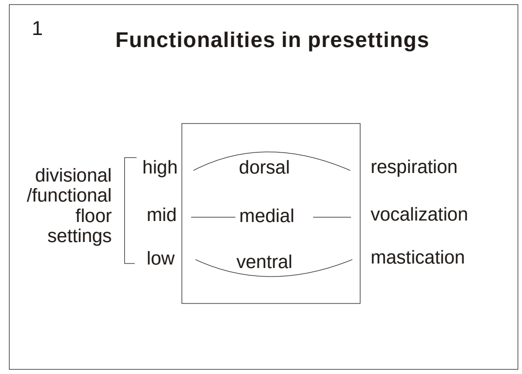
PART 4— BASIC ACTIONS

4.1 The functionality of primal presettings

As mentioned above, the primal presettings are inherent in the performance of mechanically distinct oro-lingual functions. For instance, dorsal, medial and ventral settings generate the lingual frameworks, respectively, of (a) respiration, (b) vocalization, and (c) mastication, fig, 1.

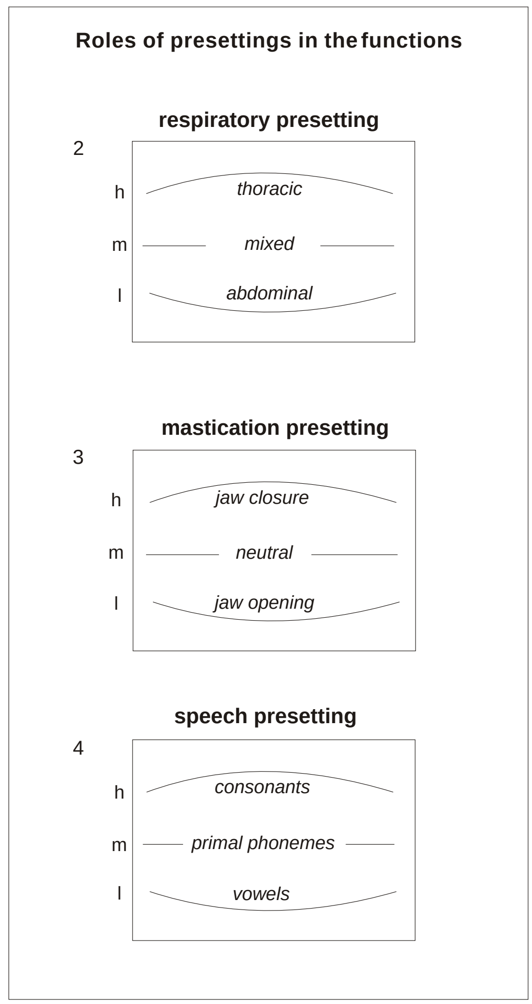
It can be noted that once established a particular presetting generates a **new** distinct frame in which its central node becomes **centered** in oral space—the tongue is no longer dorsally or otherwise positioned but becomes medio-centrally located. While the initial dorsal primary presetting remains embedded, this new secondarily generated medio-central presetting can once more be superimposed by a tertiary presetting, e.g.,when a temporary ventral tongue setting in heavy breathing is imprinted on the inherent dorsal presetting of respiration, or in various temporary articulatory tongue settings in speech.



In **respiration** the secondary settings are associated with discrete thoracic, mixed and abdominal breathing. The primal nodes appear as inherent respiratory vocalizations: e.g., /h/ is the sound of yawning and of energetic open mouth breathing, whereas /n/ and /m/ are those of the two modes of nasal respiration, fig. 2.

In **mastication** a secondary dorsal presetting biases the framework for jaw closure. The medial one is neutral and the ventral setting biases for open jaw. Inherent vocalizations in feeding include: /h/ in food ingestion, /n/ in mastication and /m/ in swallowing, fig. 3.

In **speech** the functional presettings are best referred to as consonantal (dorsal), medial (primal phonemic) and vocalic (ventral) presettings. The inherent speech vocalizations manifest as the articulated phonemes /h/, /n/, and /m/, fig. 4.



Establishing the presence of **dorsal**, **ventral** and **medial** primal presettings and their associations in speech with consonants, vowels and the three primal phonemes offers a basis for discussing the production of basic phonemes. The basic phonemes include the simple vowels /i/, /a/ and /u/, the simple consonants /t/, /k/, and the semivowels and liquids /j/, /w/, /l/, /r/, /ŋ/ and /ɣ/.

The remaining consonants, such as the spirants, fricatives and other obstruents are considered as the **complex consonants**, and will be covered separately. The close and rounded vowels are discussed under the heading of the **complex vowels**.

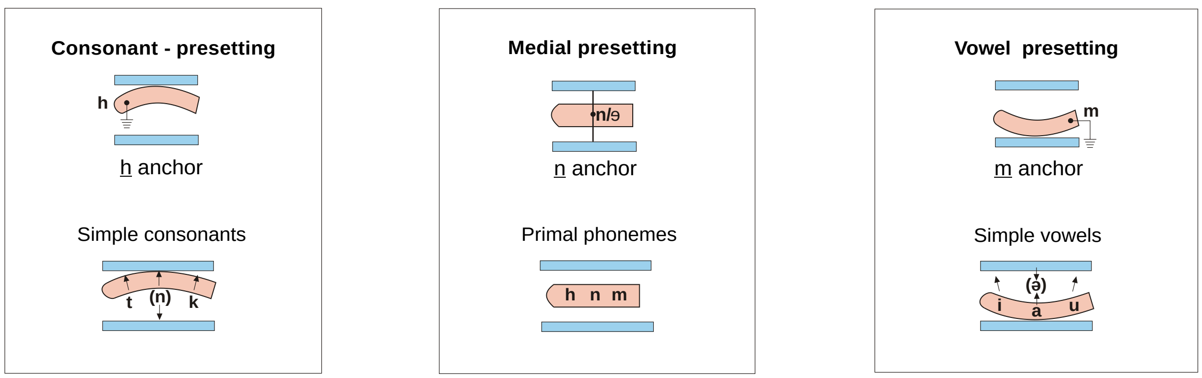
4.2 Inherent phonemic nodes of primal presettings

Just as the primal phonemic nodes h, n and m are inherently associated with the three tongue divisions, other phonemes are similarly native in the three primal settings. One can clearly observe that when holding the tongue in the dorsal presetting at minimal energy level the nodes of t, (n) (see 4.3 below), and k are present. Their vocalic counterparts in the ventral presetting are the nodes i, a and u. These sets can be referred to as the **simple consonants** and the **simple vowels**, the generation of which is covered in Part 5. Their appearance at this low level of phoneme production is justified by the facts (a) that their nodes are active in mastication, (b) that t and k are the most productive agents in complex consonant generation (see section *Complex Consonants*), and (c) that /i/, /a/, and /u/ are the minimal number of vowels a language can have, and (d) that they occur in a primitive form in infant and animal vocalizations, fig. 5.

5

Stable and mobile nodal roles in primal presettings

Dorsal presetting | **Medial presetting** | **Ventral presetting**



The **dorsal** presetting is stabilized by the h node which anchors the forces generating the basic consonants /t/, (/n/), /k/. (See stable-active roles, 3.2.2.)

The medial presetting is anchored on n/ɘ node and is generated by **intrinsic** lingual muscles, producing the respiratory phonemes /h/, (/n), /m/.

The **ventral** presetting is anchored on the ɘ node and it creates the lingual nodes of the basic vowels /i/, (/a/), /u/.

4.3 The central nodes in primal presettings

Fig. 5a outlines the roles of n node and the neutral vowel node in primal presettings. There are six possible configurations: the three primal settings each can differ according to whether the extrinsic or intrinsic lingual forces are the prime agents, rather than the antagonists in the coaction of these opposing forces that form the articulative frame at the time. Moreover, the consonantal or vocalic settings are also associated, respectively with the extrinsic and intrinsic dominance. These combinations result in the products shown in the diagram. Thus, the anchor node in the inherently intrinsic/consonantal dorsal presetting is the n node, while the inherently extrinsic/vocalic ventral presetting gives the neutral vowel node /ɘ/. The medial presetting, bridging the other two can be biased either consonantally or vocalically.

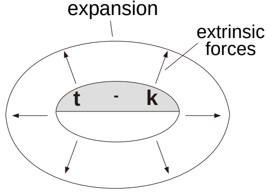
5a

prime agency	primal presettings:	dorsal *consonants*	medial *primal phonemes*	ventral *vowels*
intrinsic	consonantal	n	n/ɘ	ɣ
extrinsic	vocalic	ɣ	ɘ/n	ɘ

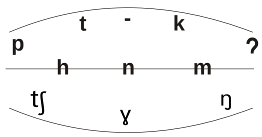
Simultaneous inherently extrinsic plus intrinsic combinations in either dorsal or ventral settings yields the fricative ɣ, which therefore is identifiable as a semivowel. The unexpected appearance of this node at this level is covered in Part 5.

4.4 The expansion of frame presettings

6 Consonant frame expansion

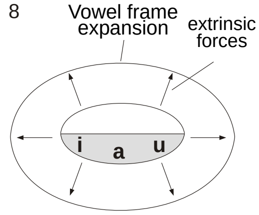


7 Expanded consonant frame

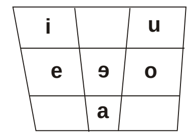


The central node is n

8 Vowel frame expansion



9 Expanded vowel frame



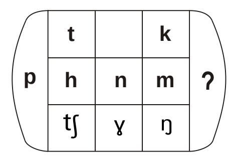
The vowel quadrilateral centered on neutral vowel \ə\

With the dorsal setting in place, generated by the intrinsic forces, the next hierarchically higher force level can be reached by increasing extrinsic muscular forces. This action expands the phonemic field in which appear the nodes of some additional consonants: /p/, /tʃ/, /ɣ/, /ŋ/ and /ʔ/. The n node remains at the **mid-central** position of the expanded field. The appearance of /tʃ/ at this basic level may seem surprising but then it occurs in the vocalizations of sneezing /hatʃu:/ and in that of expression of pain in English /autʃ /, while the /ɣ/ is related to the animal sound of growling. Vocalization of pain and other sensations and emotions can differ with articulatory bases of languages, figs. 6 and 7.

Fig. 7 illustrates the expanded consonant field as it generally appears. However, if the n node is maintained as the central anchor of the field, the latter becomes a **matrix** of discrete cells within which each node resides, and which limits nodal movement to the extent that a certain amount of added energy is needed to navigate from or into cells.

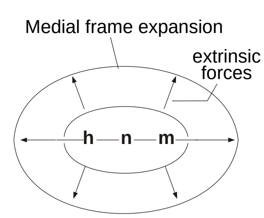
Similarly, after initiating the vocalic presetting an expansion of extrinsic forces generates in the phonemic field the vowel nodes of e, o and the neutral vowel ə, figs. 8 and 9. The latter serves as the **central node** of the expanded vocalic field. English being an exception, the vocalic central node is not easy to produce in many languages. Such expansion of the ventral primal presetting generates the basic form of the **vowel quadrilateral**, which is the analog of the **matrix** apparent in the expanded consonant field, fig. 10.

10 **Consonantal matrix**



Interestingly, the expansion of the **medial** presetting does not generate additional new phonemes, but rather causes a change in oral frame configuration to produce the frame belonging to varieties of speech with rhythmic or musical elements, such as found in story-telling, chanting and oratory, fig. 11.

11 **Musical presetting frame**



4.5 Sequential alternating

We can observe that there is an oscillating **alternation** of external and intrinsic muscular action sequences as the framework incrementally builds from neutrality to full articulation. In each case a new frame is superimposed on the preceding one. Alternation of frames is an essential function of the oral-respiratory tract. Cf., inspiration and expiration in respiration, or syllabification, which generally employs an alternating sequence of tract opening for vowels and tract closure for consonants, fig. 12.

12

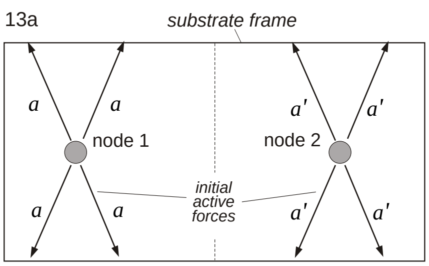
sequential order	**actions**
1. presetting	extrinsics
2. targeting	intrinsics
3. expansion	extrinsics
4. articulation	intrinsics

4.6 MERGERS

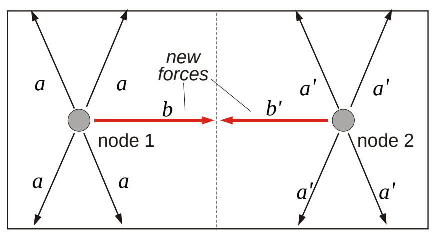
4.6.1 The function of node merger

The **merger**, or union of nodes is a indispensible function of phoneme production. Two or more nodes, along with their particular force frames can be brought together to combine into a new **single** merged node, with their force frames coalescing into a **single** framework, as well. The following is a description of node merger. fig. 13a, 13b, and 13c.

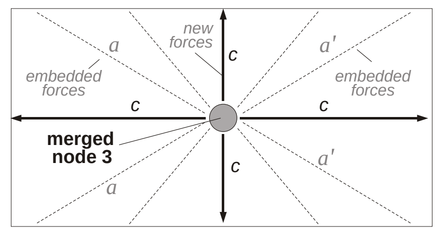
13a



13b



13c



Two distinct nodes, **node 1** and **node 2** in a state of equilibium are separately maintained by sets of forces *a* and *a′*.

A new set of forces *b* and their antagonists *b′* arise and pull together node 1 and node 2. Forces *a* and *a′* now carry increased load as their frames become distorted while attempting to maintain the initial nodes 1 and 2. They thus become antagonists of the new *b* and *b′* forces. Global tension has increased.

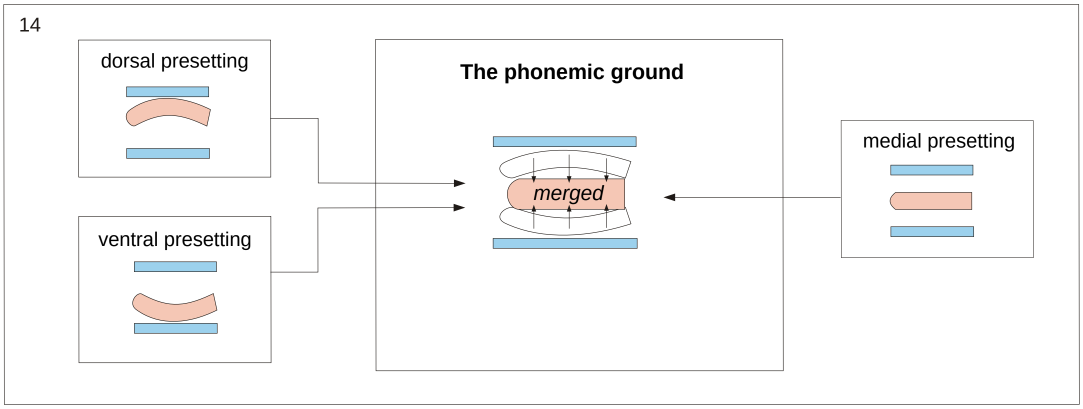
Automatically emerging optimization of efficiency dictates that once the two initial nodes are maximally approximated a new set of forces be generated, which offer greater balance and require less energy. At this time forces *a* and *a′* relinquish their prime agency roles and allow the new forces to merge nodes 1 and 2, acquiring a secondary equilibrium for the entire frame. Thus a new frame, centered in node 3, supported by forces labeled *c* is generated. The initial forces remain embedded and play an ancillary role in maintaining the new frame.

4.6.2 Mergers of primary nodes

The various classes of mergers among the h, n and m primal nodes of the tongue are the initial sources from which other nodes (secondary, tertiary, etc.) can be constructed. The primary nodes interact both with one another and with extrinsic lingual muscles. When a merger occurs a new force frame setting and a secondary equilibrium comes into existence. The secondary setting is of decreased equilibrium and when released it decays back into the primary setting. More in section on mechanics of mergers.

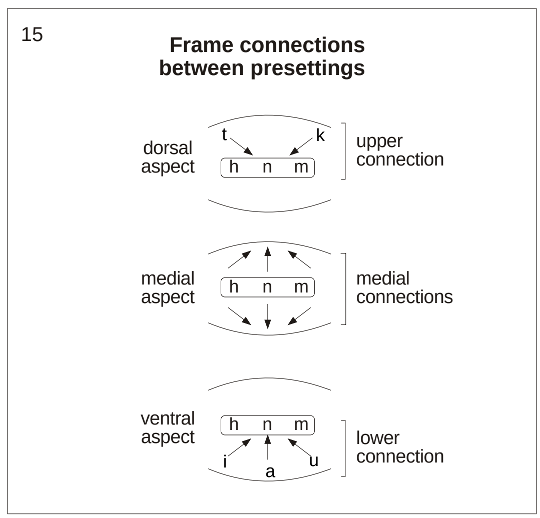
4.7 Merger of dorsal, ventral and medial presettings in full articulation

In **mergers** one or more nodes and their frameworks can coalesce to form a single frame. The phonemic ground is a merged **composite** consisting of **three unified** elements: the dorsal (consonantal), ventral (vocalic) plus the medial h-n-m primal phoneme presettings, fig. 14.



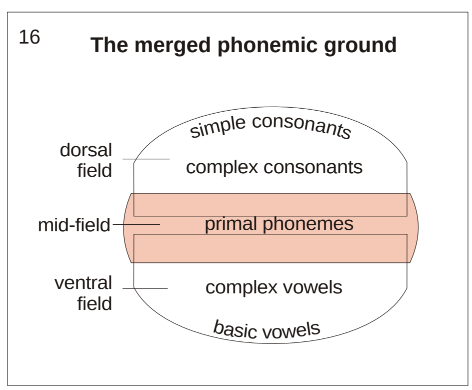
4.8 Variation of force directions depending on primal presettings

Beside its own independent functioning each presetting is coactive with the other two through **distinct** connections. That is, each presetting possesses its particular discrete frame with which it connects with the other presettings, and through which it operates most efficiently when it acts as the main agent of a syllabic framework. For example, the forces reaching the medial element adjust according to whether the articulation frame is vocalic or consonantal, fig. 231. The action of generating t, k, i, a, and u are taken up in *Matrix Mechanics*.



4.9 Phoneme distribution in the merged phonemic ground

The full phonemic ground contains the **upper** and **lower** fields connected by the primal phoneme **mid-field**. Below the upper field containing the **simple** consonantal nodes reside the nodes of the **complex** consonants, characterized by significant articulative strictures i.e., sibilants, and other obstruents, etc. Within the lower field the nodes of the **complex** vowels appear above those of the basic vowels of the ventral field. Complex vowels include rounded, spread, open, and closed varieties. See *Complex vowels*.



~~4.10 The merged general phonemic ground~~

4.10.1 Alternation of roles in the phonemic engine

In **full** articulation the **medial, dorsal** and **ventral** presettings are **merged** into a **single mechanical** configuration, or **articulative engine** with two mutually antagonist forces, the **intrinsic** and **extrinsic** lingual muscular systems. These work together in two alternate configurations: for **consonant** production the **intrinsic** agent is the **prime** (or dominant or stable) agent and the **extrinsic** active articulative agent is the **antagonist**; for **vowels** the stability is provided by the **external manifold** of forces originating from the bony and muscular structures surrounding the tongue and the intrinsic lingual agent performs the articulating action. The **medially** preset articulation of primal phonemes is accomplished by approximately equal proportions of extrinsic and intrinsic forces, fig. 17.

The consonantal and vocalic configurations readily **alternate** between initiating or inserting consonant or vowel syllables since the merged articulative engine is preset so that either one can readily become either the active agent or the antagonist stabilizing anchor. The medial presetting serves as the bridge between the two antagonists.

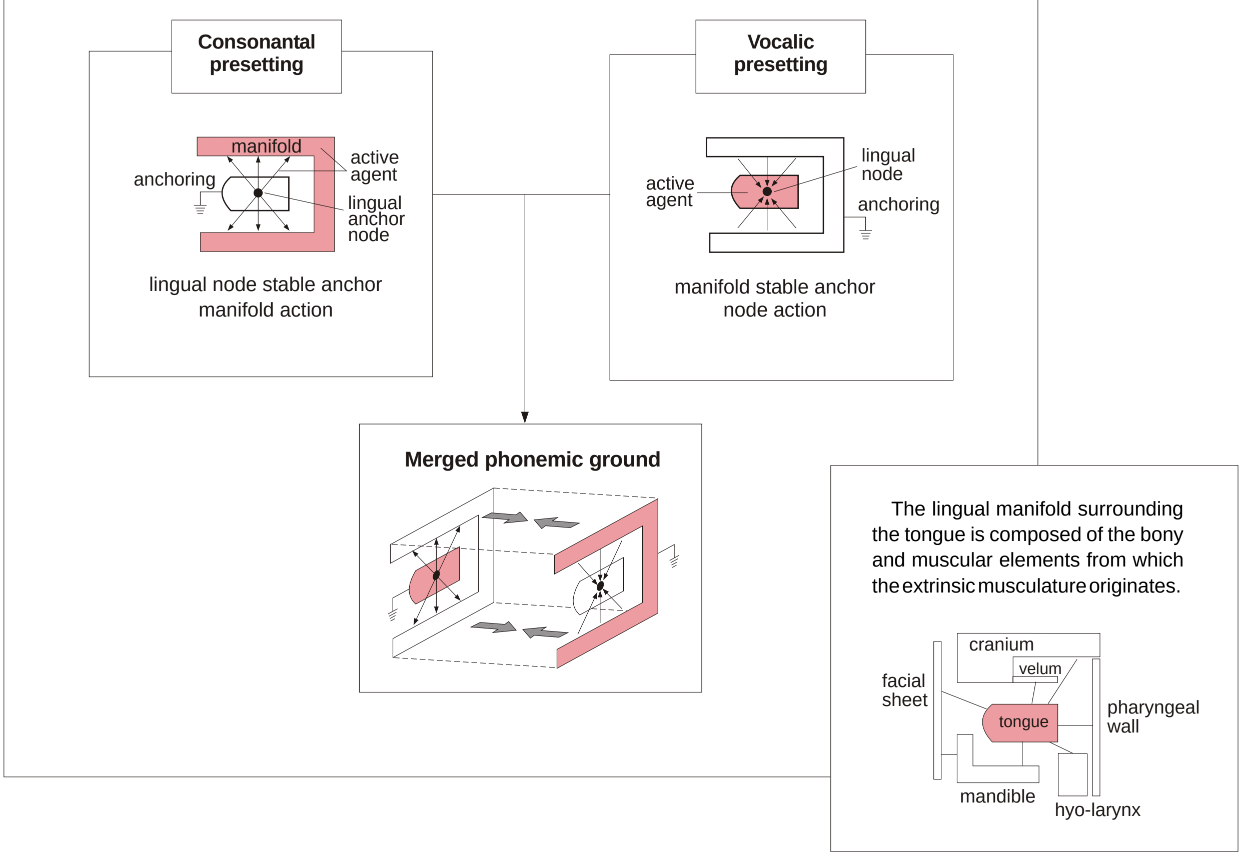
This faculty enables consonants and vowels to be both independently produced, and since the two presettings can rapidly alternate, to join in **syllables**. In physical terms the apparatus behaves as a bistable oscillator. (Stuttering may be viewed as the result of problems in such oscillation.) The initiating frame of a syllable, whether consonantal or vocalic remains dominant and it maintains a consonantal or vocalic matrix setting throughout the syllable generation.

The medial h, n, and m nodes can behave either consonantally or vocalically depending on whether they are at that time connected with the dorsal or ventral presetting. E.g., in English “no” /n/ is a consonant; in “sudden” it is vocalic. The final (moraic) /n/ of Japanese is vocalic, as well.

Observable evidence: the specific roles of extrinsic and intrinsic musculature can be observed: starting any consonant with extrinsic initiation blocks respiration but not with intrinsic initiation, whereas the converse is true

17

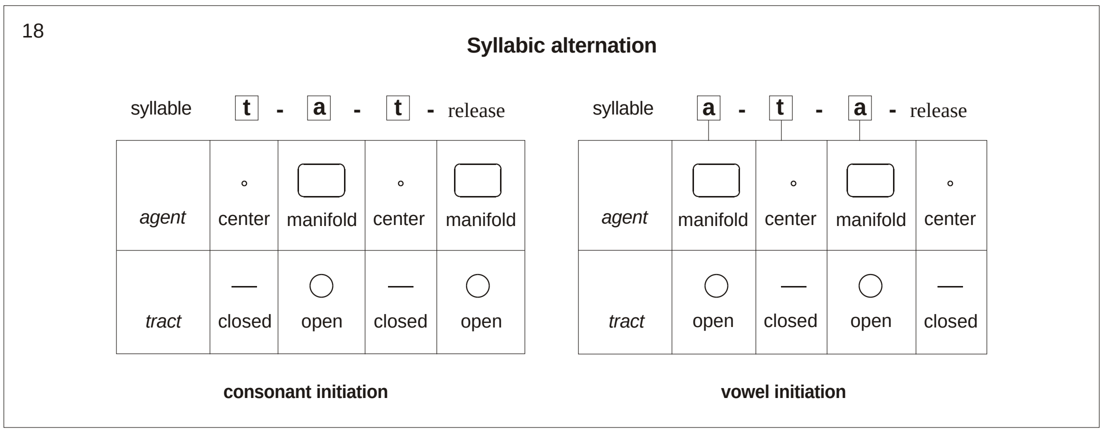
The two symmetrical aspects of the merged phonemic ground



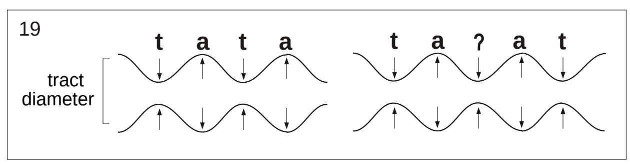
4.11 Syllabification and alternation in tract states

Syllabic alternation between consonant and vowel in either an initially consonantal or vocalic presettings is illustrated in fig. 18. The alternation occurs in taking the roles of stabilizing element vs. the active element in a mutually antagonistic coupling. Moreover, each role can be assigned to either the tongue's intrinsic or extrinsic muscular frameworks.

There are two variables: (a) in each pair the stabilizing element or alternately the active agent may either be the **centrally** located tongue or the **manifold** surrounding the tongue, and (b) the tract may be open or closed to varying degrees, depending on whether the initiating agent is vocalic or consonantal.



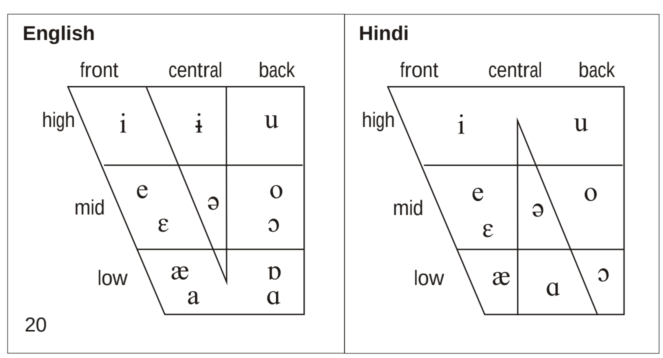
The (bistable) sequential quasi-peristaltic aspect of syllabification is discernible in terms of tract volume diameters, fig. 19. Cf. section *Metaperistalsis*. If an /a/ follows and /a/ a syllabic break occurs, which is closure.



4.12 - THE 3 x 3 MATRIX

4.12.1 Field of articulation action: the 3 x 3 matrix or the general vowel quadrilateral

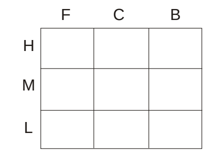
The **general** vowel quadrilateral constitutes a **3 x 3 matrix** or a field of **nine cells**. Although not all languages possess vowels located in all nine cells, the class of all languages taken as a group do so. For example, see the English and Hindi vowel systems in fig. 20. Combining both sets results in filling all nine cells.



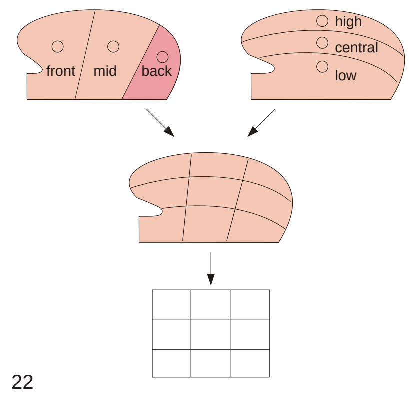
4.12.2 Transfer and locking of nodes

Vowel nodes operate in the **3 x 3 cell matrix**. Each cell is a location definable in terms of vertical and horizontal **axes**, that is, high-central-low as well as front-mid-back placements. To efficiently translate between activating different nodes, in this case those of vowels, there needs to be such a matrix system to enable ordered transformations. The functional features of this matrix consist in the ability to transfer between cells, i.e., to **switch** between nodes and to **lock** into these positions. As with vowels, consonant nodes also reside in a matrix, which is more complex and which is indicated in part on p. 3, fig. 10 under "Expansion of frame presettings". See fig. 21.

21 **The 3 x 3 matrix**



The source of vowel quadrilateral



22

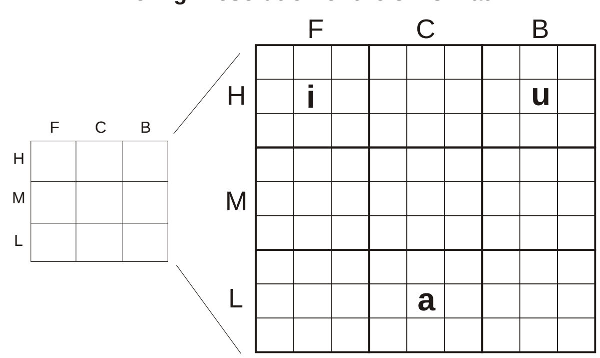
The 3 x 3 lingual matrix, which is a development of the 3 x 3 divisibility of the tongue, plays a role in **all** activities of the oral system and it is an absolutely essential element in speech production. It serves as the field in which nodes of oro-lingual functions are located and are maintainable in relative stability. The vowel quarilateral is only one particular manifestation of a 3 x 3 matrix inherent in oro-lingual mechanics, fig. 22.

Fully articulated cardinal vowels combine both articulation and phonation and due to this combination mask the elements of pure articulation. However when phonation is absolutely minimized the topography of the vowel quadrilateral emerges as a 3 x 3 matrix field in which all nodal behavior takes place. More later.

4.12.3 The 3 x 3 matrix at higher resolution

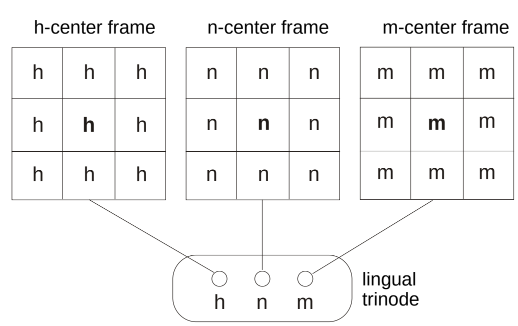
The 3 x 3 matrix possesses a more subtle secondary manifestation providing greater resolution in location. Each cell is further subdivisible into yet another 3 x 3 secondary submatrix within which a node can move by small increments and temporarily settle while still remaining within the underlying envelope of the larger cell. For instance, the vowel /i/ can shift to its own fronted, backed or other positional variation. The same functionalities apply to consonants. Such potentials ensure the flexibility of action and positioning necessary for rapid changes in fluent speech, fig. 23.

23 **The high resolution of the 3 x 3 matrix**



In addition, the framework of the 3 x 3 matrix can be secondarily **recreated** and **centered** over any lingual node. Thus each primal node when centered in the oro-lingual field possesses its own distinct 3 x 3 matrix. Within this field it can appear as its own positional variants. The central cell is the stable anchoring position, while the others are semi-stable and tend to decay to the stable central one, fig. 24.

24 **3 x 3 matrices of the primal phonemes**

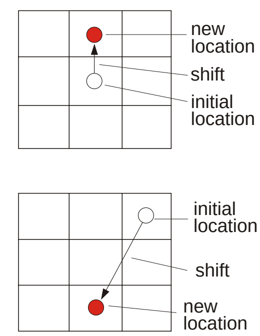


4.12.4 Gearbox mechanism

Phoneme production must be able to both maintain, or lock certain frame settings of phoneme articulation, and it must also be able to change, or switch between different locked settings. Thus, the 3 x 3 matrix in which frame nodes reside, is comparable to a **mechanical gear box** where frame settings can be steadily maintained but can also be switched. This guarantees order in the system: forces are **not** freely floating entities in the oro-lingual field, but are tied to nodes which are concisely managed in their movements as members of a mechanical system, fig. 25.

The lingual framework readily transfers between articulatory frame settings by changing the pattern and level of contributing forces: one can instantly and effortlessly **switch** between phonemes and between syllables. In other oral functions changes such as going from mastication to vocalization are readily achieved. Respiration is a constantly ongoing function of high hierarchical rank and is embedded underneath both the feeding and the vocalizing action frames. Its framework and its nodes are coactively merged with those of the others. All frame changes in the oro-lingual tract are executed through the switching system. Various muscles performing the switching action differ in dimensions and angular leverages and so their action are not simultaneous or of the same duration. Therefore the transitions are not necessarily momentary.

25 **Gear box switching**



4.12.5 Superimposition and embedding of primal presettings

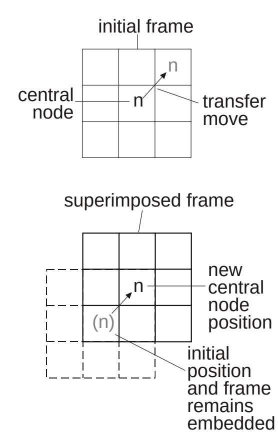
A **secondary** presetting framework can be **superimposed** on an initially existing primal presetting. The central nodes and frameworks of initial and superimposed frames merge to become a single mechanical unit. The initial presetting remains embedded in the new combined framework, while the secondary one temporarily becomes the active one. We can experience such processes in our physical behaviors. In walking there is a constantly active basic framework of forces to uphold the body against gravity. At the same time, with each step a secondary action frame operating the right or left body and the corresponding limbs becomes alternately overlaid on the underlying frame of erect stature, which remains embedded as the constant anchoring support.

Thus, a secondarily overlaid dorsal, or other presetting can be superimposed on an initial ventral one. Such activity occurs in syllables, where a vowel+consonant syllable may begin by generating the vocalic presetting onto which a following secondary consonantal presetting, created within the vocalic frame, is overprinted. On completion of articulating this superimposed consonantal setting decays to return to the vocalic setting, fig. 26.

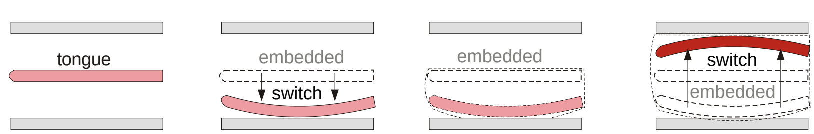
A third and additional superimpositions can be performed, with each one requiring increasing energy, and thereby decreasing in stability. For instance, the **phonation** frame is superimposed on the articulation frame, but since it works with higher energy, it follows, and not precedes the articulation action and decays when no longer needed.

Superimpositions can occur not only with primal presettings, but with any other setting. Fig. 27. shows superimposition of a high back positional variant of the n node and its frame over an initial medial n node. Here no new node comes into being, there is only a translation of the medial node.

27 **Node transfer and superimposition**



26 **A model of superimposition sequence**



a. initial lingual medial primal presetting

b. the tongue moves to superimposed ventral presetting

c. ventral presetting remains embedded in the new frame

d. the tongue moves to superimposed tertiary dorsal presetting; the secondary one is also embedded

4.13 Primal node behavior in phoneme generation

The generation of phonemes operating in the 3 x 3 matrix system is achieved through a series of coactive actions by the **three primal nodes** h, n, and m. In order to describe these actions several basic elements discussed so far can be brought together and outlined below.

4.13.1 Elements

(1) **Primal nodes** h, n, and m along with their frame settings constitue the **grounds** on which additional settings can be superimposed.

(2) **Primal dorso-medial-ventral lingual presettings**, which initiate differentiation between the generation of consonants and vowels and primal phonemes.

(3) **The 3 x 3 matrix** which is the ground of nodal activity, whereby nodes can move between cells in a stepwise fashion.

4.13.2 Actions

(4) **Frame distortion and equalization / agent-antagonist coaction**: new forces impacting a balanced frame distort the frame and cause additional forces to become active to regain equilibrium. Controlled actions and creations of equilibrium are always achieved through the coactivity of agent(s) and antagonist(s).

(5) Coactivity between two interacting parts is characterized by **alternating** roles: when one provides the stable substrate the other one moves, or otherwise acts. (An object cannot move in relation to itself, nor apply external force on itself. It can move only if it pushes or pulls against another object. In other words, controlled motion is only possible when there is a moving object and a stable reference object, a case of mutual antagonism. In a muscular system it is most efficient if the two antagonist agents alternate duties as this evens out the effort, allows for recuperation time for muscles and for maintenance of basic structure. Vertebrate animal motion applies alternation of anti-lateral movements of body and limbs. This is also true in speech mechanics in that the extrinsic and intrinsic lingual muscles work in alternation. It has traditionally been stated that vowels and consonants differ in that the former is extrinsically, and the latter is intrinsically generated. This is observable in syllabification.

(6) **Superimposition**: frameworks of forces can be temporarily superimposed on other frameworks.

(7) **Switching**: a node and its framework can be efficiently transformed into a new node and framework. Similarly, phoneme settings can efficiently **change** to subsequent settings of other phonemes, as in syllables.

(8) **Locking**: any articulatory setting, specifically that of a phoneme can be steadily and precisely **held** in place, that is, it can be **locked**.

(9) **Mergers**: Two or more nodes and their frameworks can be combined, or merged to create a new node with a new framework. There is **hierarchical** succession in a sequence of superimposed frameworks: each subsequent overlay occupies a **secondary**, or subsidiary rank in relation to the one preceding it. In **phoneme** production the merging of nodes is the **sole** faculty capable of producing **new phonemes** over and above the three primal nodes. Merging is once again illustrated in fig. 28.

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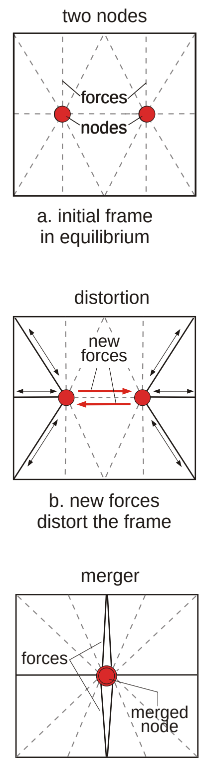
A model of merger



a. initial frame in equilibrium

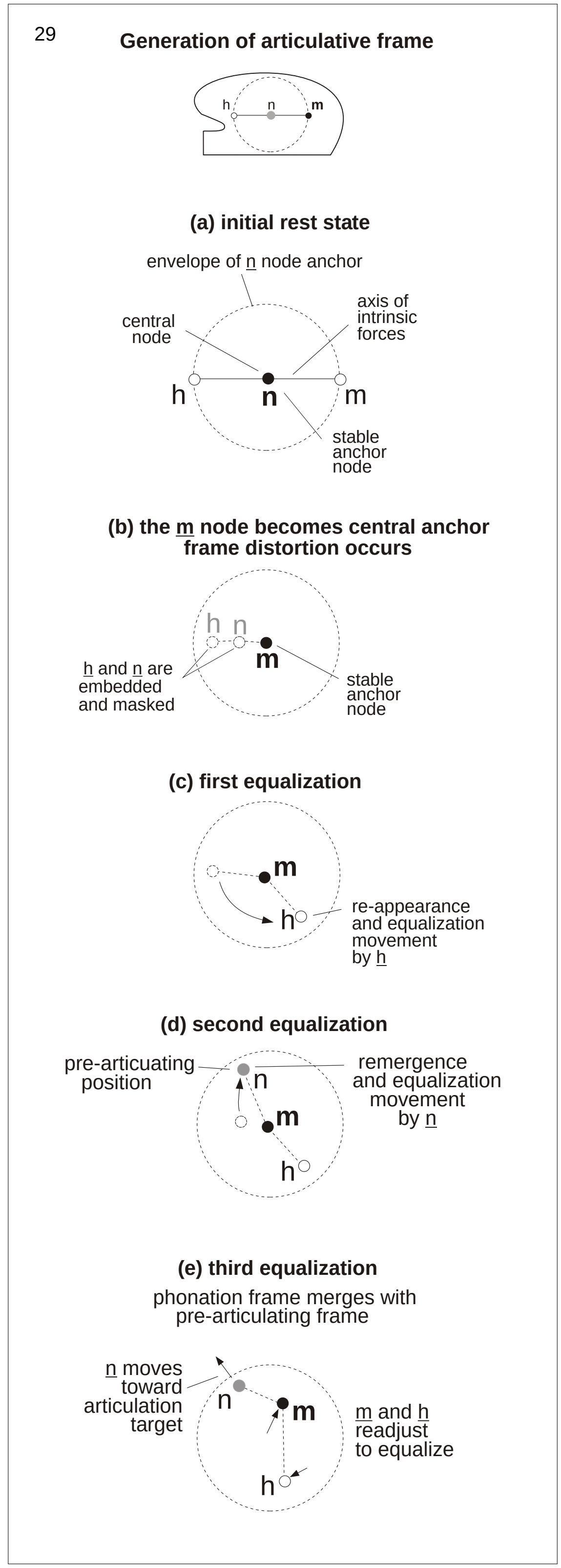
b. new forces distort the frame

c. newly superimposed frame in equilibrium

In the articulation of phonemes, **new** nodes or new phonemes are created solely through the faculty of **merger** of two or more existing nodes. As they are the inherently existing phonemic elements of speech, the generation of all other phonemes **derives** first from the various initial mergers of the primal h, n, and m nodes, which generate the simple consonants and vowels, and **secondly** from the mergers between the primal nodes and simple consonants and simple vowels, producing the complex consonants and complex vowels. Thus, it is by **starting** with the **primal** h, n, and m nodes, which exists at the lowest energy level of oro-lingual behaviors, that **all** other phonemes are generated.

4.13.3 Phoneme production: the roles of central, active and stabilizer nodes in articulation

Fig. 29 outlines the general basis of phoneme articulation. The following section *Matrix mechanics* presents the details in this process. The order of steps in the process is determined by inherent hierarchical design.



(a) In the intrinsic lingual framework at rest the nodes of the three primal phonemes are aligned. The central anchor is n. The choice of active and stabilizer nodal functioning, devolving either on the h and/or the m nodes is optional. This example deals with vowel generation where the central stabilizer anchor is m. For consonants the roles of h and m are reversed.

The present example shows the production of /i/.

(b) As vowel articulation is initiated the m node moves to become the central stabilizing anchor of the temporary secondary frame and causes frame distortion. The h and n nodes at his time are largely masked in the background, being embedded in the distorted configuration.

(c) To equalize the distortion the h node moves to a new location in order to balance the m node position.

(d) The n node, in turn, relocates to balance the two other nodes and attains the pre-articulatory position. This new position is the one from which the subsequently entering forces of phonation cause the n node to complete the

(e) As the articulation and phonation frames merge the h and m node relocate once more to an equalized position and the n node executes the targeting action.

This event once more distorts the frame and the three nodes rearrange to equalize. In the newly created frame the n node becomes the articulated /i/ node, centered within its own frame.

(f) All three nodes interact as mutual antagonists. When the articulated phoneme becomes dominant and centered, then its framework appears as a **triangle**, with a node at the three vertices. The phonatory input of forces have modified the configuration by repositioning the vertices. Depending on the phoneme, phonation also axially protracts and/or retracts the tongue.

Fig. 30 shows the articulation of /i/. Within the pre-articulative frame, n is about to move into target position. Once this occurs the completed articulative frame comes into being with /i/ at the center. Its node is now the dominant one. The n node remains at its position at the apex.

The fully articulated /i/ frame rotates counterclockwise and its configuration now becomes apparent in the shape of the tongue.

This function is more fully covered in section *Matrix Mechanics*.

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(f) articulation frame