus begins to lay out a rudimentary but new

²⁹ Work now underway anchors the persistence of vocalic chain shifts in Germanic languages directly in the prosody; see Jacewicz & Salmons (2003).

³⁰ While we will not pursue the point here, it is quite possible that these two kinds of tension, Labovian peripherality in vowels and the fortis character of obstruents, are fundamentally related. Laver (1994: 416–417) seems to suggest this kind of approach, and takes a broad view of 'the interdependence of settings', and his discussion 'considers the constellation of co-occurring settings' that result from overall adjustments of the degree of muscular tension exercised throughout the vocal apparatus'. And Jessen (1998: 149, 153–157) sketches a number of consonant–vowel interactions in German – dialectal and diachronic – which can be neatly captured if one posits [tense] for both consonants and vowels in that language.

account of how and why major phonetic or phonological attributes can persist in grammars while the particular segments carrying those attributes themselves change.

Most importantly, we find that Verner's Law *per se* never existed as a phonological rule or constraint in the grammar of Germanic, but rather is a consequence of passive voicing having become phonologised due to the coincidental validation of Vaux's Law at a preliterate stage of the language. Verner observed the restructured phonologisation of words like *fadar*, on the one hand, and the familiar set of morphophonemically supported alternations in the strong verb paradigms (*grammatischer Wechsel*), on the other. Captured like a bug in amber, as it were, this morphological residue constitutes the full extent of support for Verner's Law as an active constraint or rule in Germanic grammar, *viz.* one restricted to particular words in certain morphological classes. It is noteworthy, then, that no actual Germanic language evinces the phonetically driven form of Verner's Law voicing fricatives after unstressed vowels generally, a fact which is consistent with its ancestral non-existence but is otherwise difficult to account for.

The phonetic source of the attested Verner's Law residue emerges as a simple derivative of spontaneous voicing – specifically, as rightward extension of the redundant dimension of Glottal Tension (implicating the gesture [slack]) into a laryngeally empty obstruent. The same passive voicing phenomenon occurs in present-day phonological systems ranging from English to Korean, and, integrated into the present descriptive framework, is itself sufficient to characterise the particular voicing associated with Verner's Law. This epiphenomenal view of Verner's Law, however, stands in sharp contrast to the conventional understanding as articulated, notably, by Liberman (1982: xviii): 'there is only one theoretical work in the history of Germanic philology whose conclusions have never been contested; the work is called *Eine Ausnahme der ersten Lautverschiebung*'. Here we challenge not so much Verner's celebrated conclusions as we do the independence that has been associated with his eponymous observations. The issue at hand, then, is not so much how Verner's Law arose and abruptly became extinct in the Germanic languages, but rather how its genetic legacy has survived to the present. That legacy is passive voicing, the phonologised effects of which left a rich fossil record in Germanic in the form of voicing alternations and lexical restructurings. The phonetic building blocks of Verner's Law never went out of existence, in other words: though the residual, morpholexical Verner's Law (in the form of *grammatischer Wechsel*) met its demise long ago, its progenitor, passive voicing, persists right up to the present, rather as birds continue the genetic line of long extinct dinosaurs.

Our analysis also draws a direct featural connection between accent and the changes of Grimm's Law. Specifically, Glottal Tension, through its antagonistic daughters [stiff] and [slack], was employed in the earliest stages of Germanic to mark both high tone in vowels and contrastive voicing in obstruents. The demonstration of the connection between obstruent

voicing and vocalic accent is made possible by the seminal laryngeal feature framework developed by Halle & Stevens (1971) and incorporated with privative values into dimensional theory. In later Germanic, losses of lexically marked pitch and distinctive voicing in obstruents both reflect the decreasing role played in the phonology by the Glottal Tension dimension. Our interpretation of these developments circumvents the less parsimonious and rather poorly motivated configurations that are essential in other recent accounts of Verner's Law. The restriction of Verner's Law to fricatives, moreover, rather than to obstruents generally, falls out from the history of Germanic consonantism presented here, an important fact which previous descriptions have seldom even tried to account for.

Finally, the key phonological (and phonetic) characteristics of Germanic as a distinct branch of Indo-European are typically listed as the Accent Shift and Grimm's Law. These two properties – the core characteristics of the Germanic sound system – can now be understood as intricately bound together. In consequence, the evolution of Germanic laryngeal phonology and its prosodic system can be seen to move in the same direction, providing mutually reinforcing motivations for discarding the dimension of Glottal Tension from both obstruents and accent. This demonstration of a clear and compelling connection between such apparently disparate phenomena underpins our understanding of the emergence of Germanic as the quintessential aspiration language.

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