

SYMMETRY: CULTURE AND SCIENCE

PHONETIC SYMMETRY IN SOUND SYSTEMS

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INTRODUCTION

The sounds of a language are traditionally — and perhaps most easily — described and categorised in terms of *how* and *where* in the oral cavity they are articulated.

Consonants are described and categorised in terms of **place (point) of articulation** and **manner (method) of articulation**. The former refers to the location in the oral cavity where the obstruction or modification of the airstream occurs which produces consonantal sounds, and the latter to the manner in which that obstruction or modification of the airstream is made.

Based on this method of description, the consonant phonemes¹ of a language are generally set out in the form of a chart or matrix according to general phonetic taxonomic categories of place and manner of articulation. The various places of articulation are represented as individual columns, whilst the various manners of articulation are exemplified in rows²:

¹ A *phoneme* is defined as a minimal and contrastive unit of sound in the sound system of a language which cannot be analysed into smaller linear units.

² The phonetic symbols used in the charts below provide a unique written representation of each sound (phoneme) independent of the orthographies of particular languages. Each phonetic symbol corresponds exclusively to a particular vertical and horizontal position in a diagram. In the vowel patterns on the following pages, the symbols used do not refer to any fixed phonetic quality. The vowels of each language represented have their own distinct quality. See also Figures 1, 2 and 3, Appendix.

		bilabial	alveolar	velar
plosives	(voiceless)	p	t	k
	(voiced)	b	d	g
nasals		m	n	ŋ
fricatives	(voiceless)	ɸ	s	x
	(voiced)	β	z	ɣ

Vowels, on the other hand, do not lend themselves to such a relatively easy method of description and classification – at least not in articulatory terms. The articulation of most consonants offers enough sensory feedback to determine the place in the oral cavity where the obstruction or modification of the airstream occurs. The articulation of vowels does not offer such sensory feedback. They are articulated in a small and restricted area in the oral cavity, known as the ‘vowel space’. Very small vertical and horizontal movements of the tongue within this space can differentiate one vowel quality from another. The vowel space is generally represented as a quadrilateral (see Figures 2 and 3, Appendix), and the relative position the tongue assumes for the articulation of individual vowels is plotted within this quadrilateral.

The vowels of most languages tend to be evenly and widely distributed within the vowel space. This configuration helps to provide for maximum phonetic contrast, and as Disner (1980, p. 91) reports, about 86% of the 317 languages in the UPSID (the *UCLA Phonological Segment Inventory Database*) have ‘vowel systems that are built on a basic framework of evenly dispersed peripheral vowels’ and that ‘10% [of the languages] approach this specification’.

PHONETIC SYMMETRY

Consonant charts and vowel quadrilaterals often reveal phonetic symmetries in a language’s inventory of phonemes³. Indeed, there is a strong tendency for symmetry in the phonological inventory of most languages.

Phonetic symmetry refers to the occurrence of sounds in parallel series, so that the sounds of one type, which occur at certain points of articulation, are paralleled by sounds of another type at those same points of articulation. For example, if a language has three voiceless plosives, three voiced plosives and three voiced nasals, they would most likely be:

³ These inventories do not usually include allophonic variants of phonemes. Allophonic variants are noticeable variations in the form of a phoneme which do not affect the phoneme’s functional identity. The variations are due to the influence of neighbouring sounds.

p	t	k
b	d	g
m	n	ŋ

The phonetic symmetry exhibited in such a language's inventory of bilabial, alveolar and velar plosives is paralleled in its inventory of nasals.

French and Spanish also have three voiceless plosives, three voiced plosives and three voiced nasals, however, their inventory of these sound sets is asymmetrical:

p	t	k
b	d	g
m	n	ɲ

The places of articulation of the plosives are not mirrored by the places of articulation of the nasals. Instead of having a velar nasal, French and Spanish have a palatal nasal.

SYMMETRICAL (NATURAL) SOUND SYSTEMS

1. Symmetrical Vowel Systems

The number of vowel phonemes that any of the world's known languages may have ranges from a minimum of three to a maximum of approximately 20 - 24. Languages with a three vowel system will almost always have some form of [i], [a] and [u]. This makes sense phonetically because these three vowels provide for maximum phonetic contrast since they have maximum dispersal and are articulated towards the extremes (i.e., outer edges) of the vowel space. These extremes are:

- the front of the tongue **high** in the oral cavity, close to the hard palate (together with spread lips) which produces a close (or high) front vowel like [i], as heard English *heat*, German *wie*, and French *si*.
- the centre of the tongue **low** in the oral cavity (together with open lips) which produces an open (or low) central vowel like [a], as heard in Southern British English *hard*, German *fahren*, and French *pas* (short), *pâte* (long).
- the back of the tongue **high** in the oral cavity, close to the soft palate (together with rounded lips) which produces a close (or high) back vowel like [u], as heard in English *book*, German *Hund*, and French *tout*.

Three vowel systems are quite uncommon since they limit the total number of possible words a language may have.

At the other end of the spectrum, !Xū (a Khoisan language spoken in Botswana with a total of 141 phonemes) has 24 vowel phonemes⁴. The larger the number of vowels in a system, the smaller is the degree of dispersal. This stands to reason, as the vowel space is such a restricted area, and the more divisions made within this area the less widely distributed vowels will be. The end result is less acoustically distinct vowels, and in theory at least a less efficient system.

The question arises as to what the optimum number of vowels in a system may be. This is impossible to answer as the speakers of languages with a large number of vowels have no trouble distinguishing them. The majority of the world's languages, however, have between five and seven vowels, with the five vowel system being the most common.

The following examples of symmetrical vowel systems show that the height of the front vowels mirrors that of the back vowels independently of any central vowels that may occur in the system. This type of symmetry is evident in most of the vowel systems of the world's languages.

3 Vowel Systems⁵

Quechua (Peru and Equador), Greenlandic Eskimo, Classical Arabic, Moroccan Arabic, Iatmul (Sepik, PNG), and a large number of Australian Aboriginal languages.

i u

a

4 Vowel System (relatively rare)

Arapaho* (U.S.A. Wyoming):

i u
e o

Squamish* (U.S.A. Washington):

i u

ə

a

⁴ This includes both monophthongs and diphthongs.

⁵ Phoneme inventories marked with * are adapted from Ruhlen (1976). Those marked with ** are adapted from UPSID: *UCLA Phonological Segment Inventory Database* (1981).

5 Vowel Systems

(the most common vowel system approximately ¼ of the world's languages)

Spanish, Modern Greek, Arabic, Latin, Czech, Mandarin, Japanese, Russian, Polish, Basque, Malayalam, Telugu, Tlingit (SE Alaska), kiSwahili and some of the other Bantu languages, and most of the languages of Oceania etc.

i		u
e		o
	a	

6 Vowel Systems

Persian*; Chamorro** (Guam):

i		u
e		o
æ		ɑ

Malay*:

i		u
e	ə	o
	a	

Lapp** (Lappland):

i	ɨ	u
e		o
	a	

7 Vowel Systems

Italian*:

i		u
e		o
ɛ		ɔ
	a	

Rumanian*:

i	ɨ	u
e	ə	o
	a	

Ewe (Ghana)**:

i		u
e		o
ɛ		ɔ
	a	

8 Vowel Systems

Bahasa Indonesia*:

i		u
ɪ		ʊ
	ə	
ɛ		ɔ
	a	

Burmese*:

i		u
e		o
	e	
ɛ		ɔ
	a	

9 Vowel System

Maasai** (SW Kenya):

i		u
ɪ		ʊ
e		o
ɛ		ɔ
	a	

12 Vowel System

English (British/Australian):

i		u
ɪ		ʊ
	ɜ	
ɛ	ə	ɔ
æ		ɒ
	ɐ	
	a	

2. Symmetrical Consonant Systems

Symmetry never occurs throughout a language's entire consonant inventory, but rather:

(a) within certain classes of consonants, e.g., symmetry within the plosive, nasal or fricative inventories, and

(b) across certain classes of consonants, e.g., where the places of articulation in the plosive inventory are mirrored by those in the inventory of nasals. This type of symmetry is a very common occurrence.

Every language has 'holes' in its phoneme inventory. These are due to:

(a) The general human inability to articulate certain speech sounds. For instance, no language has bilabial, labio-dental or velar laterals since they are impossible to articulate. *All* laterals are produced by allowing the airstream to escape between the sides of the tongue's blade (or dorsum) and the alveolum (or hard palate). This cannot be achieved at the lips or the soft palate, and hence, you will never see the space on a consonant chart intersecting at 'bilabial' and 'lateral' being occupied.

(b) A language simply not 'choosing' to incorporate a particular sound or class of sounds in its inventory. For instance, English (see below) has 'chosen' not to include the palatal plosives /c, ɟ/, or the palatal nasal /ɲ/ in its inventory. Malay, on the other hand (see below), has 'chosen' to do so together with all the other plosives and nasals English possesses.

(c) Genuine asymmetries in the system (see below).

A phonetic feature that often displays extensive sometimes almost perfect symmetry is that of voice. This can be seen in a number of the plosive and fricative inventories of the examples below.

English:

p ^h	t ^h	k ^h	
b	d	g	
m	n	ŋ	
	ɕ		
	ʃ		
f	θ	s	ʃ
v	ð	z	ʒ
	l		
	ɹ	j	w

Aranda** (Central Australia):

p	t	t	t	t	k
b ^m	d ⁿ	d ⁿ	d ⁿ	q ⁿ	g ⁿ
m	n	n	n	ɲ	ŋ
	r				
	l	l	l	l	
				ɭ j	ɣ w

Ambryn* (Vanuatu):

p	t	k
^m b	ⁿ d	ⁿ g
m	n	ŋ
β	s	x
	l	
	r	j
		w

Malay**:

p	t	c	k
b	d	ɟ	g
m	n	ɲ	ŋ
	s		h
	r		
	l		

Lapp*:

p	p ^j	p:	p: ^j	t	t ^j	t:	t: ^j		k	k ^j	k:	k: ^j							
b	b ^j	b:	b: ^j	d	d ^j	d:	d: ^j		g	g ^j	g:	g: ^j							
m	m ^j	m:	m: ^j	n	n ^j	n:	n: ^j		ŋ	ŋ ^j	ŋ:	ŋ: ^j							
				t ^s	t ^s ^j	t: ^s		ɕ ^j	ɕ: ^j										
				d ^z	d ^z ^j			j ^j											
f	f ^j	f:	f: ^j	s	s ^j	s:	s: ^j	ʃ	ʃ ^j	ʃ:	ʃ: ^j	x	x ^j	x:	x: ^j	h	h ^j	h:	h: ^j
v	v ^j	v:	v: ^j	z	z ^j	z:	z: ^j	ʒ	ʒ ^j	ʒ:	ʒ: ^j								
				l	l ^j	l:	l: ^j												
				r	r ^j	r:	r: ^j												

Arosi* (Solomon Islands):

p	p ^w	t	k	k ^w
b	b ^w	d	g	g ^w
m	m ^w	n	ŋ	
		s		
		r		

ASYMMETRICAL SYSTEMS

Asymmetrical phoneme inventories have 'holes' or 'gaps' in unexpected places. For instance, if a language only has three plosives, they would most likely be /p t k/ (which are voiceless) or /b d g/ (which are voiced). The three plosives in each set articulated at the lips (i.e., bilabial plosives), the alveolum (i.e., alveolar plosives) and the velum (i.e., velar plosives). These three places of articulation provide for maximum acoustic contrast which insures a maximum degree of differentiation between them.

1. Asymmetrical Consonant Systems

Arapaho*:

	t	k	ʔ
b			
	n		
	ɕ		
θ	s	x	h

Kiribati* (i.e. Gilbertese):

	t	k	kʷ
b bʷ			
m m: mʷ m:ʷ	n n:	ŋ ŋ:	
	r		

Palauan* (Palau, Micronesia):

t	k	ʔ
b	d	
m		ŋ
	s	
	l	
	r	

Hawai'ian*:

p	k	ʔ
m	n	
	h	
l	w	

p t k
g
β
r

Blackfoot & Cree* (U.S.A.):

i
o
a

A vowel chart showing the relative positions of the vowels i, o, æ, and a. The chart is a trapezoid with 'i' at the top left, 'o' at the top right, 'æ' at the bottom left, and 'a' at the bottom center.

i
e
a
o

i	u
e	o
æ	

The vowel systems of virtually all languages have front vowels that are articulated with unrounded lips and back vowels articulated with varying degrees of lip rounding. In addition to this, some languages (e.g., Dutch, German, Swedish and French) also possess a set of rounded front vowels and/or a set of unrounded back vowels (e.g., Vietnamese). The vowel inventory of such languages is always asymmetrical because the back vowels never have a set of corresponding unrounded vowels (or in the case of languages with unrounded back vowels, the front vowels don't have a set of corresponding rounded front vowels)⁶:

Dutch*:	i	y		u
	ɪ	ʏ		
	e	ø	ə	o
	ɛ			ɔ
		a		ɑ
German*:	i	y		u
	ɪ	ʏ		ʊ
	e	ø	ə	o
	ɛ	œ		ɔ
		a		
French (Parisian)**:	i	y		u
	e	ø	ə	o
	ɛ	œ		ɔ
		a		ɑ

⁶ Note: The French nasalised vowels /œ̃, ø̃, ɔ̃/ are not included in this inventory.

Vietnamese*:

i	u
	ɯ
e	o ʏ
ɛ	ɔ ʌ
æ	a

REASONS FOR SYMMETRY

The tendency for symmetrical phonological systems can be explained as a striving for 'economy', because symmetrical systems make the most economic use of phonetic features. If phonemes (and the symbols used to represent them) are regarded not as indivisible entities, but rather as bundles of distinctive phonetic features, the repetition of the corresponding parameters in symmetrical phoneme inventories can be explained.

Symmetrical systems have a simple set of rules that maximise the use of a limited number of phonetic features by combining and reusing them to define an optimum number of phonemes.

Some simple calculations on the consonant inventories of Lapp (see above) – which is a symmetrical system – and Rotokas (see above) – which is a very asymmetrical system – will instantly reveal the advantages a symmetrical system has over an asymmetrical one.

The Lappish system is very economical as it employs only 18 phonetic features:

6 primary places of articulation:

Bilabial [p, b, m]
 Labio-dental [f, v]
 Alveolar [t, d, n, s, z, l, r]
 Velar [k, g, ŋ, x]
 Palato-alveolar [č, ʃ, ʒ, ʒ]
 Glottal [h]

2 secondary places of articulation:

Palatalised [ʲ]
 Half-palatalised [ɹ]

6 manners of articulation:	Plosive [p, b, t, d, k, g] Nasal [m, n, ŋ] Affricate [tʰ, dʒ, ʧ, ʤ] Fricative [f, v, s, z, ʃ, ʒ, x, h] Lateral [l] Trill [r]
2 values for voicing:	Voice [b, d, g, m, n, ŋ, dʒ, ʃ, v, z, ʒ, l, r] Voiceless [p, t, k, tʰ, ʧ, f, s, x, h]
2 values for length:	Long [ː] Non-long

to define a staggering 87 consonant phonemes.

Rotokas, on the other hand, has a very uneconomical phoneme inventory as it employs a total of 8 phonetic features:

3 places of articulation:	Bilabial [p, β] Alveolar [t] Velar [k, g]
3 manners of articulation:	Plosive [p, t, k, g] Fricative [β] Tap [ɾ]
2 values for voicing:	Voiced [g, β, ɾ] Voiceless [p, t, k]

to define a mere 6 consonant phonemes. This phoneme inventory is full of 'holes', as it imposes complicated rules to guarantee that only phonemes with admissible combinations of phonetic features are defined, e.g., 'only the velar plosive, bilabial fricative and alveolar tap can be voiced'; 'only the plosives can be voiceless'. No such *ad hoc* restrictive statements are needed for a symmetrical system like Lapp. There are some 'holes' in the Lappish system too as no language has an entirely symmetrical consonant system. However, a number of these 'holes' can be accounted for as they are entirely due to the general human inability to articulate such sounds.

Because of their economic use of phonetic features, symmetrical phoneme systems also reduce the burden of memorisation during language acquisition even when such systems have many more phonemes than asymmetrical systems (as in our examples above). A limited number of phonetic features need only be learned since they are constantly reused in defining phonemes grouped in natural classes (i.e., phonemes which are phonetically related). It is preferable to have a system with a limited number of phonetic features, and phonemes that form natural classes than a system in which the phonemes have little in common with each other. The latter

requires the mastering of a large number of phonetic features relative to the number of phonemes they are permitted to define in return.

The preference for symmetrical systems can also be attributed to the tendency to have the largest possible margin of safety between contrasting sounds so that they can be acoustically/perceptually distinguished with maximum efficiency. Asymmetry makes differentiation of contrasting sounds more difficult. Symmetry insures maximum degrees of differentiation between sounds.

REASONS FOR ASYMMETRY

Sound change is perhaps the principal cause of asymmetry. Languages are living, evolving, and dynamic systems, in each of which there is a constant interplay between a set structure that displays symmetry, and asymmetry. Though symmetry and maintaining a margin of safety between contrasting sounds may be a universal tendency, sound change often leads to asymmetrical or undifferentiated systems. That is, the tendencies do not provide restrictions to sound change, but may, however, act in response to sound change, motivating further sound changes which eliminate lack of symmetry. The following example of a changing five vowel system illustrates this:

i	u
e	o
a	

The loss of /e/ from this system, as a consequence from its merging with /i/ (/e/ → /i/) would result in an imbalanced 4 vowel system. Thus,

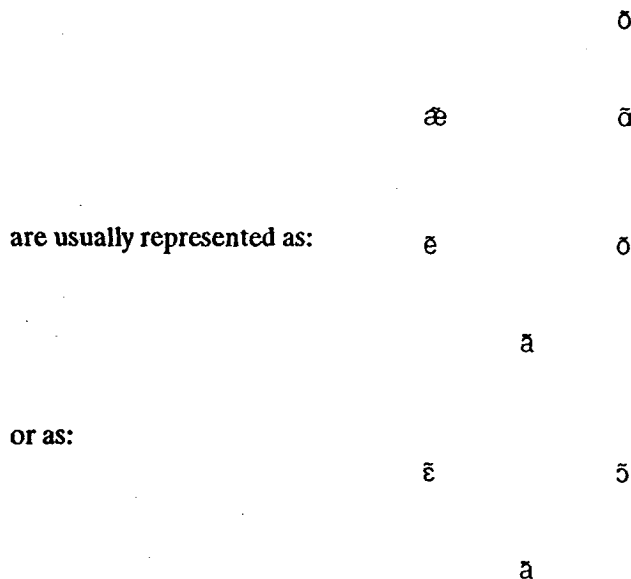
i	u
	o
a	

In time, it would not be surprising to see /o/ shift to /u/ to match the change – exhibited in the front vowels – which originally produced the imbalance (Crowley 1992 p. 201).

Sound changes occur over centuries. The diachronic study of language is only a relatively new science – dating back to the mid 19th century. Linguists have therefore not been able to study and trace sound changes for any appropriate length of time. One other problem is that linguists do not precisely know what causes a language to undergo a sound change in the first place.

CONCLUSION

There is always a danger that a discussion of symmetry in phonological systems will be more concerned with patterns on paper than with genuine insights into the phonetic or phonological nature of the system itself. Ruhlen (1976, p. 27) points out that we need to recognise both attention towards symmetry and orthographical convenience have significantly influenced the drafting of phoneme inventories. He cites the example of French for which the nasalised vowels are seldom accurately transcribed phonetically⁷:



Even though it may very be convenient to represent vowel systems as triangular or squared arrays and consonant systems in matrices; it must be appreciated that while these representations have some merit in displaying certain contrasts, they also have some serious drawbacks. These include the following:

- They do not necessarily reflect, in any realistic way, the manner or place of articulation. For instance, as a consequence of the 'asymmetry' of the oral cavity, the area in which back vowels are articulated is considerably narrower than the corresponding front vowel area; the tongue has less room for vertical movement in the back of the mouth than it has in the front. Hence, the back vowels are more 'compressed'. Stylised vowel diagrams do not reveal this in any realistic manner.
- The nature of the contrasts usually shown in the charts also do not accurately reflect significant qualitative differences. For instance, the

⁷ It is interesting to note that Ruhlen's example contains only three nasalised vowels when French actually has four such vowels.

apparent phonologically equivalent 5 vowel systems of Spanish, Russian and Japanese are quite different in their actual phonetic character. The Japanese /u/ is articulated with unrounded lips, whereas the Spanish and Russian /u/ are produced with the lips rounded.

■ Finally, it is important to understand that the patterns and symmetries often seen in these phoneme charts must, in part, be attributed to the following three artefacts:

- The phonetic interpretations and transcription methods of the field linguist will ultimately determine whether or not the phonemes of a particular language are represented in sufficient phonetic detail, as well as the final nature and configuration of the phoneme inventory (see Footnote 7).
- The taxonomic principles used by a linguist in analysing and categorising the sounds of a language will also have a direct bearing on the composition and final shape of the phoneme inventory.
- The manner in which the phoneme inventory is arranged will, of course, affect the final configuration of the phonemes in the chart. One arrangement may reveal symmetries that another may not.

For instance, a comparison of the phoneme inventories of Maori and Hawai'ian (two closely related Polynesian languages) as supplied by different linguists reveals the following:

Maori*:	i	u
	e	o
		o
Maori**:	i	u
		o
	ε	
		a

Hawai'ian*:	i	u
	e	o
		a

Hawai'ian** :	i	u
		o
	ɛ	
		a

Although the two Maori inventories are asymmetrical, the phonetic detail of each system is quite different. On the other hand, the two Hawai'ian inventories differ in their phonetic judgements to such an extent that one interpretation shows a symmetrical system whilst the other an asymmetrical one.

A more striking example resulting from these artefacts can be seen in the following inventories of Burmese, where the first interpretation reveals a five vowel system whilst the second an eight vowel system⁸:

Burmese*:	i	u
	e	o
		a

Burmese**:	i	u
	e	o
		ə
	ɛ	ɔ
		a

⁸ These inventories do not include the three nasal vowels /ĩ, ã, ẽ/.

There is, therefore, a very real danger in over-emphasising the significance of the search for symmetry and regularity in the phonological systems of languages. Language, after all, is human behaviour, which is more often than not disorderly or irregular in one way or another. A systematic analysis of language will *always* reveal loose ends.

It must also be remembered that living languages are evolving, dynamic systems in which there is a constant interplay between set structures which display symmetry and asymmetry. This is clearly illustrated by phonological change, especially with vowels.

APPENDIX

GLOSSARY

Place of Articulation

Bilabial	Articulated with both lips.
Labio-dental	Articulated with the bottom lip against the top teeth.
Interdental	Articulated between the teeth.
Dental	Articulated with the tip of the tongue on or near the top front teeth.
Alveolar	Articulated with the tip of the tongue on or near the alveolum (i.e., the ridge just behind the top front teeth).
Alveo-palatal	Articulated with the blade of the tongue on or near the alveolum and the hard palate.
Retroflex	Articulated with the tip of the tongue on or near the hard palate.
Palatal	Articulated with the dorsum of the tongue on or near the hard palate.
Velar	Articulated with the back of the tongue on or near the velum (i.e., the soft palate).
Labio-velar	A simultaneous articulation involving the lips and the back of the tongue on or near the velum.
Uvular	Articulated with the back of the tongue on or near the uvula.
Pharyngeal	Articulated with the root of the tongue drawn back towards the back wall of the pharynx.
Glottal	Articulated at the vocal folds.

Manner of Articulation

Plosive	An articulation involving three stages: (a) complete closure of the oral cavity blocking off the airstream, (b) compression of the airstream behind the blockage, (c) sudden release of the blockage.
Nasal	An articulation involving a complete blockage in the oral cavity allowing the airstream to escape through the nasal cavity.
Fricative	An articulation involving a narrowing in the oral cavity which results in audible friction of the airstream.
Affricate	A plosive with a fricative release.
Approximant	An articulation involving a narrowing in the oral cavity without resultant audible friction of the airstream.
Lateral	An articulation in which the airstream is allowed to escape along the sides of the tongue.
Flap/Tap	An articulation in which the tongue makes one rapid 'tap' against the alveolum or hard palate.
Trill	An articulation involving the rapid 'tapping' or 'tilling' of the tongue against the alveolum, or of the uvula against the back of the tongue.
Voiced/ Voiceless	Voiced sounds are articulated with vibration of the vocal folds; voiceless sounds are articulated without vibration of the vocal folds, for example the z in zoo is voiced whilst the s in sue is voiceless.

Place of Articulation → Manner of Articulation ↓	Bi- labial	Labio- dental	Inter- dental	Dental/ Alveolar	Alveo- palatal	Retroflex	Palatal	Velar	Labio- velar	Uvular	Pharyn- geal	Glottal
Plosive	p b			t d			c j	k g	kp gb	q g		ʔ
Nasal	m	ɱ		n			ɲ	ŋ	ɲm	ɴ		
Affricate	pf bv			ts dz	ɕ ʝ		ç ʝ̥	kx gy				
Central Fricative	ɸ β	f v	θ ð	s z	ʃ ʒ	ʂ ʐ	ç ʝ̥	x ɣ	ɸ β̥	χ ʁ	ħ ʕ	h ɦ
Lateral Fricative				ɬ ɮ								
Central Approximant		ʋ		ɹ			y	ɰ	w			
Lateral Approximant				l			ɻ					
Flap/Tap				ɾ						ɽ		
Trill				ʀ						ʀ		
Ejective	p'			t'				k'				
Implosive	ɓ			ɗ				ɠ				
Click	ǀ			ǁ			ǃ					

Figure 1

Horizontal position of tongue → Vertical position of tongue ↓	Front		Central		Back	
Close	i		ɨ		ɯ	
		ɪ				
½ Close	e					ɤ
			ə			
½ Open	ɛ					ɰ
		æ	ɐ			
Open			a		ɑ	

Figure 2: Vowels — Unrounded

Horizontal position of tongue → Vertical position of tongue ↓	Front		Central		Back	
Close	y			ɯ		u
		ɣ			ɔ	
½ Close	ø					o
			ɜ			
½ Open		œ				ɔ
Open			ɛ			ɒ

Figure 3: Vowels — Rounded

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