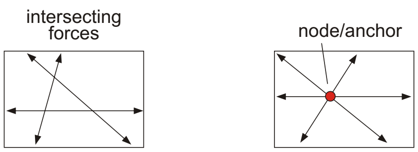
Outline of the interpretation of mastication and of and phonemic ontogeny in terms of the anchoral matrix system.

A. General aspects

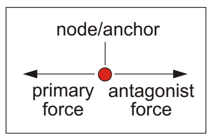
A.1. The behavior of forces

Motion in a complex system is generated by forces which interact to resolve as resultants and they intersect through nodes, or anchors. fig.a.1.

fig.a.1.



In controlled motion a point of concurrence of opposing forces is present even if only on force is active because this force must be balanced by an antagonist.



Analysis of the upper visceral system in such terms makes it possible to describe the system as a geometrical configuration of forces.

A.2. Inference

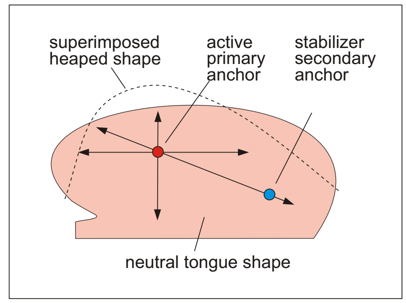
In terms of such interaction of forces, it may be inferred that the lingual forces in food processing and speech also behave similarly, forming resultants and intersecting across nodes/anchors.

For instance, the force map of the lingual frontal heap in mastication or the /t/ palatal contact by the tongue in speech would be generated by forces which produce a particular anchor or node.

A.3. Observation supports the inference

By eliminating forces of the speech mechanism other than those within the tongue, thus isolating the action to a single variable we can proprioceptively observe that there is, in fact, such a small region of force, i.e., tension present when shaping the tongue to produce the masticatory front heap or the /t/ articulating position of speech.
An anterior anchor is opposed by a posteriorly situated counteracting antagonist anchor which stabilizes the movements of the active one. fig. a.3.

a.3.



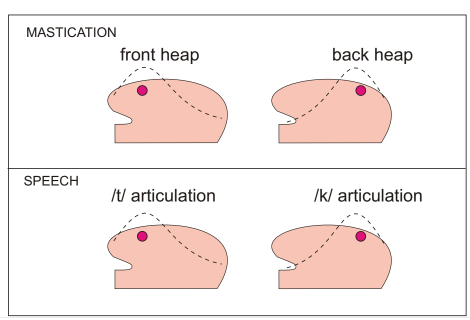
In normal actions an anchor can take any size, ranging from entire body regions to a (theoretical) point. Regional anchors are vague and difficult to locate, but point-like ones are observable. In our experiments the action of point-like anchors is described. (For details see...)

A.4. Commonality between mastication and speech

It has been stated that speech and mastication appear to have common features in tongue shaping. This similarity is clarified by the geometrical mechanism described by the anchor matrix system (AMS). *See note on page 5.*

Interpreted in terms of the AMS, the lingual front and back heaps of mastication and the phonemes /t/ and /k/ in speech are generated, respectively, by the **same** upper front and upper back anchors. The role of other anchors of the matrix will be discussed later. Unless otherwise noted, this discussion focuses on the mechanics of lingual anchors. fig. a.4.

a.4.



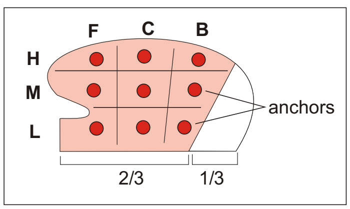
A.5. Terminology

Note: the term “node” is neutral and suggests no particular action; the term “anchor” is preferable because it implies the presence of forces which are being anchored,or stabilized.

A.6. The 3x3 anchor matrix

In such an analysis the anchors (nodes) of the most important tongue shaping force configurations, produced at a minimal energy level, either in respiration, mastication or speech,can be isolated and shown to be distributed in a 3x3 matrix in the anterior 2/3 (oral) part of the tongue. fig.a.6.

a.6.

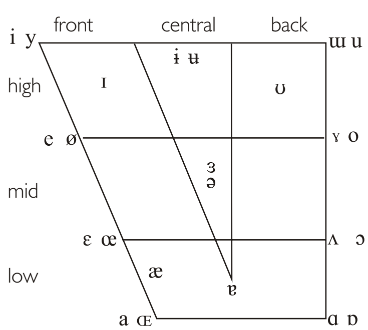


A.7. The basis for 3x3 matrices

A 3x3 matrix is the minimal mechanical unit for a single central primary anchor because it is optimally surrounded by its antagonist stabilizers.

This fast is supported by the manner in which vowels are arranged according to tongue height in the vowel quadrilateral which is also a 3x3 matrix. Such a configuration is basic to and will be shown to repeatedly appear in the mechanics of the upper visceral tract. fig. a.7.

a.7.



The vowel quadrilateral

A.8. The lingual anchor field

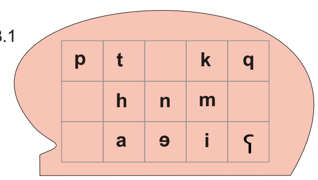
The global field of lingual anchors, which are discussed more fully in Chart A, can be **mapped** (in an abbreviated form) as shown in fig.8.1. In merged action lingual anchors at one time employ one primary and several secondary anchors.

The 3x3 configuration is mapped on this field differently depending on which anchor serves as the primary stabilizing anchor of the 3x3 set. fig. 8.2.

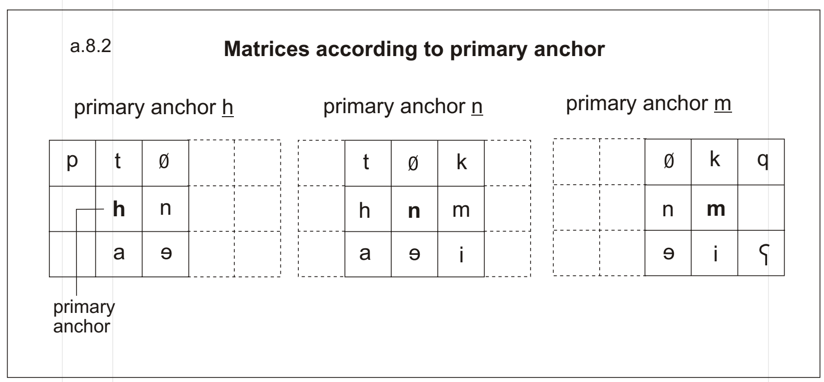
For convenience the lingual anchors can be named according to the phonemes they are associated with if and when they manifest in the speech mode.

The blank (mid central, front central and front low, back central) positions house the high front vowels, but typically produce no consonants due to anatomic limitations, although they are active as secondary anchors for semivowels, rounded vowels and glottalized consonants.

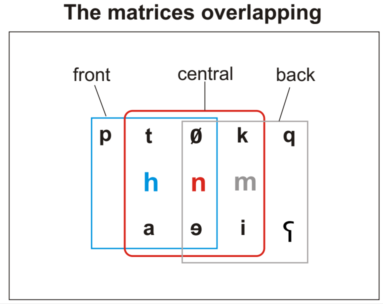
a.8.1



Lingual anchor field (abbreviated)



a.8.3 **The matrices overlapping**

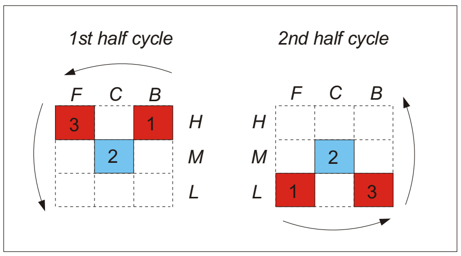


B. Mastication

B.1. Cyclical movement

In terms of the lingual anchor mechanism the cyclic processing of food (cf. Hiiemae Palmer) can be defined as a circular sequential tansferral of anchors within the matrix. fig. b.1.

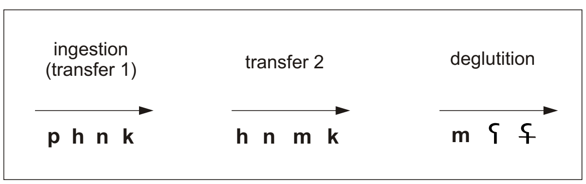
b.1.



B.2. Linear movement

Ingestion, transport and deglutition are functions of linear anchor transferrals. fig. b.2.

b.2.



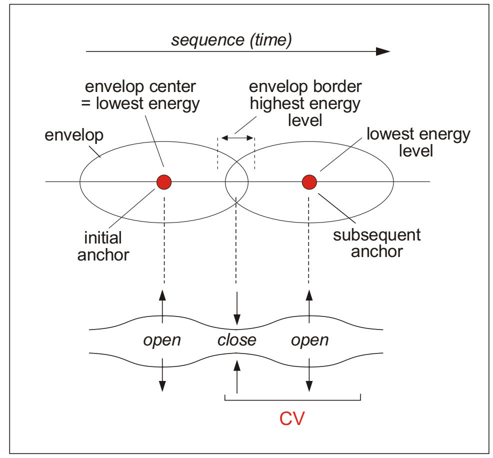
C. Phoneme production

B.3. Syllables

The production of syllables (cf. McNeilage/Davis frame/content) can be defined as ordered patterns of anchor transfers. The consonant-vowel (CV) structure consists of a dorsal to ventral transfer of anchors within the matrix. The pairing of a C with a V is grounded on the basic sequential pattern of respiratory behavior of alternating constriction and expansion of the tract. This appears to be essentially peristaltic behavior. fig. b.3.

Whereas in mastication and suckling the direction of anchor movement is physiologically determined, in speech it is not limited and can occur in any direction, enabling the complex mechanics of speech.
The merged envelop of two phoneme anchors forms the syllable frame and the transfer of primacy from the initial anchor to the subsequent one is the syllabic sequence. The process is also a tract pulse where a closed segment is followed by an open segment. The highest energy level segment is a consonantal constriction, while the lowest level is vocalic expansion.

b.3.



In fig. b.4. the syllable is depicted as a mode of peristaltic motion along the UV tract. The modification is generated by the change of the respiratory framework to that of speech.

b.4.

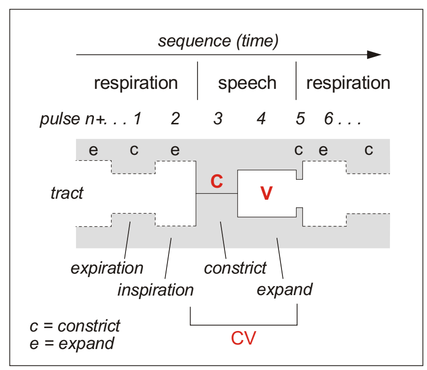
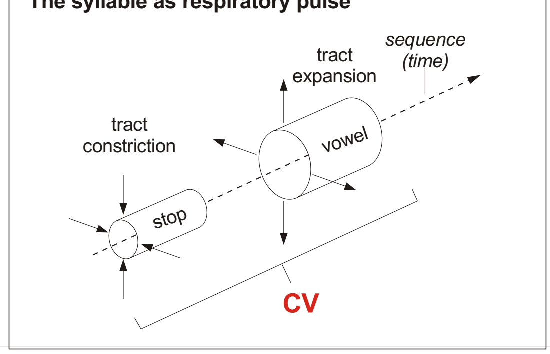


Fig. b.5. shows a model of the CV unit as a peristaltic sequence in tract cross-section changes. It is equivalent to a respiratory pulse, as has been often stated. The source of the pulse mechanism is clarified in manuscript of *The Foundation Axiom*.

b.5.

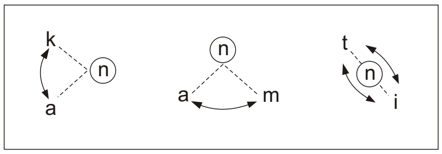


The syllable as respiratory pulse

B.4. Symmetries

Although anchor sequence patterns are not limited in speech, there is a range of efficiency in movement paths and the optimal ones are generated in symmetrical patterns.
These mechanical symmetries are built on a central primary stabilizing anchor on which two opposing secondary antagonist anchors balance, as if on a fulcrum. fig. b.4.

b.4.

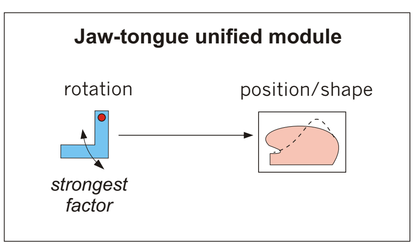


B.5. Symmetries in syllable production

There are several types of symmetries which determine the sequence of anchoral movement in generating the content of the syllabic frame.

The jaw is the most powerful agent of the upper visceral mechanism and tends to play a primary role in its antagonist relationship with the tongue. Therefore, it is the most significant agent in determining the kind of symmetrical pattern is mandibular rotation. Mandibular rotation generates movement and shaping by the tongue. fig. b.5. This coactivity has been correctly recognized by **McNeilage and Davis**.
Still, the tongue can also be assigned primacy. Other agents, as well, including head position, facial muscles and gesticulation further influence the choice of symmetry.

b.5.

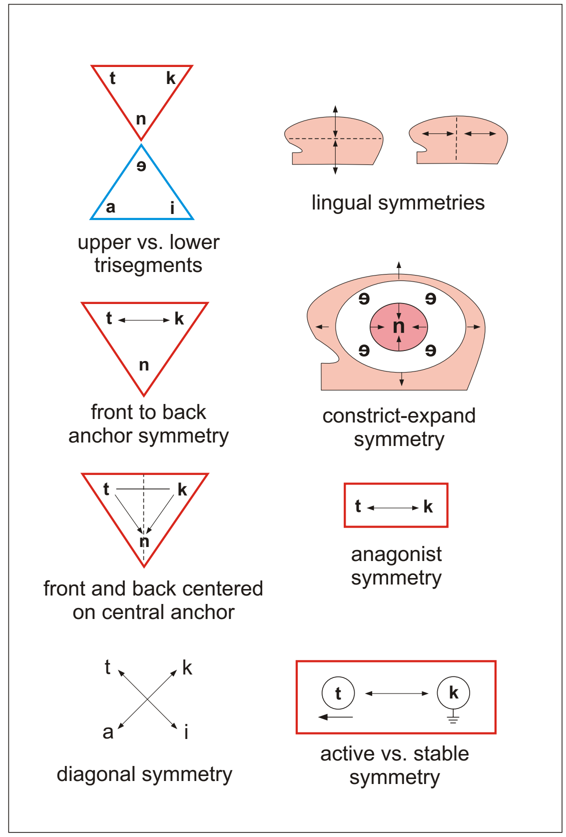


Mandibular rotation generated lingual behavior

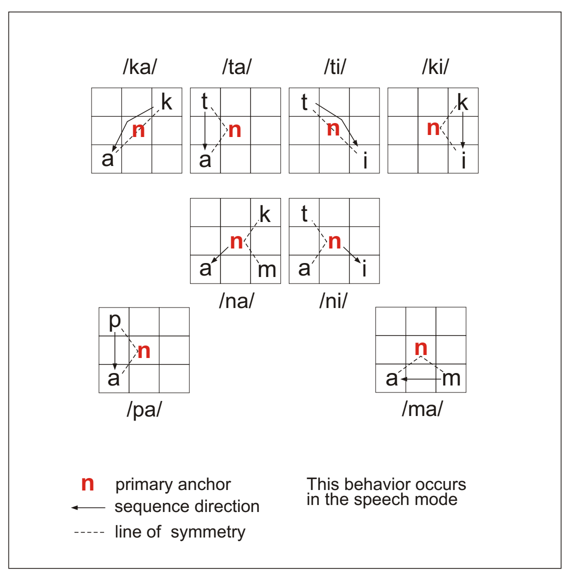
Types of symmetries b.6

Cyclic trisegments
Front anchor to back anchor symmetry
Symmetry of front and back anchors
centered on the central anchor
Diagonal symmetries
Lingual symmetries: transverse (dorso-ventral)
and axial
Symmetries between constriction and expansion
Symmetry in antagonists pairs in
Symmetry in active-stable antagonist coactivity

b.6 **The types of symmetries**



b.7. **Examples of various symmetries in forming syllable frame and content**



Depending on jaw-tongue module behavior, the anchor. sequence follows a specific path, pivoting on n. fig. b.7.

Note (p. 3)a a a

The quotes below from Hiiemae and Palmer (2003)* refer to the commonalities between feeding and speech.

"It is, therefore, reasonable to hypothesize that the matrix of tongue movements during human speech was derived from the wide variety of tongue movements found in suckling and feeding, although this view is controversial...

"...it is clear that many of the shapes adopted by the tongue in speaking are seen in feeding. It is suggested that the range of shapes used in feeding is the matrix for both behaviors."

* *Karen M. Hiiemae and Jeffrey B. Palmer, Tongue movements in feeding and speech, Crit Rev Oral Biol Med, 14(6):413-429 (2003)*