SUPPLEMENT
Tenseness and Laxness

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In discussing the opposition of the so-called tense and lax vowel classes, particularly the distinction between the tense /i/ and /u/ and the lax /ɪ/ and /ʊ/, Daniel Jones states that the reference to the different degrees of muscular tension on the part of the tongue is inadequate. 'A description of the English short [i] as a vowel in which the tongue is lowered and retracted from the "close" position is generally sufficiently accurate for ordinary, practical work. The term "lax" may also be used to describe the organic position of the English short [u] (in *put* /put/) as compared with the long "tense" [uː] in *boot* /buːt/). Here the organic characteristics of short [u] as compared with long [uː] might be more accurately described as a lowering and advancement of the tongue and a wider opening of the lips.'[1] This lowered and *retracted* [i] and the lowered and *advanced* [u] along with all other lax vowels, as observed by Carl Stumpf, 'shift toward the middle of the vocalic triangle'.[2] Any lax vowel 'liegt stets mehr nach der Dreiecksmitte zu' than the corresponding tense vowel (p. 262). Hence, as was noted by Gunnar Fant and ourselves[3] a tense vowel compared to its lax counterpart is produced with a greater deviation from the neutral position of the vocal tract, i.e. from the position that the vocal tract assumes in producing a very open [æ]; consequently a tense vowel displays a greater deviation from the neutral formant pattern.[4]

In the chapter 'Vowels' in his 'Handbook of Phonetics' (1877), Henry Sweet declared that 'the most important general modifications are those which cause the distinction of narrow and wide' (since renamed 'tense' and 'lax'). Sweet succeeded in demonstrating the autonomy of each of these two series 'from high to low' and the possibility of a division of any vocalic class into pairs of tense and lax vowels. In the following we shall differentiate these two series by employing the exponent [1] for tense vowels, and the exponent [2] for lax vowels, a device that has often been used in dialectology.

This autonomy of the tense-lax distinction is clearly exhibited by those African languages which display vowel harmony based on the opposition of tense and lax. Thus in Bari with its five tense and five corresponding lax vowels – /u¹/, /o¹/, /a¹/, /e¹/, /i¹/, and /u²/, /o²/, /a²/, /e²/, /i²/ – 'a word with a tense vowel in the stem will have a lax vowel in the prefix or suffix': cf. /to¹-gi¹rja¹/, *to make wipe*, and /to²-gi²rja²/, *to cause to cicatrize*.[5] Likewise in Maasai, stems consist either of tense

or of lax vowels which determine the tense or the lax character of the vowels in the affixes; moreover, in some grammatical categories, lax stem vowels alternate with the corresponding tense vowels.[6] In Ibo, with its four tense-lax pairs, namely close (diffuse) $/u^1/ - /u^2/, /i^1/ - /i^2/,$ and open (compact) $/o^1/ - /o^2/, /e^1/ - /e^2/,$ a peculiar interplay of the lax-tense and compact-diffuse features underlies the vowel harmony: the vowel in the verbal prefixes is diffuse before a tense root vowel, and compact, if the root vowel is lax.[7]

While Melville Bell, who first drew attention to the tense-lax distinction ascribed the decisive rôle to differences in the behaviour of the pharynx, Sweet put the chief emphasis on the 'shape of the tongue'.[8] Later investigations, however, as summed up in Heffner's *General Phonetics*, have shifted the reference 'from tongue elevations and tongue muscle tensions to laryngeal positions and air pressures'.[9]

Sievers was already aware of the fact that 'along with the lowering mouth tension also the tension of the vocal bands decreases' and 'dies macht sich praktisch in einer entsprechenden "Verdumpfung" . . . des betreffenden Vocalklangs bemerkbar'.[10] Later, Meyer, in his detailed study of tense vowels, singled out the cardinal rôle of the sound-pressure: 'In dem verschiedenen Grade der Stimmbandpressung und der dadurch bedingten Verschiedenheit des durchstreichenden Atemquantums, der 'Luftfüllung' der hervorgebrachten Laute, erblicke ich den wesentlichen Unterschied zwischen den gespannten und ungespannten Vokalen.'[11]

The heightened subglottal air pressure in the production of tense vowels is indissolubly paired with a longer duration. As has been repeatedly stated by different observers, the tense vowels are necessarily lengthened in comparison with the corresponding lax phonemes. Tense vowels have the duration needed for the production of the most clear-cut, optimal vowels; in comparison with them the lax vowels appear as quantitatively and qualitatively *reduced,* obscured and deflected from their tense counterpart towards the neutral formant pattern.

Sweet, who generally retained Bell's terminology as 'admirably clear and concise', preferred in this instance to substitute 'narrow' for the term 'primary', which labelled the tense vowels in Bell's *Visible Speech* of 1867.[12] Sweet's terminological suggestion, however, obscured the relevant fact, so clearly expressed in Bell's nomenclature, that it is the tense vowels which constitute the 'primary', optimal vocalic pattern and that laxness represents a secondary reduction of this pattern.

There exist in language alternative ways of quantitative reduction, both observable, e.g. in the unstressed vocalic patterns; one leads from tenseness to laxness, while the other, from compactness to diffuseness. *Ceteris paribus* a diffuse (closer) vowel is shorter than the corresponding compact (opener) vowel, for example /i/, /u/ vs. /e/, /o/, whereas the lax vowel, notwithstanding its opener articulation, displays a shorter duration than the corresponding tense vowel, as $/i^2/, /u^2/, /e^2/, /o^2/$ vs.

/i¹/, /u¹/, /e¹/, /o¹/. Sievers rightly warns against the deep-rooted confusion of these two distinctions: 'Man hüte sich auch davor, die Begriffe "gespannt" (oder "eng") und "ungespannt" (oder "weit") mit denen zu verwechseln, welche die althergebrachten Ausdrüke "geschlossen" und "offen" bezeichnen sollen.'[13]

The 'high-narrow' vowels are particularly short, because they are both lax and diffuse; therefore the opposition of tense/lax in the diffuse vowels may be implemented not only by such pairs as [i] – [ɪ] or [u] – [ʊ] but also by pairs syllabic vs. non-syllabic: [i] – [j] and [u] – [w]. The French vocalic pattern with its consistent opposition of tense and lax phonemes exemplifies this type of bifurcation of the diffuse vowels: the distinction [ai] /i¹/ aï – [aj] /ai²/ ail corresponds to such pairs as /te¹t/, tête – /te²t/, tette. In French, [i], like other tense vowels, displays a longer duration and a greater sum of deviations from the neutral formant pattern than the lax [j].[14]

The cardinal rôle of duration in the opposition tense/lax suggests the question of the relationship between this feature and the prosodic opposition long/short. In *Fundamentals of Language* we sought to delimit two kinds of phonemic features: 'A *prosodic* feature is displayed only by those phonemes which form the crest of the syllable and it may be defined only with reference to the relief of the syllable or of the syllabic chain, whereas the *inherent* feature is displayed by phonemes irrespective of their rôle in the relief of the syllable and the definition of such a feature does not refer to the relief of the syllable or of the syllabic chain.'[15] In Sweet's terms, quantity 'belongs essentially to the synthesis of sounds, for it is always relative, always implying comparison', particularly a comparison 'of two different sounds'.[16] The prosodic length of a vowel is inferred from the contrast of long and *ceteris paribus* short vowels in a syllabic sequence, whereas length as a component of the tenseness feature is intrinsically connected with the other, qualitative manifestations of the given feature within the same phoneme.

In his scrutiny of the Dutch phonemic pattern de Groot notes that compared with their tense counterparts, the lax vowels are not only duller and slacker but also shorter ('ceteris paribus immer kürzer'), yet for the identification of these phonemes shortness is hardly decisive, since however much one stretches /a²/ in /rá²t/, *rad*, 'wheel', it does not change into /rá¹t/, *raad*, 'council'. Thus despite a close interrelation and manifold convertibility between the inherent feature tense/lax and the prosodic feature long/short, these features belong to two substantially different kinds of distinctive features.

The attentive analysis of the tense/lax feature discloses, however, an identical tripartition of each of the two classes. The three types of prosodic feature which, following Sweet, we have termed *tone, force*, and *quantity*, and which correspond to the main attributes of sound sensation – pitch, loudness, and perceptual duration, find a close analogue in

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the three types of inherent feature. The 'tonality' and 'sonority' features, which we attempted to outline in *Fundamentals* (§ 3.6), are akin to the prosodic features of tone and force. The tense/lax opposition should, however, be detached from the sonority features and viewed as a separate, 'protensity' feature, which among the inherent features corresponds to the quantity features in the prosodic field.

The neutralization of the pharynx in the production of lax vowels (its contraction and correspondingly the somewhat lowered tonality in the front series of lax vowels and a pharyngeal dilatation with a heightened tonality in the back series) reveals a certain similarity with the formation and structure of the centralized vowels in a few Nilotic, Caucasian, and Hindu languages. Their vocalism seems to present a peculiar implementation of the phonemic opposition tense/lax, and correspondingly such a system as that of Dinka would have to be viewed as composed of seven pairs: /u¹/ [u] – /u²/ [ï], /o¹/ [o] – /o²/ [ö], /ɔ¹/ [ɔ] – /ɔ²/ [ö̈], /a¹/ [a] – /a²/ [ä], /ɛ¹/ [ɛ] – /ɛ²/ [ë̈], /e¹/ [e] – /e²/ [ë], /i¹/ [i] – /i²/ [ɪ].[18] This question, however, requires further investigation.

In analysing the phonemic pattern of Dutch, de Groot tentatively identified the relation between the tense and lax vowels with the consonantal opposition of the fortes and lenes.[19] The common denominator of both relations is now apparent. Fortes are always opposed to lenes by a higher air pressure behind the point of articulation and by a longer duration. This difference may be accompanied by the voicelessness of the fortes and the voicing of the lenes or may lack such concomitant cues. A typical example of tense and lax stops and fricatives, all of them produced without any participation of voice, is provided by the Swiss German consonantal pattern. As its first investigator Winteler stated, the distinctive mark in a fortis-lenis pair is 'das Mass der auf die Bildung der Laute verwendeten Expirations- und Artikulations-energie oder deutlicher, die Empfindung von der Stärke des Expirationsdruckes und des davon abhängigen Widerstandes der artikulierenden Organe, sowie das Mass der Dauer der beiderlei Laute'.[20] This outstanding forerunner of modern phonology precisely defined the essence of the fortis-lenis opposition: 'Bei der Bildung der Fortes verharren die Sprachwerkzeuge fühlbar in ihrer Kulminationsstellung', whereas 'diejenigen Artikulationen, welche Lenes erzeugen, in demselben Augenblicke wieder aufgegeben werden, in welchem sie ihre Kulmination erreicht haben'.[21]

The relative duration of the consonant and the antecedent phoneme may remain for certain contextual or optional variants of tense and lax consonants the chief or even the only cue to their distinction.[22]

In sum, the production of lax as opposed to tense phonemes involves a lower (vs. higher) air pressure in the cavity behind the only or main source (i.e. below the vocal cords for the vowels, and behind the point of articulation for the consonants). Furthermore, tense phonemes are produced with more deviation from the neutral, central position than

the corresponding lax phonemes: the tense consonants show primarily a longer time interval spent in a position away from neutral, while the tense vowels not only persevere in such a position optimal for the effectuation of a steady, unfolded, unreduced sound but also display a greater deformation in the vocal tract.[23]

Notes

[1] Daniel Jones, *An Outline of English Phonetics*, 8th Ed., Cambridge, 1956, 39.

[2] Carl Stumpf, *Die Sprachlaute*, Berlin, 1926, 259.

[3] R. Jakobson, C. G. M. Fant, and M. Halle, *Preliminaries to Speech Analysis* 2nd Ed., Cambridge, Mass., May 1952, 2.43.

[4] G. Fant, *Acoustic Theory of Speech Production*, 's Gravenhage, 1960, 210.

[5] D. Westermann and I. C. Ward, *Practical Phonetics for Students of African Languages*, Oxford, 1933, 388.

[6] A. N. Tucker and J. Tompo Ole Mpaayei, *A Maasai Grammar*, London, 1955, 260.

[7] I. C. Ward, *An Introduction to the Ibo Language*, Cambridge, 1936.

[8] *Handbook*, 26 ff.

[9] R-M. S. Heffner, *General Phonetics*, Madison, Wis., 1949, 96 ff.

[10] E. Sievers, *Grundzüge der Phonetik*, 5th Ed., Leipzig, 1901, § 256.

[11] E. A. Meyer, *Festschrift Wilhelm Viëtor*, Marburg, 1910, 238.

[12] *Handbook*, XI.

[13] *Grundzüge*, § 258.

[14] Cf. the numerical data in our *Preliminaries*, 36, 46.

[15] Jakobson and Halle, *The Fundamentals of Language*, 's Gravenhage, 1956, 22.

[16] *Handbook*, § 179.

[17] A. W. de Groot, *Donum Natalicium Schrijnen*, Nijmegen-Utrecht, 1929, 549 ff.

[18] Westermann and Ward, *Practical Phonetics*, 207 ff.

[19] de Groot, *Donum*, 549 ff.

[20] J. Winteler, *Die Kerenzer Mundart des Kantons Glarus in ihren Grundzügen dargestellt*, Leipzig-Heidelberg, 1876, 25.

[21] Op cit., 27.

[22] Cf. Jones, *The Phoneme*, Cambridge, 1950, 52 ff.; F. Falc'hun, *Le système consonantique du Breton*, Part I, Rennes, 1951; P. Denes, 'The Effect of Duration on the Perception of Voicing', *J. Acoust. Soc. Amer.*, XXVII, 1955, 761 ff.; P. Martens, 'Einige Fälle von sprachlich relevanter Konsonanten Dauer im Neuhochdeutschen', *Maître Phonétique*, CIII, 1955, 5 ff.: N. Chomsky, Review of Jakobson and Halle, 'The Fundamentals of Language', *Int. J. Am. Ling.*, XXIII, 1957, 238.

[23] Fant, *Acoustic Theory*, 224 ff.

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