A Typological Comparison of Vowel Harmony Systems

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Abstract: Vowel harmony (VH) is a phonological process of assimilation where the vowels of a word assimilate based on one or more vocalic features, such as backness, height, roundness and so on. Vowel harmony systems vary greatly, and this study presents a typological comparison of the vowel harmony system features of 125 languages from 65 language families, with an added look at the relationship between VH and vowel inventory size, along with a look at genealogical and areal tendencies in VH systems.

The sample is a phenomenon-based sample of languages known to feature VH, which is stratified according to the Genus-Macroarea sampling method. The data comes from descriptive grammars, or in cases where these do not describe the VH system, other scientific articles on those languages’ VH systems. Data on the VH features of individual languages is gathered into an Excel spreadsheet and presented in the study as tables of the frequencies of the various features in the different language families and macroareas.

The most common types of VH in the study are tongue-root harmony, height harmony and complete harmony, each appearing in about thirty percent of the languages observed. Languages with VH in the study have larger vowel inventories than the non-VH languages in the WALS 200-language sample, suggesting a connection between VH and vowel inventory size. There are some strong areal and genealogical tendencies in the sample. An example of an areal tendency is that almost all African languages in the sample feature tongue-root harmony, which is rare outside of Africa. A genealogical tendency can be seen in the Uralic language family, where almost all languages feature backness harmony.

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1 Introduction

This study is a typological look at vowel harmony systems across the world's languages. Vowel harmony (VH) is an assimilatory process that typically involves the vowels of a word assimilating based on one or more vocalic features (Rose & Walker 2011, 251). For example, the VH system of Finnish is based on vowel backness, so words only contain either front vowels /y, ø, æ/ or back vowels /u, o, ɑ/, and suffixes attached to words will assimilate accordingly (*talossa*, *kylässä*). Vowel harmony famously occurs in many of the languages of Africa, the Turkic language family, and the Uralic family, where most Finnic languages feature it, as do all the Ugric languages, except for some dialects of some Ob-Ugric languages (Fejes 2022, 11; 40). Other vocalic features on which vowel harmony is commonly based are vowel height, roundness and [ATR] (Gordon & Fiddler 2024, 585). Van der Hulst (2016) refers to the features spread by harmony as *harmonic features*, and I will also adopt this useful term. Harmonic features will be explained in more detail in section 2.2.

Miestamo and Sinnemäki (2020) describe linguistic typology as a form of linguistics based on large-scale linguistic comparison with the goal of determining linguistic universals, tendencies, featural interdependencies, correlations and so on, as well as possible explanations for them. They highlight the symbiotic relationship between linguistic typology and research of individual languages, where typologists rely on language descriptions, and researchers of individual languages can, in turn, look to typological research for aid in analysis and contextualization.

To my knowledge, typological studies on vowel harmony are scarce. In fact, there does not even seem to be a definitive list of vowel harmony languages. VH research has largely been qualitative and theory-focused, but large-scale research has been comparatively lacking. One exception to this is a small portion of Gordon (2016, 134–137), which served as an inspiration for this study. In this, Gordon took the WALS 100-language sample and picked out the languages in it that had vowel harmony systems by going through their grammars and sorting them by their VH systems' harmonic features. The WALS 100-language sample is a sample of a hundred languages constructed with the intention of maximizing genealogical and areal diversity (Comrie et al. 2013). In Gordon (2016, 134–137), the total came up to 26 languages with VH systems, six of which had systems where the vowels assimilated for all vowel features (*complete harmony*). Second place was shared by backness and height harmony, both of which had five languages representing. Next were roundness and [ATR] with three languages each. There were also three languages in the sample that, according to Gordon, did not fit into the previous categories. These included the somewhat often (at least in the realm of vowel harmony research) referenced harmony system of Chukchi. However, Kenstowicz (2024) has analyzed Chukchi as featuring either [ATR] harmony or height harmony.

The aim of this study is to conduct a typological comparison of vowel harmony systems according to parameters that will be introduced in chapter 2. This will include investigating matters like which harmonic feature is most commonly the basis for vowel harmony, the nature of neutral vowels and the directionality of vowel harmony in the world's languages, as well as the effect of consonants on VH. I will also attempt to determine whether there is a correlation between large vowel inventories and vowel harmony. If there is a correlation, it could support Maddieson's (2013) speculation about VH being a way to manage the hearer's cognitive load in languages with large inventories. These questions will also be looked at in the context of possible areal and genetic tendencies within vowel harmony.

Thus, the main research questions of the study are, in their simplified forms:

1. What are vowel harmony systems of the world's languages like?
2. Does the presence of vowel harmony in a language predict large vowel inventories?
3. Are there areal or genetic tendencies within vowel harmony?

As they stand, these research questions are quite vague. More specific formulations of these questions will be given later in section 2.9, after necessary theoretical background has been covered.

Chapter 2 will go over the theoretical background of the study. This will include things like a definition of vowel harmony, an explanation of the vowel features on which VH is based, an exploration of the link between vowel inventories and vowel harmony, and so on. Chapter 3 will outline the methodology of the study, such as the sampling method, as well as the nature of the data studied and how it was collected. Chapter 4 will go over the results. Chapter 5 will include discussion on the study and its surrounding context. Chapter 6 summarizes the study.

2 Theoretical background

This chapter will cover theoretical background and key concepts relevant to the study. These include a more precise definition of vowel harmony, the individual harmonic features of vowel harmony systems, i.e. the vowel features spread in vowel harmony, the relationship between vowel harmony and vowel inventories, the issue of directionality in vowel harmony, neutral vowels, and the terms umlaut and metaphony.

2.1 A definition of vowel harmony

The first piece of theoretical background that needs to be established is a more robust definition of vowel harmony. Ritter & van der Hulst (2024b) question whether vowel harmony can even be called a unified class of phenomena with specific defining properties. They quote Archangeli & Pulleyblank (2007, 353), who write that the term VH is "a descriptor of a class of similar phenomena rather than a technical term referring to phenomena with a clearly defined set of properties." Ritter & van der Hulst agree, but since the term *vowel harmony* is so ubiquitous, they seek to delimit what the term tends to denote in practice in the literature. The definition they arrive at is as follows (Ritter & van der Hulst 2024b, 3):

> VH involves a vowel-to-vowel (V-to-V) *feature agreement* which applies across intervening consonants and, in many (some would say prototypical) cases, is *unbounded* within a certain domain, often the *word*.

The term *unbounded* here refers to *iterative harmony,* which means that in a situation where nothing is blocking harmony from spreading, all eligible target vowels will assimilate. This can be contrasted with *non-iterative harmony*, where only one target vowel assimilates, and *bounded iterative harmony*, where only a set number of vowels assimilates. (McCollum 2024, 118.)

Prototypical vowel harmony is often considered to be a phonological feature, first and foremost. Morphological conditioning for vowel harmony-like processes is thus often seen as disqualifying them from the category, but as said, the term vowel harmony is quite malleable, and Ritter & van der Hulst (2024a), for instance, includes discussion of many kinds of systems under the term, some less prototypical than others.

2.2 Harmonic features

Fejes (2022) uses the term *harmonic class* to denote the groups that vowels are divided into in VH systems. He points out, citing Anderson (1980, 7–9), that though this division is usually done based on a phonetic feature, this is not always the case. Fejes classifies systems for which there is no apparent phonetic feature basis as cases of *non-canonical vowel harmony*.

Languages may harmonize vowels based on more than one harmonic feature. Turkish, for example, features roundness harmony in addition to its backness harmony, though the former is considerably more limited than the latter, as it only affects high vowels in suffixes and clitics (Göksel & Kerslake 2005, 21–22).

Ritter & van der Hulst (2024a) presents descriptions of vowel harmony systems based on seven different vowel features: backness, roundness, height, tongue-root ([ATR]/[RTR]), laxing, nasality and rhoticity. These harmonic features will be looked at in detail below. There also exist harmony systems where the harmonizing vowels assimilate completely. That is to say, instead of assimilating based on a single feature, the vowel becomes identical to the trigger. This is called *total harmony*, *complete harmony* or *vowel copy*. Gordon (2024, 585) notes that complete harmony is considered by many not to be canonical vowel harmony. However, as this study features other types of edge-cases, such as metaphony and umlaut systems as well as other non-iterative systems, complete harmony is far from the most controversial inclusion in it. Additionally, Ritter & van der Hulst (2024a) features discussion of complete harmony quite prominently as a harmony system among others, so I find the inclusion of it in this study justified.

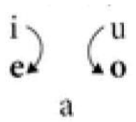
2.2.1 Backness harmony

Backness harmony (also called palatal harmony or front-back harmony) is based on the opposition between front vowels and back vowels, so vowels pronounced with the tongue in the front of the mouth form one harmonic class, which is in opposition to the harmonic class comprising of vowels pronounced with the tongue in the back of the mouth. Kisseberth & Kenstowicz (2024) give examples of languages with backness harmony, including Finnish, Turkish, Hungarian, Tuvan and Uyghur, among others. For example, in the Finnish harmony system, the back vowels /ɑ, o, u/ contrast with the front vowels /æ, ø, y/, respectively. Words containing front vowels, such as *kylä* ‘village’, receive the front vowel allomorphs of suffixes while words that contain back vowels, such as *talo* 'house' receive back vowel allomorphs, such as in the inessive case *kylä-ss**ä**, talo-ss**a**,* or in the partitive case *kylä-**ä**, talo-**a**.*

2.2.2 Height harmony

Height harmony is based on the height of vowels, also known as the closeness or openness of vowels. This refers to the position of the tongue in the mouth on the height-axis, so vowels pronounced with the tongue high, i.e. close to the roof of the mouth are called high or close vowels. This includes vowels like /i, y, u/. By contrast, low or open vowels are pronounced with the tongue at the bottom of the mouth. This includes vowels like /ɑ, a/. Goad (2024), citing Beckman (1997), gives the following example of Shona height harmony, where high vowels assimilate to the height of preceding mid vowels.

(1) Shona: Height harmony (Goad 2024, 69; citing Beckman 1997, 1–2)



a.	[bvum-isa]	'make agree'
b.	[tond-esa]	'make to face'
c.	[ʃamb-isa]	'make wash'
d.	[tʃejam-isa]	'make be twisted'

Height harmony appears in many languages globally (Goad 2024), some examples in this study include the African languages Hadza and Tigré, the Australian language Djingili, and the Papunesian language Umbu-Ungu.

2.2.3 Roundness harmony

Roundness (or rounding) harmony is based on the opposition between rounded and unrounded vowels, i.e. vowels pronounced with the lips pursed, such as /y, ø, o/ and vowels pronounced without pursing one's lips, such as /i, e, ɤ/. Kaun & McCollum (2024) highlight some common features of rounding harmony systems, such as parasitic harmony, which requires the trigger vowel to be of the same height as the target vowel. This is the case in Yawelmani, for instance. They posit that this tendency of rounding harmony stems from the fact that "the gesture associated with lip rounding is particularly dependent on the position of other articulators, particularly jaw height," (Kaun & McCollum 2024, 66; citing Linker 1982) and thus a harmony system requiring lip rounding of vowels of different heights would be cumbersome and disincentivized. They also mention cases of rounding harmony being similarly conditioned by other vowel features, such as backness, tongue root position and length. Examples of these are Yadu Qiang, the Fante dialect of Akan, and Baiyina Orochen, respectively. Kaun & McCollum (2024) give an example of Kyrgyz roundness harmony, which does not have any restrictions on it pertaining to features other than the roundedness or unroundedness of the harmonizing vowels. They note that systems like this are rare, and that far more commonly, some kind of constraint unrelated to roundness is imposed either on the trigger, the target, or both.

(2) Kyrgyz: Roundness harmony (Kaun & McCollum 2024, 62)

a. bir-intʃi one-ORD	b. ytʃ-yntʃy three-ORD	c. beʃ-intʃi horse-ORD	d. tœrt-yntʃy four-ORD
e. iʃ-ten work-ABL	f. yj-dœn house-ABL	g. alma-dan apple-ABL	h. kœl-dœn lake-ABL

Gordon & Fiddler (2024, 589) speculate that this tendency of roundness harmony to co-occur with other harmonic features rather than being the only harmonic feature to be a function of it being "somehow less basic than other harmony types."

2.2.4 Tongue-root harmony

The tongue-root vowel feature refers to the position of the root of the tongue during the pronunciation of a vowel. Harmony based on this feature can be split into two types: Advanced Tongue Root or [ATR] harmony and Retracted Tongue Root or [RTR] harmony, the difference between the two being whether the active feature, i.e. the feature being spread, is [ATR] or [RTR] (Krämer 2003, 8). [ATR] signifies that the root of the tongue is further forward in the mouth, while [RTR] signifies the opposite. The following example illustrates [ATR]-harmonization of the infinitive and first person singular perfect markers in Lese, which harmonize based on the tongue-root value of the stem. Examples (3a, 3b) feature [-ATR] verb roots and (3c, 3d) feature [+ATR] verb roots.

(3) Lese: [ATR] harmony (adapted from Lojenga 2024, 615)

a. ɪ-kɔ̀ga INF-steal	b. mʊ-kɔ̀gà PERF.1.SG-steal
c. i-tèni INF-say	d. mu-tènì PERF.1.SG-say

The tongue-root opposition is sometimes compared to the lax-tense opposition, and while the features sound similar perceptually (Schane 1990), the articulatory gestures are different. [ATR] has also been said to simply be a function of vowel height, but according to Ladefoged and Maddieson (1996, 300), this is not the case, as in Igbo, for example, the tongue-root-opposed vowels do not differ in tongue height. [ATR] harmony is noted to be particularly common in the Atlantic-Congo language family (or the so-called Niger-Congo phylum) of Africa, especially in members of it that feature large vowel inventories. The link between [ATR] harmony and certain kinds of vowel inventories is explored further in section 2.3.

2.2.5 Laxing harmony

Ladefoged and Maddieson (1996, 300–306) found that, in contrast to the tongue-root opposition, what are referred to as tense-lax pairs in English, /i, ɪ/ (like in *sheep* and *ship*, respectively) and /u, ʊ/ (like in *boot* and *hook*, respectively), did have differences in backness and height, with the tense vowels /i, u/ being higher than the lax ones /ɪ, ʊ/. (Ladefoged & Maddieson 1996, 300–306.) Henriksen & Kendro (2024, 94) differentiate laxing harmony from [ATR] harmony with the criterion that laxing harmony “creates a [±tense] contrast that otherwise does not occur in a certain language variety.” This contrasts with [ATR] harmony, which is always based on an already-existing contrast between [+ATR] and [-ATR] vowels in a language. They give examples of language varieties with this kind of laxing harmony, such as Laurentian French and Eastern Andalusian, Murcian and Cantabrian Spanish. The following example demonstrates laxing harmony in Cantabrian Spanish, where it is triggered by “lexemes containing a lax vowel in a word-final open syllable” (Henriksen & Kendro 2024, 98; citing van der Hulst 2018, 435–436), in this case the word-final /ʊ/ in (4a, 4c, 4e).

(4) Cantabrian Spanish: Laxing harmony (Henriksen & Kendro 2024, 98; citing McCarthy 1984)

a.	cántarO [ˈkæn.tæɾʊ] five-gallon jug.SG	b.	cántarOs [ˈkan.ta.ɾus] five-gallon jug.PL
c.	soldadO [sɔl.ˈdæ.ʊ] soldier.SG	d.	soldadOs [sol.ˈda.us] soldier.PL
e.	hermanO [eɾ.ˈmæ.nʊ] brother.SG	f.	hermanOs [eɾ.ˈma.nus] brother.PL

2.2.6 Nasal harmony

Nasal harmony is based on the distinction between nasalized and non-nasalized (oral) sounds. Nasalized vowels are pronounced with more airflow through the nose than oral ones (Ladefoged & Maddieson 1996, 298–300). Familiar examples of nasalized vowels may be French /ɔ̃/ and /ɛ̃/ in the words *bon* /bɔ̃/ and *bien* /bjɛ̃/. Botma (2024, 37; citing Clements & Osu 2003, 71) offers some criteria for a language to qualify as having nasal harmony: "nasalization must cross syllable boundaries, nasality must be contrastive at the level of the morpheme, and there must be alternating oral and nasal forms." Botma (2024) gives examples of languages that fit these criteria, such as Guaraní and Tuyuca. Nasal harmony often involves consonants as well as vowels, but vowels are first in the implicational scale of targets for nasal harmony, presented in Botma (2024, 42):

(5) Implicational scale of segment nasalizability
vowels > laryngeals > glides > liquids > fricatives > stops

Nasal consonants are commonly the primary triggers for nasal harmony, in that the starting point for nasal harmony is the assimilation of non-nasalized sounds to the nasality feature of a nasal consonant. However, in some cases, the original nasal consonant has been lost, leading to situations where nasal harmony is triggered without a nasal consonant, such as in the following example. (Botma 2024.)

(6) Capanahua (Pano-Tacanan): Nasal harmony without overt nasal consonant trigger (adapted from Botma 2024, 39)

/pojan/	[põj̃ã]	'arm'
/wɨran-wɨ/	[wɨrãw̃ɨ̃]	'push it over'
/wɨran-jaʃaʔn-wɨ/	[wɨrãj̃ãʃãʔ̃w̃ɨ̃]	'push it over sometime'

2.2.7 Rhotic harmony

Rhotic harmony is based on the distinction between rhotic (also called r-colored) vowels and non-rhotic vowels. Ladefoged & Maddieson (1996, 313) note, citing Maddieson (1984), that these vowels are very rare and occur in less than one percent of the world's languages, but they are still quite well-known, as they are featured in some forms of English and Chinese. They describe rhotic vowels as being connected not by their manner of articulation but rather their acoustic properties, namely a lowered frequency in the third formant. They describe the variation in the articulation of these sounds: "Sometimes these sounds are produced with the tip of the tongue up, and sometimes with it down; often the tongue is bunched up in the anterior-posterior direction; and there is usually a narrowing of the vocal tract in the region of the epiglottis." They give the American English pronunciation of words like *herd* as an example of rhotic vowels, where the vowel before /ɹ/ takes on a rhotic coloring. (Ladefoged & Maddieson 1996, 313–314). This could be transcribed in the IPA as /hɚɹd/. Smith (2024) gives four examples of languages with rhotic harmony: Kalasha (Indo-European, spoken in South Asia), Serrano (extinct Uto-Aztecan language, spoken in Southern California), Yurok (Algic, spoken in Northern California), Yonghe Qiang (Sino-Tibetan, spoken in China). The following example demonstrates rhotic harmony in Yonghe Qiang:

(7) Yonghe Qiang: Regressive and progressive rhotic harmony (Smith 2024, 108)

a. Leftward (regressive) harmony:

/pææ/ +	/hæ˞/	>	/pæ˞æ˞-hæ˞/
'pig'	'grass'		'pigweed'

b. Rightward (progressive) harmony:

/kʰɑ˞/ +	/pu/	>	/kʰɑ˞-'pu˞/
'Ka'er'+	'village'		'Ka'er Village'

2.3 Vowel harmony and vowel inventories

Maddieson (2013) proposes a link between vowel harmony and large vowel inventory size. In his view, the presence of vowel harmony may ease the hearer's cognitive load in discriminating vowels, because the number of possible vowels in a word is limited by the harmony system. He points out an area in Africa between the Equator and the Sahara, where there seems to be a correlation between large vowel inventories and the presence of vowel harmony. This area is termed the Macro-Sudan Belt by Rolle, Faytak & Lionnet (2020), who have done extensive quantitative research into vowel harmony systems in the area with regard to vowel inventories, though their focus is not on inventory size, but rather on whether a given inventory contains *interior vowels*, which they define as "those vowel qualities typically associated with formant frequencies that are less extreme than peripheral vowels," which includes "front rounded vowels, all non-low central vowels, and unrounded non-low back vowels" (Rolle, Faytak & Lionnet 2020, 139) They found that the presence of these vowels correlates negatively with [ATR] harmony in the languages of the Macro-Sudan Belt. They also found that [ATR] harmony is disproportionately present in this area and deem it a characteristic feature of it. This areal effect seems to be independent of genealogy, as there are multiple large language families in the area that prominently feature [ATR] harmony.

Another large-scale quantitative study into the Macro-Sudan Belt's harmony systems was done by Rose (2018), who found that if a language has [ATR]-contrastive high vowels, it is very likely to feature [ATR] harmony. This, she suggests, is because high vowels have very similar values of F1 (the "height formant"), which is also the main discriminatory cue for [ATR] distinctions. This perception-based explanation resembles Maddieson's point. However, it must be pointed out that VH languages do not necessarily have large vowel inventories, as Djingili, for example, only has three vowels (Pensalfini 2002, 564), yet also features VH.

2.4 Dominant-recessive harmony

The oft-discussed languages Chukchi and Nez Percé feature harmony systems based on harmonic feature dominance. It is referred to as dominant-recessive harmony, as the harmony opposition is between dominant vowels, which in Chukchi are /e, o, a/ and recessive vowels, which in Chukchi are /i, u, e/. Each vowel is paired with one from the opposite group, so that the recessive /i/ is paired with the dominant /e/, the recessive /u/ with the dominant /o/, and the recessive /e/ with the dominant /a/. The presence of a dominant vowel always causes a shift in all the recessive vowels in a word to their respective dominant pairs. This is conveniently demonstrated with the word for 'rabbit', *milute*, which contains only recessive vowels. When declined in the comitative case with the circumfix *(ɣ)a- . . . -ma*, which contains dominant vowels, it is realized as *ɣa-melota-ma*, where the recessive /i, u, e/ have shifted into the dominant /e, o, a/, respectively. (Gordon 2016, 134–137.) The harmonic feature of the harmony system is a separate question from its dominant-recessive feature, which is related to the manner in which harmony is spread. In the case of Chukchi, the harmonic feature has been suggested to be [ATR] or height (Kenstowicz 2024).

2.5 Directionality and locality

The *directionality* of vowel harmony refers to vowel harmony systems with a set direction in which harmony spreads. Mahanta (2024) lays out three types of directionality, the first of which is the root-outward system, where the direction of harmony spreading is controlled by the root/stem of a word and spread either progressively (from the stem to the suffix), regressively (from the stem to the prefix) or bidirectionally (from the stem to both the suffix and the prefix). The second type is the dominant-recessive system, where the dominant feature value (for example, [ATR]) can be spread from either the stem or an affix and is usually spread bidirectionally. In some languages with this system, it is possible for multiple harmonic features to spread in different directions in one word. The third type consists of systems which do not fit into either of the two previous categories. The overwhelming majority of these systems feature regressive harmony, which can, depending on the language, be triggered either by vowels of the root or suffix or both. Of these directionality types, this last one is the rarest, and was, until somewhat recently, unknown. The most common type, on the other hand, is the root-outward type. (Mahanta 2024.)

Mahanta (2024) mentions that in the past, directionality was assumed to always be bidirectional, and systems where bidirectionality could not be directly observed were assumed to simply be limited by some morphological or phonological factor. That is to say, the bidirectionality was underlying, but not visible on the surface. This led to the assumption that any apparent directionality was merely epiphenomenal, and there was no need to specify a harmony system's directionality. However, with the discovery of purely regressive systems in the early 2000s, this assumption was weakened. (Mahanta 2024.)

In comparing progressive and regressive harmony, Mahanta (2024) discusses a possible regressive bias in vowel harmony and cites artificial learning experiments conducted by Finley and Badecker (2009) as evidence. They found that while root-outward systems did not seem to have a bias either way, affix-controlled systems could only have prefixes trigger harmony if suffix triggers were also present, but suffix triggers did not have the same requirement.

In this study, I refer to the features *progressive, regressive* and *bidirectional* as *directionalities* of harmony. The features *root-outward, affix control* and *dominant-recessive* I refer to as *controllers* of harmony, as they describe what parts of the word can trigger harmony. This distinction is relevant as languages can mix and match different directionalities and controllers. Some languages also have harmony systems that are stress-based or limited to the word stem. I group these in with the controller feature, even though the *limited to word stem* -feature, and possibly *stress-basedness*, might more accurately be called domain features – that is, how far vowel harmony can spread in a language – rather than controller features.

These are, however, quite rare in the sample and fit in well enough with the controller features, so dedicating an entire new category to them is unnecessary.

2.6 Neutral vowels

Neutral vowels are vowels that are immune to the effects of vowel harmony and may occur together with vowels from either harmonic class. Neutral vowels come in two types.

Opaque neutral vowels stop the spread of harmony from one end of the word to the other, so words on either side of the opaque vowel can be from different harmonic classes (van der Hulst 2016). Krämer (2024) gives an example of the effect of an opaque vowel in Turkish, where non-high unrounded vowels block rounding harmony:

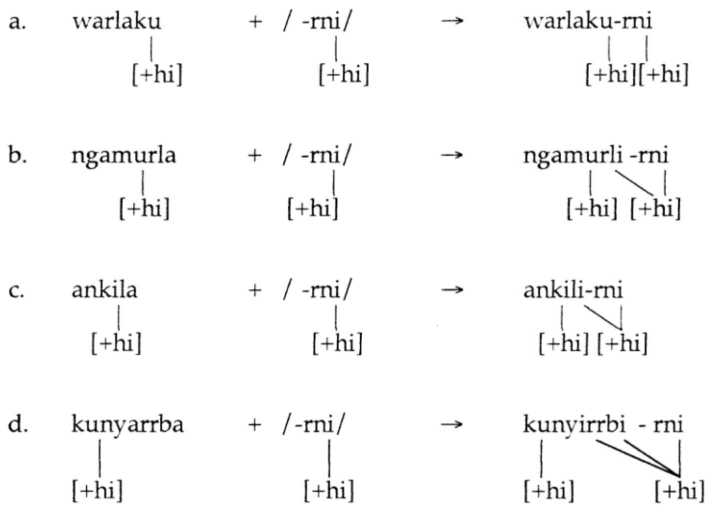
(8) Turkish: Opaque /e/ blocking progressive rounding harmony (Krämer 2024, 251)

køj-ler-in	køj-yn
village-PL-GEN	village-GEN

In the word on the left, the mid front unrounded vowel /e/ in the plural marker *-ler* blocks the rounding harmony from the root vowel /ø/, which is not let through to the genitive marker *-in*, while in the word on the right, rounding harmony reaches the genitive marker, which is realized as *-yn*.

A curious feature relating to opaque vowels can be observed in the Australian language Djingili. While all its vowels are either targets or triggers of harmony, high vowels in the language act both as triggers and blockers of height harmony (Pensalfini 2002).

(9) Djingili: High vowels acting as both triggers and blockers of height harmony (Pensalfini 2002, 565)



This curiosity makes it somewhat difficult to classify whether Djingili has neutral vowels or not, since the high vowels block harmony in the manner of an opaque neutral vowel, yet they also trigger harmony, which neutral vowels cannot do. However, as none of the vowels in the language are truly neutral in the sense of refusing to harmonize, I will analyze the language as simply having no neutral vowels with the caveat that some of them have features commonly associated with neutral vowels.

Transparent neutral vowels, on the other hand, will allow harmony to spread past them (van der Hulst 2016). To illustrate, the neutral vowels of Finnish /i, e/ are transparent, so a word whose stem contains a back vowel, like *koti,* when declined in the inessive case, produces *kodissa* ‘in the home’, which contains the back vowel allomorph of the *-ssA* inessive marker, even though the vowel /i/ is phonetically a front vowel.

2.7 Consonants and vowel harmony

In some languages, consonants have a considerable effect on the functioning of vowel harmony. Consonants are also sometimes targets of harmony, whether vowel harmony or consonant harmony. However, as this study is about vowel harmony, it will only focus on the interaction between consonants and vowel harmony in cases where the consonants have some effect on the vowel harmony, disregarding harmony effects on the consonants.

The best-known type of harmony-affecting consonant is the opaque consonant, which acts like the opaque neutral vowels discussed in 2.6. According to Hansson (2024, 19), these consonants most commonly have “phonetic properties that relate to the harmony feature in some way”. Hansson (2024) divides opaque consonants into *antagonistic blockers* and *sympathetic blockers,* adapting van der Hulst’s (2018) terminology for transparent segments. Antagonistic blockers have a feature contrary to the harmonic feature. Hansson gives the following example from Warlpiri, where unrounding harmony is blocked by labials, in this case /p/:

(10) Warlpiri: Opaque labial consonant /p/ (Hansson 2024, 20)

/milpiɾi-puɻu/ → [milpiɾ**ipu**ɻu] ‘cloud-during’, not *[milpiɾ**ipi**ɻi].

Sympathetic blockers act in the opposite way, in that they share the phonetic feature being spread (Hansson 2024). Of this, Hansson cites an example from Casali (1995) of the language Nawuri, where rounding harmony is blocked by all labial consonants except /w/, which is instead a trigger for rounding harmony. The opaque consonants are thus the labials /p, b, f, m/ and the labial-velars /k͡p, g͡b/.

(11) Nawuri: Interference of labials in regressive rounding harmony (Hansson 2024, 22; citing Casali 1995)

a. Harmony across non-labial C

gɨ-keːliː	‘kapok tree’	gu-kuː	‘digging’
gɨ̞-sɨ̞bɨ̞taː	‘sandal’	gʊ-lɔː	‘illness’

b. Harmony blocked by labial C

gɨ-boːtoː	‘leprosy’	(*gu-boːtoː)
gɨ-fufuli	‘white’	(*gu-fufuli)
gɨ-k͡poː	(type of dance)	(*gu-k͡poː)

c. Harmony triggered by /w/ and non-labial Cʷ

gʊ-wɛː	‘sympathy’	kʊkʷɪː	‘different’
gʊ-waː	‘doing’	sʊsʷaː	‘to grease’

d. No harmony triggered by labial Cʷ

gɨ̞-pʷɛː	‘guilt’	(*gʊ-pʷɛː)
gɨ̞-bʷaːruː	‘water yam’	(*gʊ-bʷaːruː)
gɨ̞-fʷɪː	‘bodily gas’	(*gʊ-fʷɪ)

Hansson (2024) notes that there are some systems that cannot be categorized as either antagonistic or sympathetic. These are most often tongue-root or height harmony systems. In these systems, sonorants and continuants are often blockers. (Hansson 2024.)

Another role that consonants play in vowel harmony is that of triggers. That is, they initiate a harmonic shift where there otherwise would not be one. In Nawuri, for example, the labiovelar approximant /w/ triggers rounding harmony, being labial itself. Hansson (2024) notes that trigger consonants are almost always approximants or have some kind of secondary articulation feature, such as palatalization or labialization.

2.8 Metaphony and umlaut

My sample contains some languages described as having *metaphony* or *umlaut* systems. These phenomena are considered by some to be edge-cases, if not wholly outside the purview of vowel harmony (Anderson 1980, 3; Hansson & Wiese 2024, 864; Nikulin 2024, 709), but they are included in the discussion in Ritter & van der Hulst (2024a), with Romance metaphony and Germanic umlaut receiving a whole chapter each, so I think including them in this study is justified. In fact, Calabrese (2011, 2631) points out, citing Anderson (1980, 43), that "the formal mechanism characterizing metaphony is not distinct from that underlying other sorts of vowel harmony", and that the only factors that separate it from other kinds of vowel harmony are that metaphony only targets stressed vowels and always spreads a height feature ([high], [low] or [ATR]). Calabrese's categorizing [ATR] as a height feature is somewhat problematic, as explored in 2.2.

According to Calabrese (2011, 2631), the term metaphony traditionally refers to "a process in which a vowel assimilates partially or totally to the height of a following vowel," the assimilating vowel being a stressed vowel. The direction here is regressive. Example (4) illustrates this.

(12) Antrodoco (Italo-Romance): Regressive vowel raising targeting stressed vowel, i.e. typical metaphony (Mascaró 2024, 85; citing Scorretti 2012)

s**ɛ́**nt-o	s**é**nt-i	hear-PRS.1SG/2SG
k**ɔ́**ggj-o	k**ó**ggj-i	collect, take-PRS.1SG/2SG
v**é**nn-o	v**í**nn-I	sell-PRS.1SG/2SG
k**ó**rr-o	k**ú**rr-i	run-PRS.1SG/2SG

Mascaró (2024), however, points out that other metaphony configurations also exist. In some varieties of Valencian Catalan, for example, metaphony is triggered by the stressed vowel and targets the following final vowel, reversing the usual order.

(13) Valencian Catalan (Ibero-Romance): Progressive vowel raising triggered by stressed vowel (Mascaró 2024, 86)

pér-a	pear-F.SG	tɛ́r-ɛ	earth-F.SG

tót-a all-F.SG kɔ́z-ɔ thing-F.SG

Other configurations also exist, though these are rarer. Two Asturleonese dialects of Spanish, Tudanca and Pasiego, feature metaphony triggered by the stressed vowel and targeting the unstressed vowel preceding it. By contrast, the Saracena dialect (Italo-Romance) features metaphony targeting the stressed vowel and triggered by the unstressed vowel preceding it. Within Italo-Romance, there are also cases of harmony being limited to two unstressed vowels on either side of the stressed vowel, usually involving complete harmony rather than mere vowel raising. Complicating things further, there is also bidirectional spreading in the Vinalopó Mitjà dialect of Valencian Catalan. (Mascaró 2024.)

The term metaphony is used specifically in Romance linguistics, whereas similar phenomena elsewhere are usually called umlaut, which can cause assimilation based on other features in addition to height, such as backness and roundness (Mascaró 2024; Hansson & Wiese 2024). The term originates from Germanic linguistics but has been applied to various languages from other language families and parts of the world.

2.9 Research questions revisited

The research questions given in chapter 1 were:

1. What are vowel harmony systems of the world's languages like?
2. Does the presence of vowel harmony in a language predict large vowel inventories?
3. Are there areal or genetic tendencies within vowel harmony?

Now that sufficient theoretical background has been established, the questions can be made more specific with sub-questions.

1. What are vowel harmony systems of the world's languages like?
    a. What harmonic features do vowel harmony systems have?
        i. How common is each harmonic feature?
    b. How do neutral vowels behave?
        i. How common are neutral vowels?
    c. How does the directionality of vowel harmony behave?
        i. How common is each directionality feature?
    d. How do consonants affect vowel harmony?
        i. How common are consonant effects on vowel harmony?

2. Does the presence of vowel harmony in a language predict large vowel inventories?
    a. Are larger vowel inventories more common within vowel harmony languages than without?
3. Are there areal or genetic tendencies within vowel harmony?
    a. Do the macroareas or language families have different tendencies pertaining to the previous questions?

3 Methods and materials

To ensure the representativeness of a study, especially a typological one, care must be taken to ensure that the data with which the research is conducted is derived from a balanced sample of languages. The measures taken to achieve this are described in this chapter, as well as the data itself and the methods of analysis.

3.1 Sampling method

Miestamo et al. (2016), citing Rijkhoff et al. (1993, 171), offer a rough division of typological sampling methods: variety sampling and probability sampling. Variety sampling, as the name suggests, is used for finding as much cross-linguistic variation of a given feature as possible, while probability sampling is used for statistical testing of tendencies and correlations. A requirement for probability sampling is the genealogical and areal independence of the languages in the sample, which poses a challenge, as the larger the sample gets, the harder it gets to control the independence of the languages. Miestamo et al. quote Perkins (1989, 312), who recommends around a hundred languages as a sweet spot between representativeness and independence for probability samples. Variety sampling, by contrast, places less emphasis on independence, as the need for independence is caused by the statistical tests that probability samples are intended for, which variety samples sidestep. (Miestamo et al. 2016, 233–237.) A newer way to sidestep the necessity for independence when sampling for quantitative analysis is to use statistical modeling, which allows for the sample to contain many languages and even dependencies and still gives reliable results.

As the vowel harmony feature does not exist in every language, and there is no definitive list of languages with vowel harmony, the sample used in this study is a Phenomenon Sample (PS), as proposed by Miestamo (forthcoming), where instead of simply taking a sample from all the world’s languages, the sample consists of the subgroup of the world’s languages that are known to feature vowel harmony. This eliminates the unfortunate possibility that I take a sample of fifty languages, take the time to go through all of their grammars, and find that only ten of them even feature vowel harmony, leaving me with little data and little time to take another sample. The lack of a comprehensive list of VH languages, on the other hand, means that the sample may be limited to something of a surface glance, as I have had to compile an incomplete list myself from existing vowel harmony literature, since a truly comprehensive list is far beyond the scope of this study. This may bias the data towards more well-known

VH languages or more interesting harmony systems. This initial list of known VH languages is the Phenomenon Sample.

The Phenomenon Sample is stratified according to the Genus-Macroarea sampling method presented in Miestamo et al. (2016), which is a variety sampling method based on stratification with the concepts of the *genus* and the *macroarea*. These concepts will be explained below, along with the GM method.

Miestamo et al. (2016, 238–240) describe Dryer's (1989) concept of the *genus* as "a level of genealogical classification intended to be comparable across the world in terms of time depth," that time depth being 3 500 to 4 000 years. It is essentially the earliest genealogical split that is not older than 3 500 to 4 000 years. They give the example of the branches of Indo-European, which are all different genera, because they split off from Proto-Indo-European more than 3 500 to 4 000 years ago. In other words, they do not have any common ancestors that date back earlier than that. Dryer (1989, 267) notes that "in some areas of the world, these genera are the maximal level of grouping whose genetic relationship is uncontroversial," and that languages within the same genera tend to be typologically similar. These combined factors make the genus concept quite useful for typological research. Another factor that makes it useful is, as pointed out in Miestamo et al. (2016, 248), the aforementioned crosslinguistic comparability in terms of time depth, as it ensures variation between the sampled languages, since the genera they belong to have split so long ago.

Dryer's (1989) *macroareas* are described in Miestamo et al. (2016, 240) as "continent-size linguistic areas which are independent of each other, but within which languages are to some extent typologically similar due to either (ancient) contact or (very deep) genealogical affinity, beyond the reach of the methods of historical linguistics." They relay the six macroareas proposed by Dryer (1992): Africa, Eurasia, Southeast Asia & Oceania, Australia & New Guinea, North America, and South America. (Miestamo et al. 2016, 240–241.)

In its simplest form, in cases where the sample size has not been predetermined, the Genus-Macroarea sampling method merely involves sampling one language from all of the world's genera, of which there are over six hundred and can be found in WALS (Dryer & Haspelmath 2013). This sample is called the Genus Sample (GS). In cases where this is not possible, due to limited data on some genera, one takes a subsample of the GS: a Core Sample (CS). This CS sample contains all of the languages in the GS that have usable data on the feature being studied. This can then be stratified with macroareas. This means the more genera (i.e.

genealogical diversity) a macroarea has, the more genera it will have in the sample relative to the other macroareas. This is called the Restricted Sample (RS), and it makes the sampling method suitable for quantitative generalizations in addition to the variety it can find. If variety is the only concern instead of quantitative generalizations, one can add in languages by hand, so to speak, to add to the variety, if one knows there are feature types missing in the sample, for example. This is called an Extended Sample (ES). (Miestamo et al. 2016, 247–260.)

The initial VH language list from which the Genus Sample is picked includes as many vowel harmony languages as I have been able to find. The languages in the list were gathered into an Excel sheet along with their language families, genera and macroareas. From these, I selected the languages that were used in the sample. Each genus has one representative language in the sample. Typically in the GM method, stratification according to genealogical diversity would be done by balancing the number of genera from each macroarea in the sample based on the total number of genera in that macroarea, so that macroareas with a lot of genera (i.e. genealogical diversity) receive more genera in the sample. This is called the Restricted Sample.

For this study, stratification is difficult because of the confluence of two factors. The sample is phenomenon-based, which complicates the process, and makes stratification based on the number of genera with vowel harmony in each language family observed an attractive solution. However, most of the families in the sample (50 of 65) receive only one genus in the Core Sample, which makes the family-based stratification less suitable. Because of these complications, I present two separate Restricted Samples. Restricted Sample 1 (RS1) is stratified based on the number of genera with VH in each family, and Restricted Sample 2 (RS2) is stratified based on the number of genera with VH in each macroarea. The languages in this sample are chosen randomly, as in the family-based RS1, but with the caveat that every family is represented at least once before any family gets a second representative.

Table 1. Languages, genera and families in each sample.

	Phenomenon Sample	**Genus Sample**	**Core Sample**	**Restricted Sample 1 (based on number of genera with VH in each family)**	**Restricted Sample 2 (based on number of genera with VH in each macroarea)**
Languages	428	187	125	75	80
Genera	188	187	125	75	80
Families	99	96	65	65	65

To maximize the usefulness of the Genus Sample, the language chosen in the initial pass to represent the genus was the one expected to have the most available data. In cases where a genus contained multiple VH languages, and the one chosen to represent the genus in the initial pass did not have sufficient usable data, I tried to find a language from the same genus that did. This does not mean that the Core Sample is eliminated, however, as this extra refinement of the sample does not guarantee data for all of the languages in the Genus Sample, even for genera with multiple members. This also does not jeopardize the sample because I am primarily counting genera rather than individual languages. Furthermore, the sample is a phenomenon-based one, so all the possible languages observed feature vowel harmony, and this study is primarily not concerned with how common vowel harmony is overall. Refining the sample in this way may help to better represent less-extensively studied genera, as these are the ones where this refinement was necessary. However, it may also compound the possible bias towards more well-known VH languages or more interesting harmony systems mentioned earlier, just within the more obscure genera, which otherwise would not even be represented.

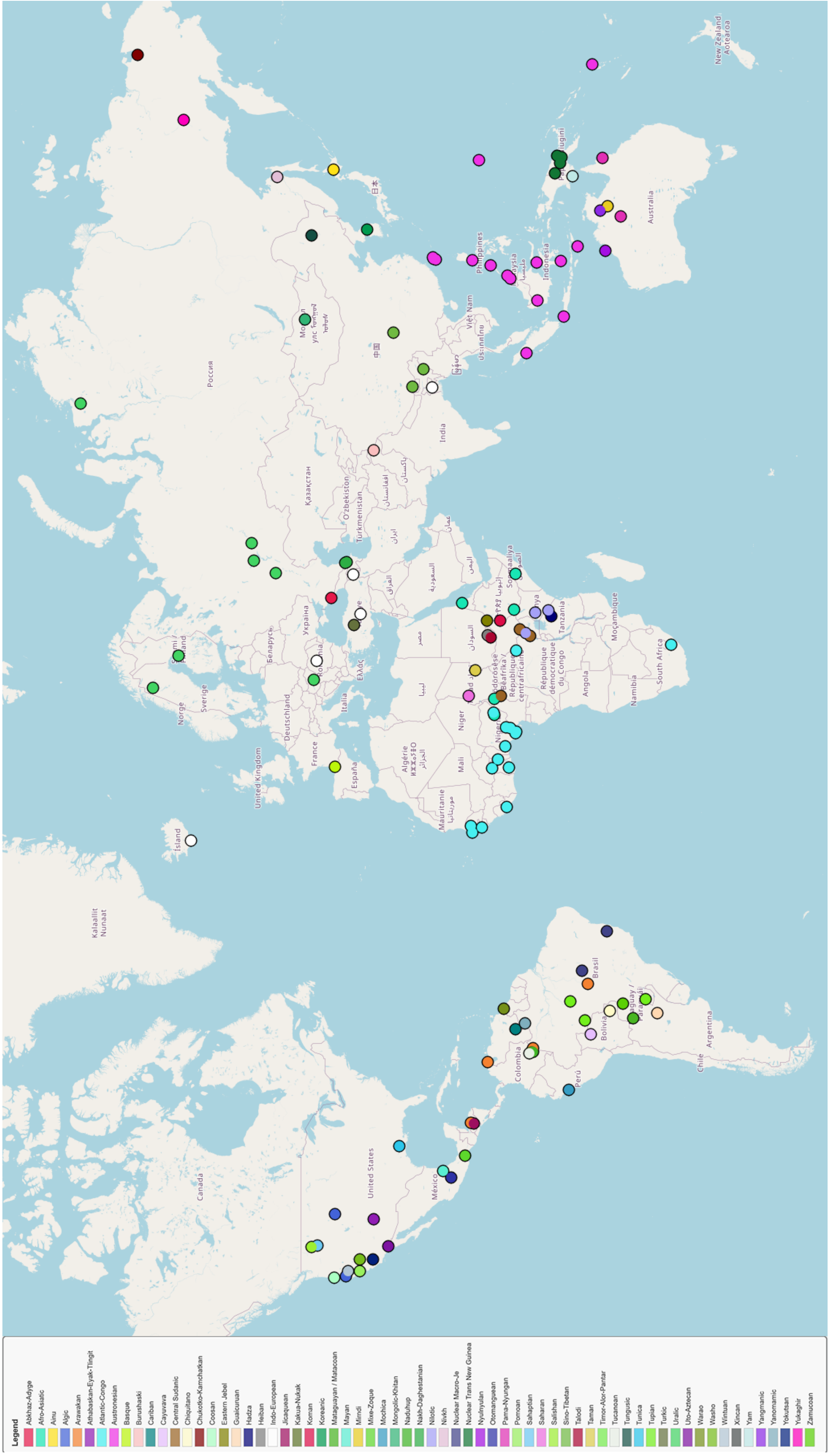


Figure 1. Core Sample (CS) by language family.

The Core Sample has 125 genera from 65 different families. 50 of the families in the sample have only one genus with vowel harmony. In fact, 40 families in the sample have only one genus in all.

Table 2. Genera in CS and RS1 by language family. Genera counts deviating from those of WALS have been marked with an asterisk and are based on comparison with Glottolog. These are expounded upon in appendix C.

Family	Genera in family	Genera in GS	Genera in CS	Coverage	Genera in RS1 (based on number of genera with VH in each family)
Abkhaz-Adyge	1	1	1	100%	1
Afro-Asiatic	16	8	5	31.3%	1
Ainu	1	1	1	100%	1
Algic	3	2	2	66.7%	1
Arawakan	11	5	4	36.6%	1
Athabaskan-Eyak-Tlingit	3	1	1	33.33%	1
Atlantic-Congo	56*	28	15	26.8%	5
Austroasiatic	12	1	0	0%	0
Austronesian	31	17	15	48.4%	3
Basque	1	1	1	100%	1
Bororoan	1	1	0	0%	0
Burushaski	1	1	1	100%	1
Cariban	1	1	1	100%	1
Cayuvava	1	1	1	100%	1
Central Sudanic	7	6	3	42.9%	1
Chimakuan	1	1	0	0%	0
Chiquitano	1	1	1	100%	1
Chukotko-Kamchatkan	2	1	1	50%	1
Chumashan	1	1	0	0%	0
Coosan	1*	1	1	100%	1
Dajuic	1*	1	0	0%	0
Dravidian	1	1	0	0%	0
Eastern Jebel	1*	1	1	100%	1
Furan	1	1	0	0%	0
Guaicuruan	3	1	1	33.3%	1
Hadza	1	1	1	100%	1

Heiban	1*	1	1	100%	1
Huavean	1	1	0	0%	0
Ijoid	1	1	0	0%	0
Indo-European	11	5	5	45.5%	1
Jicaquean	1*	1	1	100%	1
Kadu	1	1	0	0%	0
Kakua-Nukak	1	1	1	100%	1
Kartvelian	1	1	0	0%	0
Karuk	1*	1	0	0%	0
Katla-Tima	1*	1	0	0%	0
Keresan	1	1	0	0%	0
Khoe-Kwadi	1	1	0	0%	0
Klamath-Modoc	1*	1	0	0%	0
Koman	1	1	1	100%	1
Koreanic	1	1	1	100%	1
Lencan	1*	1	0	0%	0
Maban	1	1	0	0%	0
Maiduan	1*	1	0	0%	0
Mande	2	2	0	0%	0
Mangarrayi-Maran	2	1	0	0%	0
Matacoan	1	1	1	100%	1
Mayan	1	1	1	100%	1
Mirndi	3	1	1	33.3%	1
Miwok-Costanoan	2*	1	0	0%	0
Mixe-Zoque	1	1	1	100%	1
Mochica	1	1	1	100%	1
Mongolic-Khitan	1	1	1	100%	1
Naduhup	1	1	1	100%	1
Nakh-Daghestanian	6	3	2	33.3%	1
Natchez	1	1	0	0%	0
Nilotic	3*	3	3	100%	1
Nivkh	1	1	1	100%	1
Nuclear Macro-Je	8	3	2	25%	1
Nuclear Trans New Guinea	46	6	4	8.7%	4
Nyulnyulan	1	1	1	100%	1

Otomanguean	12	3	1	8.3%	1
Pama-Nyungan	4	2	2	50%	1
Pomoan	1*	1	1	100%	1
Rashad	1*	1	0	0%	0
Sahaptian	1*	1	1	100%	1
Saharan	2	2	1	50%	1
Salishan	5	1	1	20%	1
Sepik	9	1	0	0%	0
Sino-Tibetan	22	5	3	13.6%	2
Songhay	1	1	0	0%	0
Surmic	2*	1	0	0%	0
Takelma	1	1	0	0%	0
Talodi	1*	1	1	100%	1
Tamaic	1*	1	1	100%	1
Temeinic	1*	1	0	0%	0
Timor-Alor-Pantar	2*	1	1	50%	1
Tucanoan	1	1	1	100%	1
Tungusic	1*	1	1	100%	1
Tunica	1	1	1	100%	1
Tupian	7	3	3	42.9%	1
Turkic	1*	1	1	100%	1
Uralic	7	7	7	100%	1
Uto-Aztecan	8	1	1	12.5%	1
Wagiman	1	1	0	0%	0
Warao	1	1	1	100%	1
Washo	1	1	1	100%	1
Wintuan	1*	1	1	100%	1
Xincan	1	1	1	100%	1
Yam	2	1	1	50%	1
Yangmanic	1	1	1	100%	1
Yanomamic	1	1	1	100%	1
Yokutsan	1*	1	1	100%	1
Yukaghir	1	1	1	100%	1
Zamucoan	1	1	1	100%	1
Total	**373**	**187**	**125**	**33.5%**	**75**

Table 3. Genera in CS and RS2 by macroarea.

Macroarea	Genera in macroarea	Genera in GS	Genera in CS	Coverage	Genera in RS2
Africa	124	66	33	26.6%	16
Eurasia	87	34	28	32.2%	11
North America	106	31	18	17.0%	13
South America	110	23	20	18.2%	14
Papunesia	165	26	21	12.7%	21
Australia	38	7	5	13.2%	5
Total	**630**	**187**	**125**	**20%**	**80**

3.2 Data

Data on the vowel harmony systems in the sample was gathered from descriptive grammars and other VH descriptions, such as research papers on vowel harmony. To verify whether a grammar was usable, I first looked at the table of contents to see if there was a subsection of phonology titled 'vowel harmony,' and if there was, I looked at the length of it and took a cursory glance at it. Often these were no more than a few pages long, but because the sample is so extensive, the questions that need answering about the vowel harmony systems are also quite simple. If there was no dedicated subsection present, I used the search within text - function to look for keywords like *harmony* and *assimilation*. This was typically a less reliable way to find data and usually led to having to look for a research paper about the language's vowel harmony system specifically.

The vowel harmony feature is poorly represented in linguistics databases, as neither WALS nor PHOIBLE nor Grambank have any data on it. I have, however, managed to find one database (Ruhlen 2008) with data on which languages have the feature. The database has the tag *vowel harmony* on 156 of the 5736 languages in it but does not go into further detail on the nature of these harmony systems. I have used this list as a starting point for my own list and have supplemented it with other languages mentioned in vowel harmony literature, such as in Ritter & van der Hulst (2024a).

Information on each language's language family was gathered from Glottolog (Hammarström 2025), while information about genera and macroareas was taken from WALS (Dryer & Haspelmath 2013). In cases where this information was not directly available in WALS, i.e. a language is not listed there, but languages related to it are, it was connected to the right genus through genealogical information in Glottolog. Glottolog was also used to gather more specific information about where the sample languages are spoken, such as the country. This is helpful in determining areal tendencies, particularly in larger macroareas like Africa. While WALS also lists countries languages are spoken in, it does not have data on as many languages as Glottolog, which is why the latter is preferred.

Glottolog and the current version of WALS use a slightly different list of macroareas than listed in Dryer (1992). Dryer's list consists of Africa, Eurasia, Southeast Asia & Oceania, Australia & New Guinea, North America, and South America, while the macroareas currently in use in WALS and Glottolog are Africa, Eurasia, Papunesia, Australia, South America, and North America. This study uses the latter list of macroareas. For the sake of efficiency, data on languages' vowel inventory sizes was taken from WALS (Maddieson 2013), where available. For languages not listed in WALS, inventory sizes were obtained from reference grammars, following Maddieson's (2013) criteria for determining inventory size, as well as his three-way categorization of inventory size: Small (2–4), Average (5–6), Large (7–14).

The tendency among researchers to omit directionality mentioned by Mahanta (2024) has caused some issues for my data collection, as the vowel harmony descriptions I have had to work with are already somewhat sparse in some places with regard to specific features of the harmony systems.

Much of the drop-off between the Genus Sample and the Core Sample happened in the African macroarea. North American languages were also somewhat more difficult to find data for.

3.3 Analysis methods

Methods for data analysis include tabulation of vowel harmony systems and their harmonic features, possible neutral vowels and consonant effects on harmony, directionality of harmony, as well as the languages' vowel inventory sizes, genetic information like genera and language families, and areas in which they are spoken. These values will be compared against each other to find possible correlations or areal or genetic patterns.

I will also use Multiple Correspondence Analysis (MCA) as a tool for exploratory statistical modeling of VH system features and their interdependencies. Multiple Correspondence Analysis works by transforming categorical variables into an indicator matrix, where each possible category (in this study, whether a feature appears in a language or not) becomes its own binary column. MCA then applies correspondence analysis to this matrix to detect patterns of co-occurrence among the categories. The results can be visualized as a map, where the axes (or dimensions) reflect combinations of categories that often appear together. Categories that are closer together on the map tend to co-occur across the dataset. For the purposes of this study, in the same language or across different languages with similar structural features. (Greenacre 2017.)

Many of the sample's languages combine multiple values of the different aspects of vowel harmony observed, such as having multiple harmonic features or directionalities and so on.

In some languages, there was ambiguity about whether a harmony system was based on one harmonic feature or another. In cases like these, I marked the system down as having both features. There are six cases like this in the CS, and usually the ambiguity is between tongue-root and height harmony. The other cases of ambiguity are caused by languages having small vowel inventories, so it is difficult to judge whether the harmony system is truly based on complete harmony or a singular feature, such as height or backness, since there are so few possible assimilations.

For some languages, I was not able to ascertain whether their neutral vowels were transparent or opaque. Cases like this are the reason for the occasional discrepancies between the value on the row Neutral vowels (any) and the combined values of the rows Opaque neutral vowels and Transparent neutral vowels.

4 Results

This chapter will go over the results and their analysis. It is divided into general tendencies, areal tendencies and genealogical tendencies.

4.1 General tendencies

The Phenomenon Sample, though not systematically gathered or balanced, can perhaps give some hint as to how common the vowel harmony feature is in the world's languages. In my search for VH languages, I found mentions for 428 individual languages from 99 language families and 188 genera. The number of VH languages in the PS is about five percent of the total number (8 612) of languages in the world listed in Glottolog (Hammarström 2025). However, looking at families and genera, the share increases. Glottolog lists 430 language families, of which the 99 in the PS is about 23 percent. For genera, the share is even larger. The 188 genera in the PS represent thirty percent of the 630 genera listed in WALS (Dryer & Haspelmath 2013).

The table below lays out the Core Sample by macroarea and by each vowel harmony system feature observed.

Table 4. Core Sample (CS) harmony systems by macroarea.

CORE SAMPLE	**Africa**	**Eurasia**	**North America**	**South America**	**Papunesia**	**Australia**	**Total**
Languages in sample	**33**	**28**	**18**	**20**	**21**	**5**	**125**
Large vowel inventories (7–14)	27 (82%)	16 (57%)	1 (6%)	7 (35%)	4 (19%)	0 (0%)	**56 (45%)**
Average vowel inventories (5–6)	6 (18%)	11 (39%)	14 (78%)	11 (55%)	13 (62%)	1 (20%)	**55 (44%)**
Small vowel inventories (2–4)	0 (0%)	1 (4%)	3 (17%)	2 (10%)	4 (19%)	4 (80%)	**14 (11%)**
Tongue-root harmony	28 (85%)	6 (21%)	2 (11%)	1 (5%)	3 (14%)	0 (0%)	**40 (32%)**
Backness harmony	2 (6%)	14 (50%)	5 (28%)	1 (5%)	5 (24%)	0 (0%)	**27 (22%)**
Height harmony	5 (15%)	10 (38%)	7 (39%)	4 (20%)	6 (29%)	3 (60%)	**36 (29%)**
Roundness harmony	7 (21%)	15 (54%)	2 (11%)	3 (15%)	0 (0%)	1 (20%)	**28 (22%)**
Nasal harmony	0 (0%)	0 (0%)	1 (6%)	9 (45%)	1 (5%)	0 (0%)	**11 (9%)**

Rhotic harmony	0 (0%)	1 (4%)	1 (6%)	0 (0%)	0 (0%)	0 (0%)	**2 (2%)**
Complete harmony	4 (12%)	5 (7%)	7 (39%)	8 (40%)	14 (67%)	1 (20%)	**39 (31%)**
Other types of harmony	0 (0%)	1 (4%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	**1 (1%)**
Neutral vowels (any)	15 (45%)	14 (50%)	6 (33%)	2 (10%)	5 (24%)	3 (60%)	**45 (36%)**
Transparent neutral vowels	5 (15%)	7 (25%)	1 (6%)	0 (0%)	1 (5%)	0 (0%)	**14 (11%)**
Opaque neutral vowels	7 (21%)	7 (25%)	1 (6%)	2 (10%)	2 (10%)	1 (20%)	**20 (16%)**
Trigger consonants	0 (0%)	1 (4%)	4 (22%)	7 (35%)	2 (10%)	0 (0%)	**14 (11%)**
Opaque consonants	1 (3%)	0 (0%)	4 (22%)	6 (30%)	2 (10%)	1 (20%)	**14 (11%)**
Progressive	8 (24%)	17 (61%)	9 (50%)	10 (50%)	10 (48%)	3 (60%)	**57 (46%)**
Regressive	14 (42%)	11 (39%)	6 (33%)	12 (60%)	18 (86%)	3 (60%)	**64 (51%)**
Bidirectional	10 (30%)	3 (11%)	3 (17%)	7 (35%)	0 (0%)	1 (20%)	**24 (19%)**
Dominant-recessive	11 (33%)	3 (11%)	1 (6%)	1 (5%)	0 (0%)	0 (0%)	**16 (13%)**
Root-outward	19 (58%)	17 (61%)	10 (56%)	11 (55%)	10 (48%)	3 (60%)	**70 (56%)**
Affix control	6 (18%)	2 (7%)	2 (11%)	4 (20%)	5 (24%)	2 (40%)	**21 (17%)**
Stress-based	0 (0%)	4 (14%)	1 (6%)	1 (5%)	3 (14%)	0 (0%)	**9 (7%)**
Limited to roots	0 (0%)	3 (11%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	**3 (2%)**

The Core Sample features 55 languages with average size vowel inventories (5–6 vowel phonemes), 56 languages with large vowel inventories (7–14 vowel phonemes), and 14 languages with small vowel inventories (2–4 vowel phonemes). In the WALS 200-language sample (which has data on the vowel inventories of 190 languages), the number of average-size inventories is 104, while large inventories stand at 50, and small inventories at 36. For the purposes of a simple statistical test, I produced a second WALS 200 list independent of my samples by taking out all of the WALS sample’s VH languages based on my Phenomenon Sample. This leaves the count at 162 of the initial 200 languages, but the inventory distribution is quite similar. Looking at just the CS, large inventories seem very overrepresented compared to Maddieson's (2013) figures in WALS, as is visible in the table below. However, after stratifying the Core Sample, the gap is narrowed somewhat, though both Restricted Samples still show higher shares of large inventories than the WALS sample, suggesting a tendency towards larger vowel inventories within vowel harmony languages. A chi-square test only showed a statistically significant deviation from the modified WALS 200-language sample when comparing it to the Core Sample ($p = 0.001847$). While the stratified samples are not statistically significant, RS1 ($p = 0.1771$) and RS2 ($p = 0.5352$) still follow the same trend of larger inventories being more prevalent.

Table 5. Vowel inventory sizes in the WALS 200-language sample, the Core Sample and Restricted Samples 1 and 2.

	Large	**Average**	**Small**	**Total**
WALS 200	50 (26%)	104 (55%)	36 (19%)	**190**
WALS 200 (No VH languages)	42 (26%)	86 (53%)	34 (21%)	**162**
CS	56 (45%)	55 (44%)	14 (11%)	**125**
RS1	27 (36%)	38 (51%)	10 (13%)	**75**
RS2	26 (33%)	40 (50%)	14 (18%)	**80**

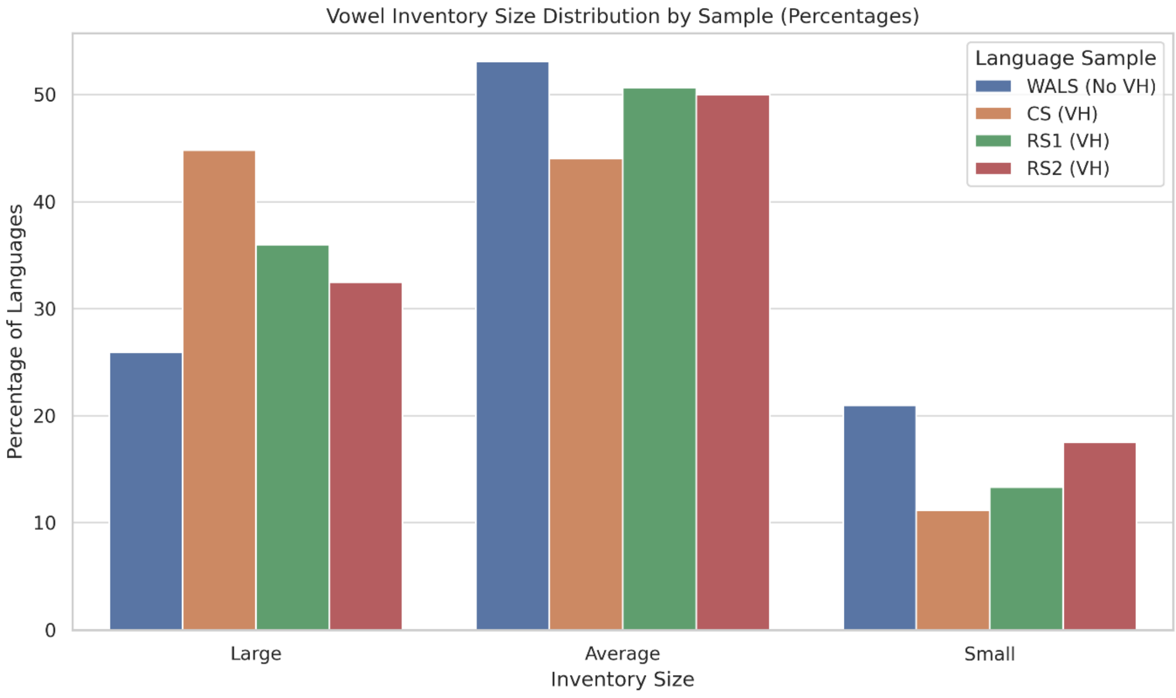
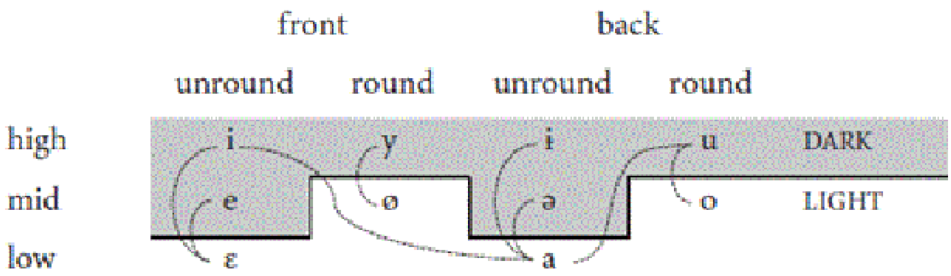


Figure 2. Vowel inventory sizes in the WALS 200 languages without VH, and CS, RS1 and RS2.

Harmonic features present in the Core Sample are tongue-root, backness, height, roundness, nasality, rhoticity, and vowel copy. Additionally, there is one quite idiosyncratic system, namely that of Contemporary Korean's, listed in the above table on the row called Other types of harmony. According to Ko (2024), it is based on an earlier [RTR] harmony system in Middle Korean, but as a result of sound changes, namely the loss of /ʌ/ and the creation of four new front vowels /e, ɛ, y, ø/, it can no longer be analyzed as just a tongue-root harmony system. In Contemporary Korean, vowel harmony occurs in two places: ideophones (words that describe sensory imagery) and suffixes. The harmonic opposition, which is partly based on the Middle Korean [RTR] opposition, is between so-called 'light' and 'dark' vowels. Figure 2 below shows the harmonic opposition in ideophones, while Figure 3 shows the suffixal harmony opposition. The major difference between the two is that in the suffixal harmony system, /ɛ, ø/ are dark vowels instead of being light vowels like they are in the ideophone harmony system.

Harmonic vowel pairs in ideophones (revised from Kim-Renaud 1976: 398)



The eight harmonic pairings are illustrated with examples in (14).

Dark and light vowel alternations (data drawn from Cho 1994 and Kim 2000)

	Dark	Light		Dark	Light	
a. /ə~a/	/əlluk/	/allok/	'mottled'	/səpək/	/sapak/	'crunching'
b. /u~o/	/cʰulləŋ/	/cʰollaŋ/	'splash'	/sukun/	/sokon/	'whispering'
c. /e~ɛ/	/teŋkəŋ/	/teŋkaŋ/	'chopping'	/səlle/	/sallɛ/	'waving'
d. /y~ø/	/tyluk/	/tølok/	'obese'	/hyhy/	/høhø/	'round about'
e. /ɨ~a/	/k'itək/	/k'atak/	'nodding'	/silc'ək/	/salc'ak/	'stealthy'
f. /i~ɛ/	/cicəl/	/cɛcal/	'chattering'	/k'icək/	/k'ɛcak/	'scribbling'
g. /i~a/	/kilc'uk/	/kyalc'uk/	'longish'	/cik'in/	/cak'in/	'snappingly'
h. /u~a/	/putil/	/patil/	'quivering'	/pulk'in/	/palk'in/	'burst of anger'

Figure 3. Ideophone harmony in Korean (Ko 2024, 812).

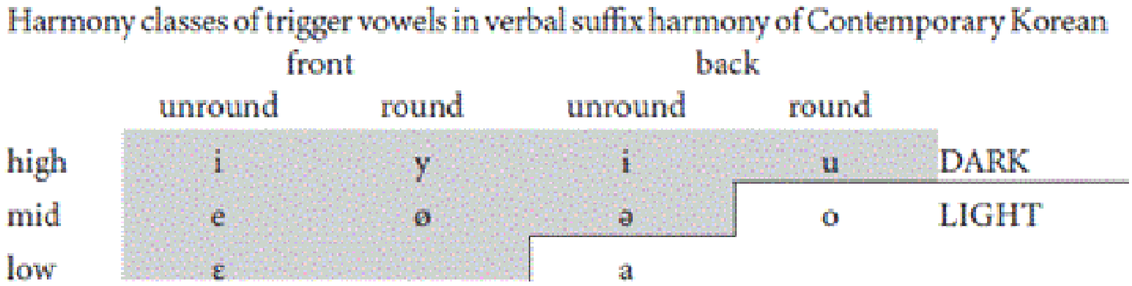


Figure 4. Suffixal harmony opposition in Korean (Ko 2024, 814).

Overall, the most common harmonic features in the sample are tongue-root harmony (CS 32%, RS1 31%, RS2 26%), complete harmony (CS 31%, RS1 29%, RS2 40%) and height harmony (CS 29%, RS1 32%, RS2 30%). Gordon & Fiddler (2024, 587) claim the following: “Given the strong genetic link in harmony systems, the typologically more common VH systems tend to be widespread in larger language families due to their inheritance from a linguistic ancestor. Tongue-root harmony is thus statistically the most common type of VH owing to its widespread occurrence in the Niger-Congo and Nilo-Saharan languages of Sub-Saharan Africa.” The data in my sample seems to agree with the genealogical argument, as the African macroarea represents over 60% of the total tongue-root harmony languages in CS, RS1 and RS2, and the feature was present in all sampled languages from the comparatively large Atlantic-Congo and Nilotic language families. However, the claim that tongue-root harmony is the most common type is not quite as strongly backed up by my data.

Neutral vowels are present in about a third of the sample’s languages (CS 36%, RS1 36%, RS2 33%). For languages where the nature of the neutral vowels was distinguishable, opaque neutral vowels (CS 16%, RS1 15%, RS2 13%) are more common than transparent neutral vowels (CS 11%, RS1 9%, RS2 9%). The most common kind of vowel among the neutral vowels is the low vowel. 19 (42%) of the 45 CS languages with neutral vowels feature a low vowel /a/ or /ɑ/ as a neutral vowel. The second most common vowel to have as a neutral vowel is /i/, with 14 languages (31%) described as having it specifically (11 languages, 24%) or high vowels in general (4 languages, 9%) as neutral. By contrast, the vowel /u/, while also a being high vowel, was only specified as neutral in 6 languages (13%), which is also how many of languages feature /e/ as neutral.

For consonant effects, trigger consonants (CS 11%, RS1 11%, RS2 14%) are about equally as common as opaque consonants (CS 11%, RS1 13%, RS2 15%).

Bidirectional spreading of harmony (CS 19%, RS1 19%, RS2 16%) is much less common than progressive (CS 46%, RS1 48%, RS2 46%) and regressive spreading (CS 51%, RS1 49%, RS2 58%), with regressive spreading seeming a little more common than progressive spreading, supporting the idea of a regressive bias in vowel harmony, though the difference is not statistically significant (chi-square, assuming an even split between progressive and regressive spreading as the null hypothesis: CS $p = 0.5245$, RS1 $p = 0.9068$, RS2 $p = 0.329$).

For controller features, root-outward spreading (CS 56%, RS1 57%, RS2 55%) is much more common than dominant-recessive spreading (CS 13%, RS1 16%, RS2 14%) and affix-controlled spreading (CS 17%, RS1 19%, RS2 18%). There are six languages (Yanomám, Icelandic, Mochica, Hamar, Huastec, Djingili; all with regressive spreading) in the Core Sample marked as having no other controller feature than affix control. This seems to contradict the claim made by Gordon & Fiddler (2024, 586) that "feature spreading from affixes to roots is typologically unattested except where the spreading feature is dominant." Interestingly, these six languages come from five different macroareas and six different language families. However, all six languages come with some important caveats. Yanomám has its VH limited entirely to clitics, while Icelandic and Mochica have systems of morphologically conditioned umlaut, whose inclusion into discussion of vowel harmony is controversial even within the already controversial category of umlaut systems. Hamar is also somewhat limited in its vowel harmony, as it involves the complete assimilation of only one vowel /a/ into three possible verbal suffixes. In Huastec, the suffixes that trigger harmony can also trigger disharmony, with no apparent rule in place. Finally, regarding Djingili, Pensalfini (2002) claims that a purely phonological analysis is not sufficient for its VH system, but requires some morphosyntactic analysis, which makes it somewhat non-prototypical VH.

There seems to be a connection between dominance-based harmony and tongue-root harmony, as 13 of the 16 dominant-recessive languages in the CS are tongue-root harmony systems. Of these 13, 10 are African languages. This connection is not quite as distinct when looking at the tongue-root systems as a whole, however, as there are 40 tongue-root systems in the CS, 22 of which are root-outward systems.

In the Core Sample, there are only two languages whose harmony systems are exclusively roundness-based, even though roundness harmony occurs in 28 languages in the CS and is among the most common harmonic features in RS1. 15 of the 28 roundness harmony languages also feature backness harmony. These languages are mostly Eurasian. This fits into the tendency for rounding harmony being parasitic pointed out by Kaun & McCollum (2024).

Table 6. RS1 harmony features by macroarea.

RESTRICTED SAMPLE 1	Africa	Eurasia	North America	South America	Papunesia	Australia	Total
Languages in sample	**15**	**16**	**16**	**15**	**9**	**4**	**75**
Large vowel inventories (7–14)	13 (87%)	6 (38%)	1 (6%)	5 (33%)	2 (22%)	0 (0%)	**27 (36%)**
Average vowel inventories (5–6)	2 (13%)	9 (56%)	12 (75%)	8 (53%)	6 (67%)	1 (25%)	**38 (51%)**
Small vowel inventories (2–4)	0 (0%)	1 (6%)	3 (19%)	2 (13%)	1 (11%)	3 (75%)	**10 (13%)**
Tongue-root harmony	14 (93%)	5 (31%)	2 (13%)	1 (7%)	1 (11%)	0 (0%)	**23 (31%)**
Backness harmony	0 (0%)	6 (38%)	4 (25%)	1 (7%)	3 (33%)	0 (0%)	**14 (19%)**
Height harmony	3 (20%)	4 (25%)	7 (44%)	4 (27%)	3 (33%)	3 (75%)	**24 (32%)**
Roundness harmony	4 (27%)	6 (38%)	2 (13%)	3 (20%)	0 (0%)	1 (25%)	**16 (21%)**
Nasal harmony	0 (0%)	0 (0%)	1 (6%)	6 (40%)	0 (0%)	0 (0%)	**7 (9%)**
Rhotic harmony	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	**0 (0%)**
Complete harmony	1 (7%)	2 (13%)	7 (44%)	6 (40%)	6 (67%)	0 (0%)	**22 (29%)**
Other types of harmony	0 (0%)	1 (6%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	**1 (1%)**
Neutral vowels (any)	6 (40%)	9 (56%)	5 (31%)	2 (13%)	3 (33%)	2 (50%)	**27 (36%)**
Transparent neutral vowels	3 (20%)	4 (25%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	**7 (9%)**
Opaque neutral vowels	2 (13%)	4 (25%)	1 (6%)	2 (13%)	1 (11%)	1 (25%)	**11 (15%)**
Trigger consonants	0 (0%)	0 (0%)	4 (25%)	4 (27%)	0 (0%)	0 (0%)	**8 (11%)**
Opaque consonants	0 (0%)	0 (0%)	4 (25%)	4 (27%)	1 (11%)	1 (25%)	**10 (13%)**
Progressive	5 (33%)	9 (56%)	8 (50%)	8 (53%)	4 (44%)	2 (50%)	**36 (48%)**
Regressive	7 (47%)	4 (25%)	6 (38%)	9 (60%)	8 (89%)	3 (75%)	**37 (49%)**

Bidirectional	4 (27%)	2 (13%)	2 (13%)	5 (33%)	0 (0%)	1 (25%)	**14 (19%)**
Dominant-recessive	7 (47%)	3 (19%)	1 (6%)	1 (7%)	0 (0%)	0 (0%)	**12 (16%)**
Root-outward	9 (60%)	10 (63%)	8 (50%)	10 (67%)	4 (44%)	2 (50%)	**43 (57%)**
Affix control	4 (27%)	1 (6%)	2 (13%)	3 (20%)	2 (22%)	2 (50%)	**14 (19%)**
Stress-based	0 (0%)	2 (13%)	1 (6%)	0 (0%)	2 (22%)	0 (0%)	**5 (7%)**
Limited to roots	0 (0%)	3 (19%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	**3 (4%)**

Table 7. RS2 harmony features by macroarea.

RESTRICTED SAMPLE 2	**Africa**	**Eurasia**	**North America**	**South America**	**Papunesia**	**Australia**	**Total**
Languages in sample	**16**	**11**	**13**	**14**	**21**	**5**	**80**
Large vowel inventories (7–14)	12 (75%)	4 (36%)	1 (8%)	5 (36%)	4 (19%)	0 (0%)	**26 (33%)**
Average vowel inventories (5–6)	4 (25%)	6 (55%)	9 (69%)	7 (50%)	13 (62%)	1 (20%)	**40 (50%)**
Small vowel inventories (2–4)	0 (0%)	1 (9%)	3 (23%)	2 (14%)	4 (19%)	4 (80%)	**14 (18%)**
Tongue-root harmony	12 (75%)	4 (36%)	2 (15%)	0 (0%)	3 (14%)	0 (0%)	**21 (26%)**
Backness harmony	1 (6%)	5 (45%)	4 (31%)	1 (7%)	5 (24%)	0 (0%)	**16 (20%)**
Height harmony	3 (19%)	4 (36%)	5 (38%)	3 (21%)	6 (29%)	3 (60%)	**24 (30%)**
Roundness harmony	5 (31%)	6 (55%)	2 (15%)	3 (21%)	0 (0%)	1 (20%)	**17 (21%)**
Nasal harmony	0 (0%)	0 (0%)	1 (8%)	7 (50%)	1 (5%)	0 (0%)	**9 (11%)**
Rhotic harmony	0 (0%)	1 (9%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	**1 (1%)**
Complete harmony	3 (19%)	3 (27%)	5 (38%)	6 (43%)	14 (67%)	1 (20%)	**32 (40%)**
Other types of harmony	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	**0 (0%)**
Neutral vowels (any)	8 (50%)	5 (45%)	4 (31%)	1 (7%)	5 (24%)	3 (60%)	**26 (33%)**
Transparent neutral vowels	4 (25%)	2 (18%)	0 (0%)	0 (0%)	1 (5%)	0 (0%)	**7 (9%)**

Opaque neutral vowels	4 (25%)	2 (18%)	0 (0%)	1 (7%)	2 (10%)	1 (20%)	**10 (13%)**
Trigger consonants	0 (0%)	0 (0%)	4 (31%)	5 (36%)	2 (10%)	0 (0%)	**11 (14%)**
Opaque consonants	1 (6%)	0 (0%)	4 (31%)	4 (29%)	2 (10%)	1 (20%)	**12 (15%)**
Progressive	5 (31%)	5 (45%)	6 (46%)	8 (57%)	10 (48%)	3 (60%)	**37 (46%)**
Regressive	8 (50%)	5 (45%)	5 (38%)	7 (50%)	18 (86%)	3 (60%)	**46 (58%)**
Bidirectional	2 (13%)	2 (18%)	2 (15%)	6 (43%)	0 (0%)	1 (20%)	**13 (16%)**
Dominant-recessive	8 (50%)	2 (18%)	1 (8%)	0 (0%)	0 (0%)	0 (0%)	**11 (14%)**
Root-outward	8 (50%)	7 (64%)	7 (54%)	9 (64%)	10 (48%)	3 (60%)	**44 (55%)**
Affix control	4 (25%)	0 (0%)	2 (15%)	1 (7%)	5 (24%)	2 (40%)	**14 (18%)**
Stress-based	0 (0%)	1 (9%)	1 (8%)	0 (0%)	3 (14%)	0 (0%)	**5 (6%)**
Limited to roots	0 (0%)	1 (9%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	**1 (1%)**

Below is the MCA plot showing interdependencies between the VH system features observed in the study. Dimension 1 is based mostly on whether the language features neutral vowels or not, while dimension 2 is based mostly on the appearance of dominant-recessive control, nasality, consonant effects and tongue-root harmony. The charts on the dimension contributions are in appendix D, along with a scree plot depicting the percentage of explained variances per dimension.

Interestingly, nasal harmony and tongue-root harmony map close to each other on the MCA chart even though no language in the sample features both. Furthermore, there are only two (out of 65 families in the CS) cases of a language family featuring both, those being in the Nuclear Macro-Je and Austronesian families. It seems that despite the genealogical distance between languages with tongue-root and nasal harmony, there is some considerable structural similarity between them. The strongest convergence between the two groups seems to be in the realm of directionality and controller features, where they have quite similar distributions across the board. On the other hand, tongue-root languages feature almost no consonant effects and plenty of neutral vowels while nasal harmony languages feature no neutral vowels at all and almost all feature consonant effects.

Another point of interest is the grouping of affix control, complete harmony, regressive spreading and roundness harmony. These features seem to co-occur often, though there is only one language in the CS with all four features present.

Height and backness harmony being close together is to be expected, as the tables above seem to also have them in similar numbers across the different families and macroareas. There are also six languages in the CS that feature both of these harmonic features.

Of note is also the apparent opposition of neutral vowels to not only dominant-recessive systems but also progressive spreading. The latter opposition is surprising, as there are 17 languages in the CS that feature both progressive spreading and neutral vowels. However, the number of languages that feature neutral vowels and not progressive spreading is larger, as is the number of languages that feature progressive spreading and no neutral vowels. The opposition between neutral vowels and dominant-recessive control is more obvious, as there are only four languages in the CS that feature both neutral vowels and dominant-recessive control.

Consonant effects of both kinds seem to occur in similar languages, and this seems borne out in the tables as well.

The group of five features near the origin of the chart seem to be connected by the fact that they are rare in the CS, with the exception of bidirectionality, which is comparatively common. The connection to bidirectionality seems to be that many of the languages that have these rarer features also happen to feature bidirectional spreading. This group of languages comes from separate language families from the Eurasian and North American macroareas.

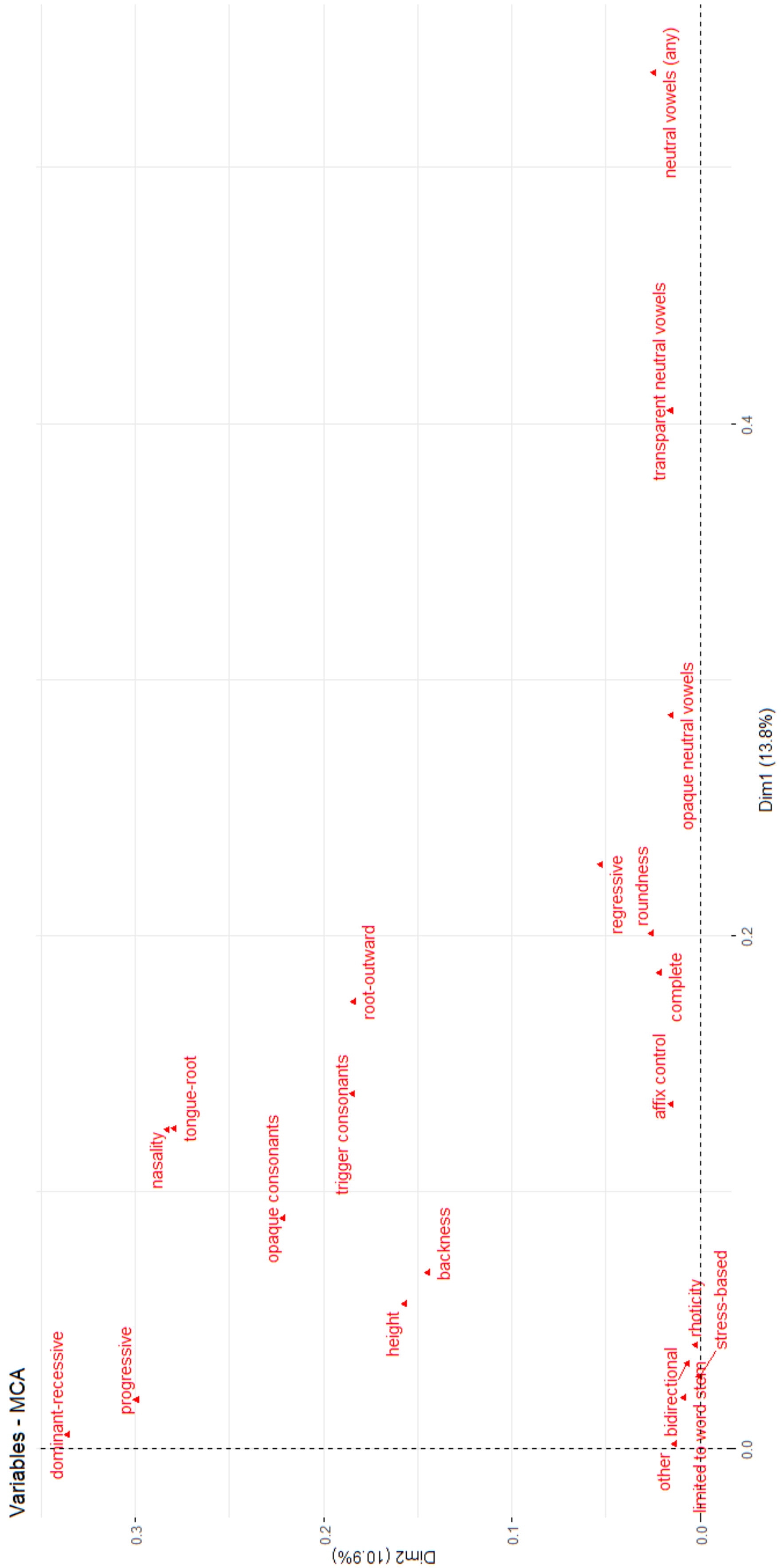


Figure 5. Multiple Correspondence Analysis of Core Sample VH system features.

4.2 Areal tendencies

Africa

The African macroarea seems averse to harmonic features other than tongue-root, which is present in 85% of the CS, 93% of RS1 and 75% of RS2. The next most common feature is roundness (CS 21%, RS1 27%, RS2 31%), but as discussed earlier, it almost always co-occurs with some other harmonic feature, and indeed, the sample contains no African languages with roundness as the only harmonic feature. Height harmony follows roundness (CS 15%, RS1 20%, RS2 19%).

African languages lean very heavily towards large vowel inventories (CS 82%, RS1 87%, RS2 75%). In fact, the Core Sample contains no African languages with small vowel inventories. The second-highest percentage of large vowel inventories is in the Eurasian macroarea (CS 57%, RS1 38%, RS2 36%) and is considerably smaller.

Neutral vowels are present in many African languages (CS 45%, RS1 40%, RS2 50%), but consonant effects are very rare, with only one African language in the sample featuring opaque consonants.

Regressive harmony (CS 42%, RS1 47%, RS2 50%) is more common than progressive (CS 24%, RS1 33%, RS2 31%) and bidirectional (CS 30%, RS1 27%, RS2 13%) harmony, though bidirectional harmony is more common here than average. Dominant-recessive harmony (CS 33%, RS1 47%, RS2 50%) is also higher than average in Africa, though root-outward spreading (CS 58%, RS1 60%, RS2 50%) is most common, hovering around the sample average. Affix-controlled spreading (CS 18%, RS1 27%, RS2 25%) is also a little more common than average in Africa.

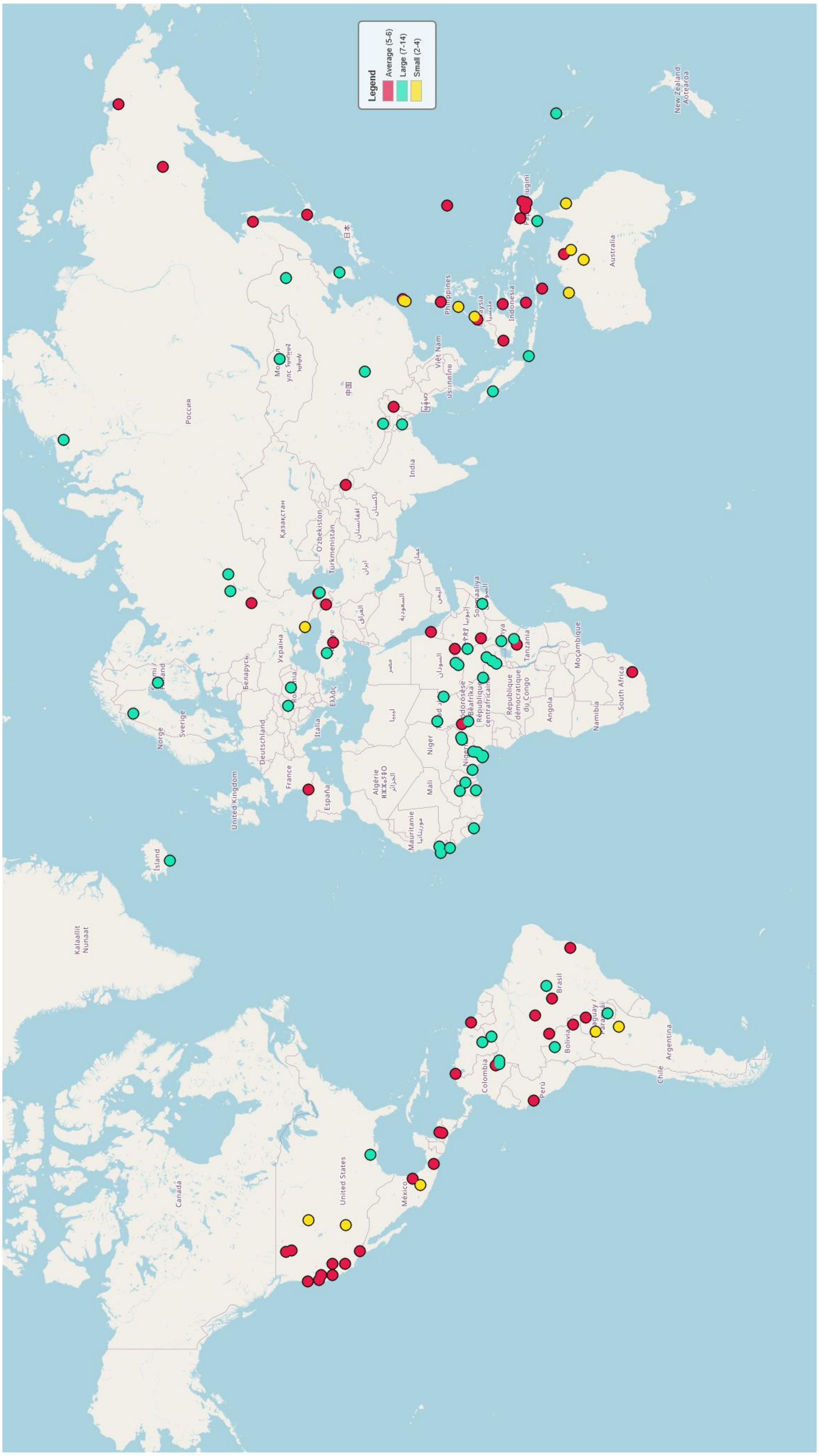


Figure 6. Core Sample (CS) by vowel inventory size.

Eurasia

Tongue-root (CS 21%, RS1 31%, RS2 36%), backness (CS 50%, RS1 38%, RS2 45%), height (CS 38%, RS1 25%, RS2 36%) and roundness (CS 54%, RS1 38%, RS2 55%) harmony seem quite evenly distributed in the Eurasian macroarea, though backness and roundness are more common than height. Despite being so common in the overall sample, complete harmony is quite rare in Eurasia (CS 7%, RS1 13%, RS2 27%), as it is in Africa. One of the two rhotic harmony languages in the sample comes from Eurasia.

After stratification, Eurasian vowel inventories are mostly of average size (CS 39%, RS1 56%, RS2 55%), though large inventories still have a considerable share (CS 57%, RS1 38%, RS2 36%). The prevalence of large inventories in the CS is largely a product of the prevalence of VH in the vowel-rich Uralic family, whose number is diminished quite heavily in stratification. The sample also contains one Eurasian language with a small vowel inventory (CS 4%, RS1 6%, RS2 9%).

Eurasia has the highest percentage of languages with neutral vowels (CS 50%, RS1 56%, RS2 45%) (aside from Australia which has only five languages in the sample). Eurasia's neutral vowels are perfectly evenly split between transparent and opaque neutral vowels, both at 25% in CS, 25% in RS1, and 18% in RS2. Consonant effects are rare, with only one in CS (4%) and none in either RS.

Directionality is progressive-oriented (CS 61%, RS1 56%, RS2 45%). The percentage of languages with regressive spreading seems to vary quite a lot between samples (CS 39%, RS1 25%, RS2 45%). Eurasia is in the low end for bidirectional spreading (CS 11%, RS1 13%, RS2 18%). Dominance is not very common (CS 11%, RS1 19%, RS2 18%), though it is even less so in the remaining macroareas. Root-outward spreading is by far the most common controller feature (CS 61%, RS1 63%, RS2 64%). Eurasia has the fewest languages with affix control in the sample (CS 7%, RS1 6%, RS2 0%). Stress-based harmony systems are more prominent here than average (CS 14%, RS1 13%, RS2 9%), and harmony limited to roots makes its only appearance in the whole sample (CS 11%, RS1 19%, RS2 9%).

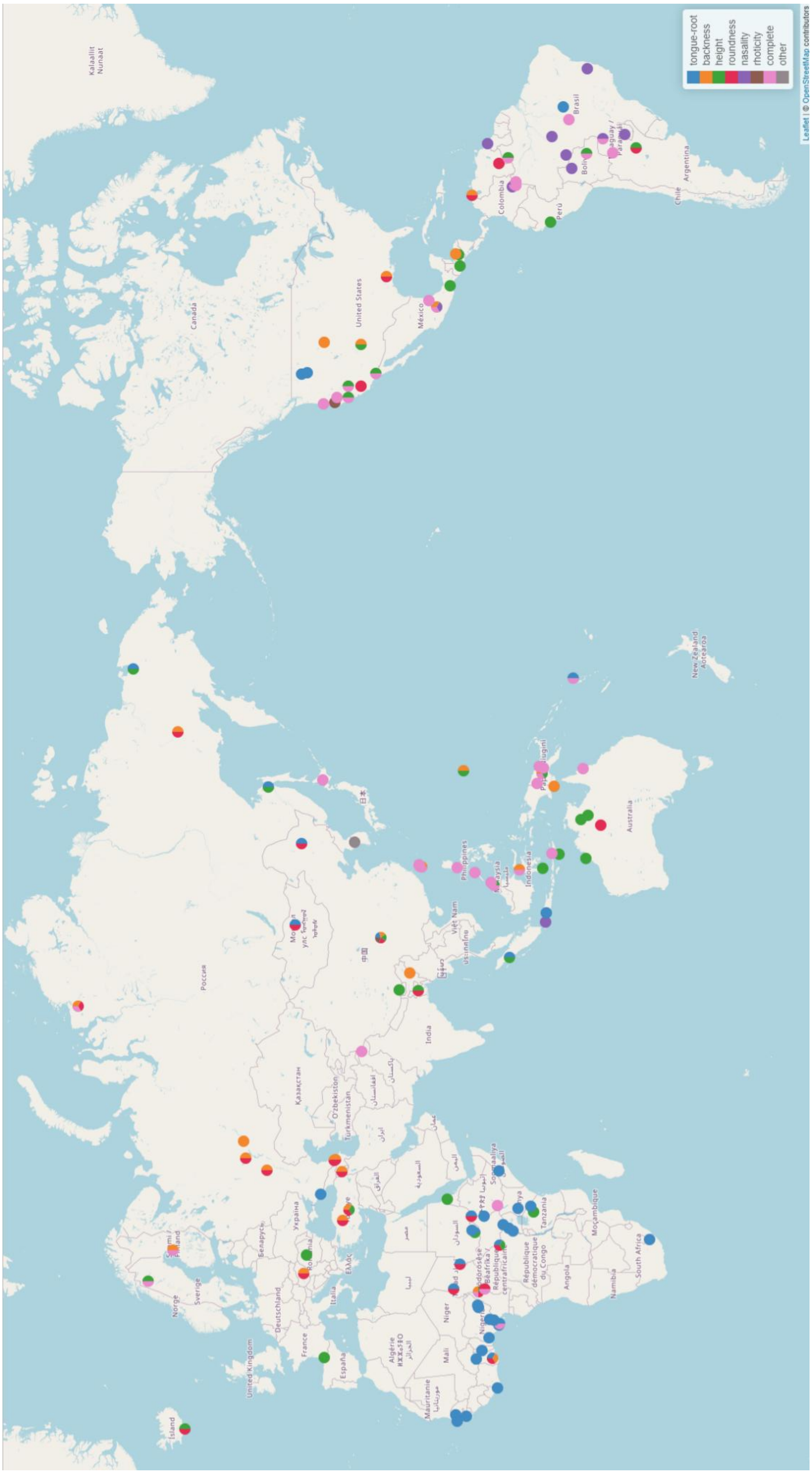


Figure 7. CS harmonic features.

North America

Backness (CS 28%, RS1 25%, RS2 31%), height (CS 39%, RS1 44%, RS2 38%) and vowel copy (CS 39%, RS1 44%, RS2 38%) are North America's most common harmonic features. There is a single nasal harmony system (CS 6%, RS1 6%, RS2 8%) present, as well as the second of the two rhotic harmony systems in the sample.

North American languages have a strong tendency towards average size vowel inventories (CS 78%, RS1 75%, RS2 69%), with only one large inventory (CS 6%, RS1 6%, RS2 8%) and three small inventories (CS 17%, RS1 19%, RS2 23%).

Neutral vowels occur in about a third (CS 33%, RS1 31%, RS2 31%) of the languages, though their nature seems quite poorly recorded in the source data. Opaque consonants and trigger consonants are equally common (CS 22%, RS1 25%, RS2 31%)

In terms of directionality, progressive spreading (CS 50%, RS1 50%, RS2 46%) occurs in about half, regressive spreading (CS 33%, RS1 38%, RS2 38%) in about a third, and bidirectional spreading (CS 17%, RS1 13%, RS2 15%) in about a seventh of North American languages. For controller features, root-outward is the most common (CS 56%, RS1 50%, RS2 54%), with the other controllers far behind. The sources seem not to have recorded much data on directionality controllers in North American languages.

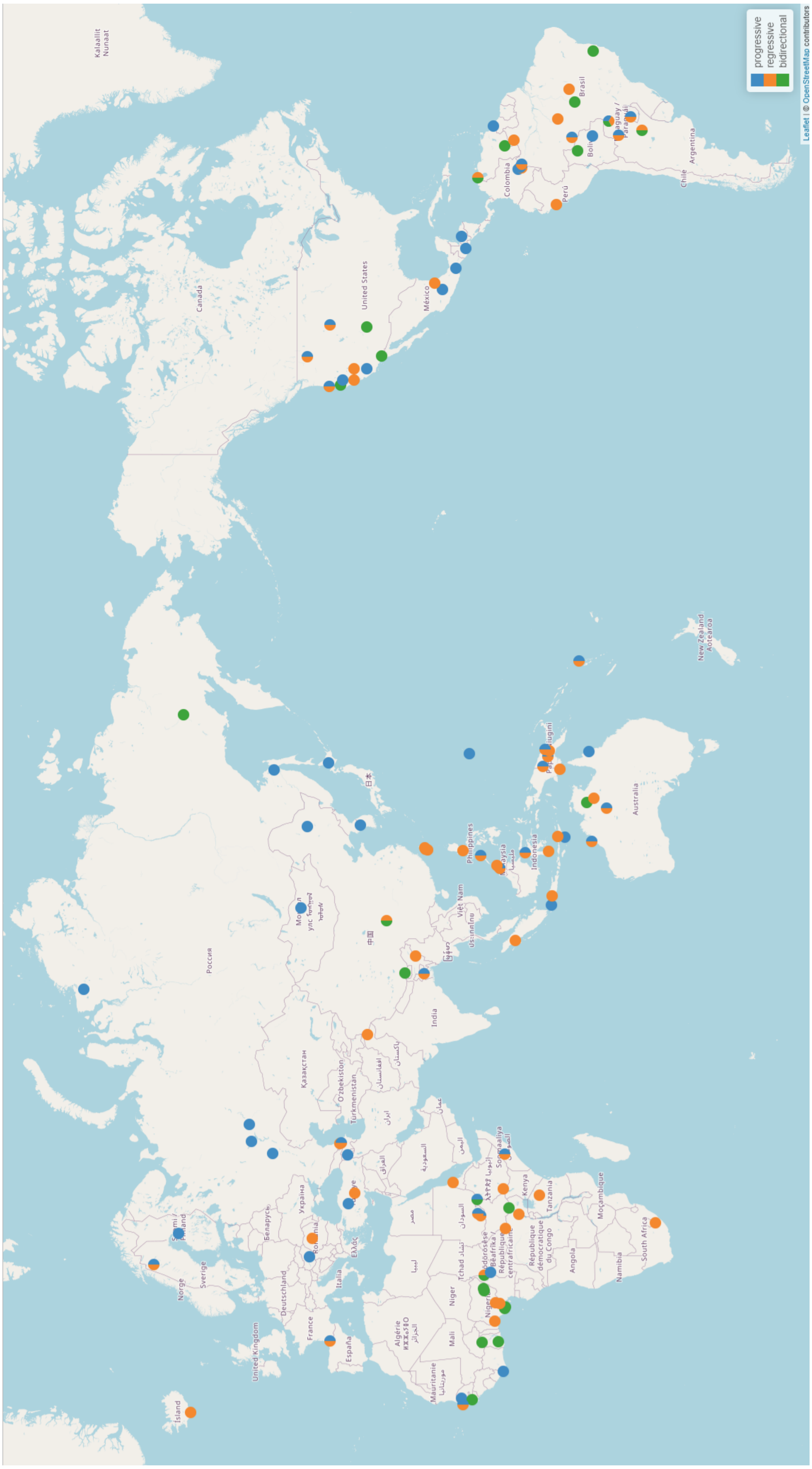


Figure 8. CS harmony directionalities.

South America

Nasal harmony (CS 45%, RS1 40%, RS2 50%) and complete harmony (CS 40%, RS1 40%, RS2 43%) are the most common types of harmony in South America. Height harmony (CS 20%, RS1 27%, RS2 21%) and roundness harmony (CS 15%, RS1 20%, RS2 21%) are also somewhat common.

Average size vowel inventories are most common (CS 55%, RS1 53%, RS2 50%), though the distribution of inventory sizes is notably even. Large inventories (CS 35%, RS1 33%, RS2 36%) make up about a third of the sample, while small inventories (CS 10%, RS1 13%, RS2 14%) make up about an eighth.

Neutral vowels are quite rare (CS 10%, RS1 13%, RS2 7%) and show up in only two languages in the CS, both having opaque neutral vowels. By contrast, consonant effects are most likely to show up in South America, with trigger consonants (CS 35%, RS1 27%, RS2 36%) and opaque consonants (CS 30%, RS1 27%, RS2 29%) both occurring in about a third of the macroarea's languages. This can, at least on the part of trigger consonants, be connected to the prevalence of nasal harmony languages in the area, as nasal consonants are almost always involved in triggering nasal harmony.

Directions of spreading are also quite evenly distributed, with progressive spreading (CS 50%, RS1 53%, RS2 57%) and regressive spreading (CS 60%, RS1 60%, RS2 50%) both showing up in a little over half of South American languages, and bidirectional spreading (CS 35%, RS1 33%, RS2 43%) in about a third. Controllers are more centralized towards root-outwardness (CS 55%, RS1 67%, RS2 64%), though affix control also makes an impressive showing (CS 20%, RS1 20%, RS2 7%) compared to the last two macroareas.

Figure 9. CS harmony controllers and domains.

Papunesia

Complete harmony (CS 67%, RS1 67%, RS2 67%) is very prevalent in in Papunesia. The other harmonic features that appear there, tongue-root (CS 14%, RS1 11%, RS2 14%), backness (CS 24%, RS1 33%, RS2 24%) and height (CS 29%, RS1 33%, RS2 29%), are less than half as prevalent at most.

Papunesia has a tendency towards average size vowel inventories (CS 62%, RS1 67%, RS2 62%). Interestingly, large (CS 19%, RS1 22%, RS2 19%) and small inventories (CS 19%, RS1 11%, RS2 19%) are about equally common.

The prevalence of neutral vowels (CS 24%, RS1 33%, RS2 24%) is a little under average, as is the prevalence trigger consonants (CS 10%, RS1 0%, RS2 10%) and opaque consonants (CS 10%, RS1 11%, RS2 10%).

Directionality is overwhelmingly regressive (CS 86%, RS1 89%, RS2 86%), but progressive spreading (CS 48%, RS1 44%, RS2 48%) is still also present in almost half of the sample's Papunesian languages. Papunesia is the only macroarea not to feature any bidirectional spreading. Papunesia is also one of two macroareas without any dominant-recessive systems in the sample. Root-outwardness (CS 48%, RS1 44%, RS2 48%) is present in almost half of the Papunesian languages, and affix control (CS 24%, RS1 22%, RS2 24%) is more common than average. Stress-based harmony (CS 14%, RS1 22%, RS2 14%) is most common in this macroarea.

Figure 10. CS neutral vowels and VH-affecting consonants.

Australia

The Australian macroarea is considerably smaller than the others, having only five languages in the CS, when the rest have about twenty to thirty. Making generalizations about it is thus a little more unsure than with the other macroareas. However, the tendencies that it presents are quite uniform.

The harmonic features present in Australia are height (CS 60%, RS1 75%, RS2 60%), roundness (CS 20%, RS1 25%, RS2 20%) and complete harmony (CS 20%, RS1 0%, RS2 20%), with height being the most common.

Vowel inventories tend to be small (CS 80%, RS1 75%, RS2 80%), with one language showing average size (CS 20%, RS1 25%, RS2 20%). Large inventories are absent.

Neutral vowels are present in most languages (CS 60%, RS1 50%, RS2 60%), but only one has had the opaque nature (CS 20%, RS1 25%, RS2 20%) of its neutrality recorded. Opaque consonants (CS 20%, RS1 25%, RS2 20%) also show up in one language.

Directionality is varied, with progressive spreading (CS 60%, RS1 50%, RS2 60%) and regressive spreading (CS 60%, RS1 75%, RS2 60%) being about equally common and bidirectional spreading also appearing (CS 20%, RS1 25%, RS2 20%). The only controller features present are root-outward (CS 60%, RS1 50%, RS2 60%) and affix control (CS 40%, RS1 50%, RS2 40%).

4.3 Genealogical tendencies

For analysis of genealogical tendencies, the Core Sample is used rather than either of the Restricted Samples, as the number of languages per family decreases sharply in stratification, making analysis of intra-family tendencies ineffective.

Table 8. Harmonic features of the language families that had more than a single genus in the Core Sample (CS).

CORE SAMPLE	Languages in sample	Tongue-root	Backness	Height	Roundness	Nasal	Rhotic	Complete
Afro-Asiatic	**5**	2 (40%)	1 (20%)	2 (40%)	1 (20%)	0 (0%)	0 (0%)	2 (40%)
Algic	**2**	0 (0%)	1 (50%)	0 (0%)	0 (0%)	0 (0%)	1 (50%)	0 (0%)
Arawakan	**4**	0 (0%)	2 (50%)	0 (0%)	1 (25%)	0 (0%)	0 (0%)	2 (50%)

Atlantic-Congo	**15**	15 (100%)	1 (7%)	1 (7%)	2 (13%)	0 (0%)	0 (0%)	1 (7%)
Austronesian	**15**	3 (20%)	3 (20%)	5 (33%)	0 (0%)	1 (7%)	0 (0%)	9 (60%)
Central Sudanic	**3**	2 (67%)	0 (0%)	0 (0%)	1 (33%)	0 (0%)	0 (0%)	1 (33%)
Indo-European	**5**	0 (0%)	2 (40%)	4 (80%)	4 (80%)	0 (0%)	0 (0%)	0 (0%)
Nakh-Daghestanian	**2**	0 (0%)	2 (100%)	0 (0%)	2 (100%)	0 (0%)	0 (0%)	0 (0%)
Nilotic	**3**	3 (100%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Nuclear Macro-Je	**2**	1 (50%)	0 (0%)	0 (0%)	0 (0%)	1 (50%)	0 (0%)	0 (0%)
Nuclear Trans New Guinea	**4**	0 (0%)	1 (25%)	1 (25%)	0 (0%)	0 (0%)	0 (0%)	4 (100%)
Pama-Nyungan	**2**	0 (0%)	0 (0%)	0 (0%)	1 (50%)	0 (0%)	0 (0%)	1 (50%)
Sino-Tibetan	**3**	1 (33%)	2 (67%)	2 (67%)	1 (33%)	0 (0%)	1 (33%)	0 (0%)
Tupian	**3**	0 (0%)	0 (0%)	0 (0%)	0 (0%)	3 (100%)	0 (0%)	0 (0%)
Uralic	**7**	0 (0%)	6 (86%)	1 (14%)	4 (57%)	0 (0%)	0 (0%)	3 (43%)

Several of the families observed have all their languages base their harmony systems on the same harmonic feature. The Atlantic-Congo and Nilotic families' languages all feature tongue-root harmony, Tupian languages all feature nasal harmony, Nuclear Trans New Guinea languages all feature complete harmony, and both Nakh-Daghestanian languages feature backness harmony as well as roundness harmony. Furthermore, Nakh-Daghestanian, Nilotic and Tupian do not feature any harmonic features other than their respective 100% features.

There are also some other strong harmonic tendencies. Complete harmony is quite popular in the Austronesian family (60%), as is backness harmony in Uralic (86%), and height and roundness harmony (both 80%) in Indo-European. The Sino-Tibetan family seems to have a preference for backness and height harmony (both 67%), though the number of these languages in the sample is quite small, as is the case for Central Sudanic and tongue-root harmony (67%).

Table 9. Vowel inventories of the language families that had more than a single genus in the Core Sample (CS).

CORE SAMPLE	Languages in sample	Large vowel inventories (7–14)	Average vowel inventories (5–6)	Small vowel inventories (2–4)
Afro-Asiatic	**5**	2 (40%)	3 (60%)	0 (0%)
Algic	**2**	0 (0%)	1 (50%)	1 (50%)
Arawakan	**4**	1 (25%)	3 (75%)	0 (0%)
Atlantic-Congo	**15**	14 (93%)	1 (7%)	0 (0%)
Austronesian	**15**	3 (20%)	8 (53%)	4 (27%)
Central Sudanic	**3**	3 (100%)	0 (0%)	0 (0%)
Indo-European	**5**	3 (60%)	2 (40%)	0 (0%)
Nakh-Daghestanian	**2**	1 (50%)	1 (50%)	0 (0%)
Nilotic	**3**	3 (100%)	0 (0%)	0 (0%)
Nuclear Macro-Je	**2**	1 (50%)	1 (50%)	0 (0%)
Nuclear Trans New Guinea	**4**	0 (0%)	4 (100%)	0 (0%)
Pama-Nyungan	**2**	0 (0%)	0 (0%)	2 (100%)
Sino-Tibetan	**3**	2 (67%)	1 (33%)	0 (0%)
Tupian	**3**	1 (33%)	2 (67%)	0 (0%)
Uralic	**7**	6 (86%)	1 (14%)	0 (0%)

Large (7–14) vowel inventories are especially common in the Uralic (86%) and Atlantic-Congo (93%) families, and ubiquitous in Nilotic and Central Sudanic (both 100%). Indo-European (60%) and Sino-Tibetan (67%) also go over the fifty percent mark.

Small (2–4) vowel inventories are rarer, with only the Pama-Nyungan (100%) family going over fifty percent. They also show up in the Algic (50%) and Austronesian (27%) languages.

Aside from Nuclear Trans New Guinea (100%), average (5–6) size vowel inventories are not overwhelmingly prevalent in any individual families in the same way large inventories are. Other percentages over fifty percent are in Arawakan (75%), Tupian (67%), Afro-Asiatic (60%) and Austronesian (53%).

Among the families, Austronesian seems to have the most even split between the three inventory size categories. Two possible explanations come to mind right away: the genealogical variation of the family and the genealogical variation of the Papunesian macroarea. The first seems unconvincing, as the other large family in this study, the Atlantic-Congo family, has almost twice as many total genera (56) as the Austronesian family (31), yet is quite uniformly oriented towards large vowel inventories. For the areal effect explanation to be true, one would have to assume language contact affecting Papunesian vowel inventory sizes to quite a large extent, which is possible, given the Papunesian macroarea's genealogical diversity. It would be interesting to see if there is as much vowel inventory size variation among the two families' non-VH languages.

Table 10. Directionalities (darker columns) and controllers of the language families that had more than a single genus in the Core Sample (CS).

CORE SAMPLE	Languages in sample	Progressive	Regressive	Bidirectional	Dominant-recessive	Root-outward	Affix control	Stress-based
Afro-Asiatic	**5**	1 (20%)	4 (80%)	2 (40%)	1 (20%)	2 (40%)	3 (60%)	0 (0%)
Algic	**2**	1 (50%)	1 (50%)	1 (50%)	0 (0%)	1 (50%)	0 (0%)	0 (0%)
Arawakan	**4**	2 (50%)	2 (50%)	2 (50%)	0 (0%)	3 (75%)	1 (25%)	1 (25%)
Atlantic-Congo	**15**	3 (20%)	6 (40%)	6 (40%)	2 (13%)	11 (73%)	1 (7%)	0 (0%)
Austronesian	**15**	7 (47%)	12 (80%)	0 (0%)	0 (0%)	6 (40%)	3 (20%)	2 (13%)
Central Sudanic	**3**	1 (33%)	1 (33%)	1 (33%)	0 (0%)	2 (67%)	0 (0%)	0 (0%)
Indo-European	**5**	2 (40%)	4 (80%)	0 (0%)	0 (0%)	1 (20%)	1 (20%)	1 (20%)
Nakh-Daghestanian	**2**	1 (50%)	2 (100%)	0 (0%)	0 (0%)	1 (50%)	0 (0%)	2 (100%)
Nilotic	**3**	0 (0%)	0 (0%)	0 (0%)	3 (100%)	0 (0%)	0 (0%)	0 (0%)
Nuclear Macro-Je	**2**	0 (0%)	1 (50%)	1 (50%)	1 (50%)	0 (0%)	0 (0%)	0 (0%)

Nuclear Trans New Guinea	**4**	3 (75%)	4 (100%)	0 (0%)	0 (0%)	2 (50%)	2 (50%)	0 (0%)
Pama-Nyungan	**2**	2 (100%)	1 (50%)	0 (0%)	0 (0%)	2 (100%)	1 (50%)	0 (0%)
Sino-Tibetan	**3**	0 (0%)	2 (67%)	2 (67%)	1 (33%)	2 (67%)	1 (33%)	0 (0%)
Tupian	**3**	2 (67%)	3 (100%)	0 (0%)	0 (0%)	1 (33%)	1 (33%)	0 (0%)
Uralic	**7**	7 (100%)	1 (14%)	0 (0%)	0 (0%)	6 (86%)	0 (0%)	0 (0%)

The Uralic and Pama-Nyungan families feature progressive harmony spreading in all their languages. In addition, one language from each features regressive spreading. The sample's Nakh-Daghestanian, Nuclear Trans New Guinea and Tupian languages all feature regressive spreading, though the Tupian (67%) and Nuclear Trans New Guinea (75%) families also feature quite a lot of progressive spreading as well. The Austronesian family is also somewhat ambivalent, with 80% of its languages featuring regressive spreading, and 47% featuring progressive spreading. Indo-European has a similar spread (80% regressive, 40% progressive). Afro-Asiatic and Sino-Tibetan are interesting in that they feature primarily regressive spreading, but more bidirectional spreading than progressive spreading. Bidirectional spreading seems to appear in fewer families overall than the two other directionalities. The split of directionalities in the Atlantic-Congo family (and the smaller Algic, Arawakan and Central Sudanic families) seems quite even compared to the other families.

The Nilotic languages all feature dominant-recessive control. In the other families this feature is quite rare. Despite what one might expect based on the connection between African tongue-root languages and dominant-recessive control, the tongue-root harmony -rich Atlantic-Congo family has very few languages with dominant-recessive control and is instead very root-outward-oriented. Both Pama-Nyungan languages in the sample feature root-outward spreading, and it may be safe to assume the whole Uralic family does as well, as they are quite uniform in directionality, and the source does not make any claims to the contrary, rather the directionality of Lule Saami is left unspecified in Fejes (2022). Though Lule Saami is also the only Uralic language to feature regressive spreading in addition to progressive spreading, so it is already exceptional in that regard. Arawakan (75%), Central Sudanic (67%) and Sino-Tibetan (67%) also seem to prefer root-outward control. The rare feature of affix-controlled harmony appears most prominently in Afro-Asiatic (60%), Nuclear Trans New Guinea (50%) and Pama-Nyungan (50%), and less prominently in others, if at all. The other rare feature, stress-based harmony, appears in both of the sample's Nakh-Daghestanian languages, 25% of the Arawakan languages, 20% of the Indo-European languages and 13% of the Austronesian languages.

Table 11. Neutral vowels (darker columns) and vowel harmony-affecting consonants of the language families that had more than a single genus in the Core Sample (CS).

CORE SAMPLE	Languages in sample	Neutral vowels (any)	Transparent neutral vowels	Opaque neutral vowels	Trigger consonants	Opaque consonants
Afro-Asiatic	**5**	1 (20%)	0 (0%)	1 (20%)	0 (0%)	0 (0%)
Algic	**2**	1 (50%)	1 (50%)	0 (0%)	0 (0%)	1 (50%)
Arawakan	**4**	0 (0%)	0 (0%)	0 (0%)	1 (25%)	0 (0%)
Atlantic-Congo	**15**	8 (53%)	1 (7%)	4 (27%)	0 (0%)	0 (0%)
Austronesian	**15**	3 (20%)	1 (7%)	2 (13%)	2 (13%)	1 (7%)
Central Sudanic	**3**	2 (67%)	2 (67%)	0 (0%)	0 (0%)	1 (33%)
Indo-European	**5**	1 (20%)	1 (20%)	1 (20%)	0 (0%)	0 (0%)
Nakh-Daghestanian	**2**	1 (50%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Nilotic	**3**	1 (33%)	0 (0%)	1 (33%)	0 (0%)	0 (0%)
Nuclear Macro-Je	**2**	1 (50%)	0 (0%)	1 (50%)	1 (50%)	1 (50%)
Nuclear Trans New Guinea	**4**	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (25%)
Pama-Nyungan	**2**	2 (100%)	0 (0%)	1 (50%)	0 (0%)	1 (50%)
Sino-Tibetan	**3**	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Tupian	**3**	0 (0%)	0 (0%)	0 (0%)	2 (67%)	2 (67%)
Uralic	**7**	6 (86%)	3 (43%)	3 (43%)	1 (14%)	0 (0%)

Only four families feature neutral vowels in more than half of their languages. Pama-Nyungan (100%), Uralic (86%), Central Sudanic (67%) and Atlantic-Congo (53%). Four families feature no neutral vowels at all. For Central Sudanic, all neutral vowels are transparent, while Uralic neutral vowels are split evenly between transparent and opaque ones. Aside from the aforementioned families, neutral vowels do not seem too common in VH systems.

Trigger consonants do not appear in many families, and in the ones that it does appear, it is quite sparse. An outlier here is the Tupian family, though it must be mentioned that the number of Tupian languages in the sample is quite low. Opaque consonants seem about as common, though they appear in more families than trigger consonants. Tupian features these in 67% of its languages as well.

Most of the disruptions to the uniformity of Uralic VH systems come from Lule Saami, which features height harmony where all others feature backness harmony, and lacks neutral vowels where the others have them. It also features both progressive and regressive harmony spreading whereas the other Uralic languages are exclusively progressive-oriented. Erzya also has two exceptional features. It is the only Uralic language in the sample to have an average size vowel inventory rather than a large one, and the only one to feature trigger consonants.

5 Discussion

Vowel inventory sizes in WALS (Maddieson 2013) seem to be counted based on phonemes, as one might expect. Using WALS as a source of vowel inventories thus somewhat complicates the observation of the relationship between vowel inventory size and VH since the harmony opposition of some VH systems is based on allophones. One language where tongue-root harmony is purely based on the alternation of allophones is Shapsugh Circassian, where the four [RTR] vowel phonemes of the language, presented by Wallis (1987) as /I, ə, U, a/, alternate with their [ATR] allophones [i, e, u, æ], respectively (Wallis 1987). Going purely off phoneme count, allophonic harmony systems like this will appear to have harmonic variation between fewer phones than is really the case. However, the alternative is hardly better, as comparing total numbers of phones in languages would balloon inventory sizes in some languages, leaving the data very difficult to compare effectively, not to mention that many grammarians do not even concern themselves with sound inventories beyond phonemes. This allophonic aspect is relevant for my interest in looking at the relationship between inventory size and harmony, and it may be relevant for other angles as well. For instance, [ATR] harmony seems like a common place for allophone-based harmony. This issue is fortunately not very disruptive for this sample, as harmony based solely on allophones is quite rare in it.

While most VH system descriptions describe the direction of harmony spreading, many lack specification on its controller. In most cases of no controller being found in the VH description, it was difficult to know whether the language's VH controller is truly impossible to determine because of some morphological aspect, or whether the grammarian simply neglected to specify the controller. Neutral vowels were a similar challenge, with many grammarians simply mentioning the existence of neutral vowels in a language but failing to record which type of neutral vowels they are. This posed a limitation on my data collection on these features.

Most families (50 of 65) received only one genus in the Core Sample. In fact, 40 of the CS families consist entirely of only one genus. This made genealogical comparison impossible within many of the sample's families. Making things more difficult, a large portion of the families that had more than one genus only had two or three genera. Fortunately, these smaller families were still useful for areal and general comparison.

Because the Papunesian macroarea is so genealogically diverse, it receives a lot of representation in Restricted Sample 2, which is stratified based on the macroarea. However, because most of the Phenomenon Sample's Papunesian languages are from the Austronesian language family, that family gets disproportionate coverage in RS2 with all 15 of its CS genera represented, whereas in RS1 it receives only 3 representatives of the family's 31 total genera. One of the effects of this difference in stratification strategy is thus a noticeable difference in the prevalence of complete harmony between RS1 and RS2, because complete harmony is very prevalent in the Austronesian family.

Gordon's (2016, 134–137) comparison of 26 VH languages had complete harmony as the most common harmonic feature, with six languages (23%) featuring it. Backness and height both had five languages (19%) representing, roundness and [ATR] both had three (12%). There were also three VH languages whose systems did not fit as neatly into any of these categories, but one of them, Chukchi, could be analyzed as having either an [ATR] or height harmony system, possibly making height share the top spot with complete harmony. The other two were a language with pharyngeal harmony ([RTR] harmony) and a language where a single phoneme alternates for laxness. To facilitate comparison between Gordon's study and mine, I will combine Gordon's [ATR] and [RTR] languages under the category of tongue-root harmony, as they are in my study. This brings the total of tongue-root systems in the sample to four (15%) or five (19%), depending on which analysis one adopts for Chukchi. Unfortunately, the small size of Gordon's (2016, 134–137) sample makes drawing conclusions from it a bit murky. More recently, Gordon & Fiddler (2024, 587) have claimed that tongue-root harmony is statistically the most common type of VH.

In my study, tongue-root harmony (CS 32%, RS1 31%, RS2 26%), complete harmony (CS 31%, RS1 29%, RS2 40%) and height harmony (CS 29%, RS1 32%, RS2 30%) are all quite evenly matched, echoing Gordon (2016). Based on my results, the later claim by Gordon & Fiddler (2024, 587) of tongue-root being the most common harmonic feature is not obvious, as each of the three samples has a different feature as the most common. Going by sheer numbers in the CS, tongue-root harmony is the most common, but in stratification – that is, balancing sample – it loses its number one spot.

Curiously, while Gordon (2016, 134–137) had backness and height harmony as equally common, backness harmony is considerably below height harmony here (CS 22%, RS1 19%, RS2 20%), more akin to roundness harmony in frequency (CS 22%, RS1 21%, RS2 21%).

6 Conclusion

This study compared the vowel harmony systems of 125 languages from 65 language families and 6 macroareas. In addition to vowel harmony features, the languages' vowel inventory sizes were also investigated in order to see whether there is a connection between VH and vowel inventory size. The result was a set of tables detailing how common the various features of vowel harmony systems are in general and in the different macroareas and language families.

It was found that tongue-root harmony, height harmony and complete harmony are the most common types of VH overall, each appearing in about thirty percent of VH languages. Neutral vowels appeared in about a third of the languages observed. The most common direction of VH spreading was regressive spreading and the most common controller for harmony was the word root, both features appearing in about half of the languages observed. Progressive spreading was slightly less common than regressive spreading, while bidirectional spreading was observed in only about a fifth of the sample. The presence of consonant effects hovered around 11% to 15% in the different samples.

Comparing the vowel inventory sizes of VH languages to a set of non-VH languages, the VH languages had larger vowel inventories on average, though the difference was only statistically significant in the non-stratified sample. Nevertheless, the stratified samples followed the same trend, suggesting that the presence of VH at least somewhat predicts larger vowel inventories.

The macroareas and language families vary greatly in their preferred VH features. Tongue-root harmony, for example, is almost ubiquitous in the African macroarea, but quite uncommon elsewhere, except for Eurasia. The Austronesian and Nuclear Trans New Guinea language families feature a lot of complete harmony, while almost all languages in the Uralic family feature backness harmony. Vowel inventory sizes also vary by family and macroarea. The overwhelming majority of North American languages has average-size vowel inventories, while Africa and Eurasia have larger ones on average. Australia, on the other hand, has small inventories almost exclusively.

In addition to typological data on vowel harmony, this study provides a framework for future typological comparison of VH systems.

Future work on the subject of vowel harmony typology could use a larger sample and more extensive statistical modeling to observe feature interdependencies in more detail. It could also look at consonant harmony and how it compares and possibly interacts with vowel harmony.

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Appendices

A. Core Sample vowel harmony system features

Language name / other name, dialect	Genus	Family	macroarea	iso	GS	CS	RS 1	RS 2	Details on system	Inventory size	Harmonic feature	Neutral vowels	Consonant effects	Directionality / controller	Reference
Kera	East Chadic	Afro-Asiatic	Africa	ker	X	X		X	three types: complete, height, backness + roundness	Average (5-6)	complete, height, backness, roundness			backness-roundness regressive (suffix control), complete limited to root, height dominant-recessive (bidirectional)	Pearce, Mary. 2003. *Vowel Harmony in Kera (Chadic).* MA thesis. University College London.
Somali	Lowland East Cushitic	Afro-Asiatic	Africa	som	X	X	X			Large (7-14)	ATR			progressive (root-outward) and regressive (suffix control)	Green, Christopher R. 2021. *Somali Grammar*. Boston: De Gruyter. 63–65
Tigre / Tigré	Semitic	Afro-Asiatic	Africa	tig	X	X			/a/ and /ä/ in opposition	Average (5-6)	height	opaque: long non-low vowels		regressive	Lowenstamm, Jean & Jean-François Prunet. 1988. Tigre Vowel Harmonies. *Rapport Annuel du Groupe de Recherche sur la Linguistique Africaniste au CRSH 1987–88.* Montréal: Université du Québec à Montréal.
Hamar / Hamer	South Omotic	Afro-Asiatic	Africa	amf	X	X		X	a assimilates completely in certain verbal suffixes	Average (5-6)	complete			regressive (suffix control)	Petrollino, Sara. 2016. *A grammar of Hamar: a South Omotic language of Ethiopia*. PhD dissertation. Leiden: Leiden University. 59.
Tangale	West Chadic	Afro-Asiatic	Africa	tan	X	X				Large (7-14)	ATR	/a/ noted as not being neutral, at		bidirectional (root-outward)	Kleinewillinghöfer, Ulrich. 1990. Aspects of vowel harmony in Waja and Tangale -

												least in all situations			Waja common vocabulary. *Frankfurter Afrikanistische Blätter (FAB) 2.* 93–106
Xhosa	Bantu	Atlantic-Congo	Africa	xho	X	X			mid vowels undergo, high vowels trigger, [-ATR] is default	Average (5-6)	ATR	opaque: low vowels		regressive	Killian, Kelly. 2017. *Vowel harmony in isiXhosa: an OT and acoustic study of [ATR].* MA thesis. Makhanda: Rhodes University. 9–14.
Ndut	Cangin	Atlantic-Congo	Africa	ndv	X	X	X			Large (7-14)	ATR			progressive (root-outward), regressive (suffix control)	Drole, Ursula. 2004. A Diachronic Analysis of Ndut Vowel Harmony. *Studies in African Linguistics 33, 1*. 37–39.
Yoruba (Standard)	Defoid	Atlantic-Congo	Africa	yor	X	X	X			Large (7-14)	ATR	opaque: high vowels		regressive	Przedziecki, Marek A. 2005. *Vowel Harmony and Coarticulation in Three Dialects of Yoruba: Phonetics Determining Phonology*. PhD dissertation. Ithaca: Cornell University. 73–89.
Degema	Edoid	Atlantic-Congo	Africa	deg	X	X				Large (7-14)	ATR			bidirectional (root-outward)	Kari, Ethelbert E. 2007. Vowel Harmony in Degema, Nigeria. *African Study Monographs 28, 2.* 87–97.
Kabre / Kabiyé	Grusi	Atlantic-Congo	Africa	kbp	X	X				Large (7-14)	RTR	/a/ in nouns, not clear if transp or opaque		root-outward	Padayodi, Cecile M. 2010. *A revised phonology of Kabiye segments and tone*. PhD dissertation. Austin: University of Texas.
Igede	Idomoid	Atlantic-Congo	Africa	ige	X	X		X		Large (7-14)	ATR	/a/, not clear if transp or opaq		regressive? (root-outward, language only has prefixes)	Abiodun, Michael. 1991. Vowel harmony in Igede. *Studies in African Linguistics 22, 2.* 157–169.

Igbo	Igboid	Atlantic-Congo	Africa	ibo	X	X	X		complete harmony in one morpheme	Large (7-14)	ATR, very marginal complete	/e, a/, not clear if transp or opaq		bidirectional (root-outward)	Emenanjo, Nolue E. 2015. *A Grammar of Contemporary Igbo*. Port Harcourt: M & J Grand Orbit Communications. 71–84.
Diola / Diola-Fogny, Fogny	Jola	Atlantic-Congo	Africa	dyo	X	X				Large (7-14)	ATR	none		dominant-recessive (stem and affix trigger), bidirectional?	Ringen, Catherine O. 1979. Vowel harmony in Igbo and Diola-Fogny. *Studies in African linguistics 10, 3*. 262–271.
Klao	Kru	Atlantic-Congo	Africa	klu	X	X		X		Large (7-14)	RTR	opaque: low vowels		progressive (root-outward)	Singler, John V. 1983. Vowel harmony in Klao: linear and nonlinear analyses. *Studies in African Linguistics 14, 1*. 1–33.
Konni	Oti-Volta	Atlantic-Congo	Africa	kma	X	X	X			Large (7-14)	ATR	/a/ noted as not being neutral, can alternate with /e/ and /o/		bidirectional (root-outward)	Cahill, Michael Clark. 1996. ATR harmony in Konni. *Ohio State Univ. working papers in linguistics 48*. Columbus: Ohio State University. 13–30.
Akan	Tano	Atlantic-Congo	Africa	aka	X	X			all rounded vowels also back vowels	Large (7-14)	ATR, roundness/backness depending on source	transparent: /a/		bidirectional (root-outward)	O'Keefe, Michael. 2004. *Akan vowel harmony*. Senior Thesis, Swarthmore College.
Waja	Tula-Waja	Atlantic-Congo	Africa	wja	X	X				Large (7-14)	ATR	/a/ noted as not being neutral, at least in all situations		bidirectional (root-outward)	Kleinewillinghöfer, Ulrich. 1990. Aspects of vowel harmony in Waja and Tangale - Waja common vocabulary. *Frankfurter Afrikanistische Blätter (FAB) 2*. 93–106.
Zande	Ubangi	Atlantic-Congo	Africa	zne	X	X	X		reaches across word boundaries, purview is a	Large (7-14)	ATR, some height and roundness			dominant-recessive, regressive	Landi, Germain. 2019. *Phonologie et morphophonologie de la langue Zandé*. PhD dissertation. Cologne:

									phonological phrase						Universität zu Köln. 188–201.
Lokaa / Yakurr	Upper Cross	Atlantic-Congo	Africa	yaz	X	X		X	opaque and transparent	Large (7-14)	ATR	transparent: /i, u/ opaque: /a/ "intermediate": /ə/		regressive? (root-outward, language only has prefixes)	Akinlabi, Akinbiyi. 2006. Neutral vowels in Lokaa harmony. *The Canadian Journal of Linguistics / La revue canadienne de linguistique 54*. 197–228.
Wolof	Wolof	Atlantic-Congo	Africa	wol	X	X			/i, u/ sort of neutral but not quite	Large (7-14)	ATR			progressive? (root-outward, language only has suffixes)	Krämer, Martin. 2003. *Vowel harmony and correspondence theory*. Berlin: De Gruyter. 172–181.
Mbay	Bongo-Bagirmi	Central Sudanic	Africa	myb	X	X		X	some consonants block	Large (7-14)	complete, roundness		if second consonant is obstruent, it blocks. Often sonorants do too	progressive	Keegan, John M. 1995. Sara Vowel System. *Proceedings of the Sixth International Nilo-Saharan Linguistics Conference Santa Monica 1995, March.* 27-29. AND Keegan, John M. 1997. *A Reference Grammar of Mbay*. München: Lincom. 13–23.
Ngiti	Lenduic	Central Sudanic	Africa	niy	X	X		X		Large (7-14)	ATR, some height assimilation	transparent: /a/		regressive? (root-outward, language only has prefixes)	Kutsch Lojenga, Constance. 1994. *Ngiti: A Central-Sudanic Language of Zaire*. Köln: Rüdiger Köppe. 62–82.
Ma'di	Moru-Ma'di	Central Sudanic	Africa	mhi	X	X	X			Large (7-14)	ATR	/a/ somewhat transparent		bidirectional (root-outward)	Blackings, Mairi & Nigel Fabb. 2003. *A Grammar of Ma'di*. New York: De Gruyter. 47–53.
Gaam	Eastern Jebel	Eastern Jebel	Africa	tbi	X	X	X	X	different directionalities for different features, +ATR is spread, not -ATR	Average (5-6)	ATR, roundness	none		ATR VH is dominant-recessive (stem and affix trigger), bidirectional. roundness VH is	Stirtz, Timothy. 2012. *A grammar of Gaahmg, a Nilo-Saharan language of Sudan*. PhD dissertation. Leiden:

														progressive (root-outward)	Rijksuniversiteit te Leiden. 56–59.
Hadza	Hadza	Hadza	Africa	hts	X	X	X	X	/e/ and /o/ raise to /i/ and /u/	Average (5-6)	height	opaque: /a/		regressive (root-outward)	Coburn, Jeremy. 2025. Personal correspondence.
Laru	Heiban	Heiban	Africa	lro	X	X	X	X	limited vh	Large (7-14)	ATR			dominant-recessive (mostly root-outward, also affix control), direction varies by type of trigger	Kuku, Nabil Abdallah. Laru Vowel Harmony. *Occasional papers in the study of Sudanese languages 10*. 17–34.
Opo / Opuo / Tapo	Koman	Koman	Africa	lgn	X	X	X	X		Large (7-14)	ATR	transparent: /a/		dominant-recessive	Mellese, Gelaneh Alemu. 2017. *Documentation and grammatical description of Tapo*. PhD dissertation. Addis Ababa: Addis Ababa University. 38–42.
Maasai	Eastern Nilotic	Nilotic	Africa	mas	X	X		X		Large (7-14)	ATR	opaque: /ɑ/		dominant-recessive (stems and suffixes control)	Quinn-Wriedt, Lindsey Taylor. 2013. *Vowel Harmony in Maasai*. PhD dissertation. Iowa City: University of Iowa.
Kalenjin	Southern Nilotic	Nilotic	Africa	kln	X	X	X			Large (7-14)	ATR			dominant-recessive	Local, John & Ken Lodge. 1996. Another Travesty of Representation: phonological representation and phonetic interpretation of ATR harmony in Kalenjin. *York papers in linguistics 17*. 77–117.
Alur	Western Nilotic	Nilotic	Africa	alz	X	X		X	prefixes do not harmonize	Large (7-14)	ATR			dominant-recessive (stems and suffixes control)	Ozburn, Avery. 2019. An analysis of ATR harmony in Alur. *Proceedings of the 2019 annual conference of the*

															Canadian Linguistic Association.
Dazaga	Western Saharan	Saharan	Africa	dzg	X	X	X	X		Large (7-14)	ATR, some roundness	transparent: /a/		root-outward	Walters, Josiah Keith. 2016. *A grammar of Dazaga*. Leiden: Brill. 34–36.
Dagik	Talodi	Talodi	Africa	dec	X	X	X	X	VH of high vowels is phonemic and they only act as triggers. /ɛ ɔ ə a/ harmonize allophonically.	Large (7-14)	ATR (or possibly height)			progressive (root-outward), some clitics dominant	Vanderelst, John. 2016. *A Grammar of Dagik: A Kordofanian Language of Sudan*. Cologne: Köppe. 9–14.
Tama	Taman	Tamaic	Africa	tma	X	X	X	X		Large (7-14)	ATR, some roundness			dominant-recessive (stems and suffixes control)	Dimmendaal, Gerrit J. 2009. Tama. In: Dimmendaal, Gerrit J. (ed). *Coding Participant Marking: Construction Types in Twelve African Languages*. Amsterdam: John Benjamins. 305–330.
Djingili	Djingili	Mirndi	Australia	jig	X	X	X	X		Small (2-4)	height	no neutral vowels. However, high vowels block harmony, even though they are the triggers.		regressive (suffix control)	Pensalfini, Rob. 2002. Vowel harmony in Jingulu. *Lingua 112, 7*. 561–586.
Bardi / Nyulnyul	Nyulnyulan	Nyulnyulan	Australia	bcj	X	X	X	X	/a/ assimilates into /o/, high vowels and /o/ trigger. In some cases, /a/ assimilates into /i/ or /u/	Small (2-4)	height (?)	no neutral vowels. However, non-low vowels block harmony, even though they are the triggers.		regressive, some progressive	Bowern, Claire. 2012. *A Grammar of Bardi*. Berlin: De Gruyter. 131–133.
Kuku-Yalanji / Gugu Yalandyi	Northern Pama-Nyungan	Pama-Nyungan	Australia	gvn	X	X		X	some suffixes harmonize, trigger is last vowel of stem.	Small (2-4)	complete	/i/		progressive (root-outward)	Patz, Elisabeth. 2002. *A Grammar of the Kuku Yalanji Language of North Queensland*. Canberra: Research School of Pacific and

															Asian Studies, Australian National University. 31–33.
Warlpiri	Western Pama-Nyungan	Pama-Nyungan	Australia	wbp	X	X	X	X	labial consonants /p w/ are opaque	Small (2-4)	roundness	opaque: /a/	labial consonants /p w/ are opaque	progressive (root-outward), regressive (suffix control)	Harvey, Mark & Brett Baker. 2005. Vowel harmony, directionality and morpheme structure constraints in Warlpiri. *Lingua 115, 10*. 1457–1474.
Wardaman	Yangmanic	Yangmanic	Australia	wrr	X	X	X	X	some affixes participate	Average (5-6)	height?	/u/		bidirectional (root-outward)	Merlan, Francesca C. 1994. *A Grammar of Wardaman: A Language of the Northern territory of Australia*. Berlin: De Gruyter. 40–45.
Adyghej / Adyge / West Circassian, Shapsugh	Abkhaz-Adyge	Abkhaz-Adyge	Eurasia	ady	X	X	X	X	harmony based on allophones	Small (2-4)	ATR			root-outward	Wallis, Ethel E. 1987. The dynamics of vocalic harmony in Shapsugh Circassian. *Word 38*. 81–90.
Ainu, Hokkaido	Ainu	Ainu	Eurasia	ain	X	X	X	X	very limited, and more of a tendency rather than a rule	Average (5-6)	complete(?)	/i,e/(?)		progressive (root-outward)	Shiraishi, Hidetoshi & Bert Botma. 2024. 64: Vowel Harmony in Ainu. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 816–823.
Basque dialects	Basque	Basque	Eurasia	eus	X	X	X	X	/a /→ /e/ when preceding syllable contains a high vowel, raising of /e/ to /i/ before a high vowel, anticipatory assimilation of /i/ (and /u/) to /y/ in	Average (5-6)	height(?)			progressive, regressive	Hualde, José Ignacio. 2024. 70: Vowel Harmony in Basque. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 893–898.

									Zuberoan Basque						
Burushaski, Srinagar	Burushaski	Burushaski	Eurasia	bsk	X	X	X	X	/u/ assimilates to /i/, triggered by /i/. Limited to verbs and by some lexical ambiguity avoidance	Average (5-6)	complete	non-high vowels		regressive (dominant-recessive?)	Munshi, Sadaf. 2018. *Srinagar Burushaski: A Descriptive and Comparative Account with Analyzed Texts*. Leiden: Brill. 63–65.
Chukchi	Northern Chukotko-Kamchatkan	Chukotko-Kamchatkan	Eurasia	ckt	X	X	X	X		Average (5-6)	height or ATR	none		dominant-recessive	Kenstowicz, Michael J. 2024. 65: Vowel Harmony in Chukotko-Kamchatkan Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 824–831.
Armenian, Goris	Armenian	Indo-European	Eurasia	hye	X	X	X			Average (5-6)	backness, roundness	opaque: /i, e, ə/, sometimes transparent		progressive (root-outward)	Vaux, Bert & Ariwan Addy Suhairi. 2024. 72: Vowel Harmony in Armenian. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 905–917.
Icelandic	Germanic	Indo-European	Eurasia	isl	X	X			"u-umlaut can have a non-segmental trigger" this makes the inclusion of Icelandic in vh iffy. /ʏ/ triggers u-umlaut. i-umlaut involves loss of roundness	Large (7-14)	height, (loss of) roundness			regressive (suffix control)	Hansson, Gunnar Ólafur & Richard Wiese. 2024. 68: Umlaut in Germanic Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 864–871.

Inner Asia Minor Greek (Cappadocian and Pontic)	Greek	Indo-European	Eurasia	cpg, pnt	X	X		X	last vowel of word spreads (some of) its features to penultimate vowel	Average (5-6)	backness, roundness, height			regressive	Revithiadou, Anthi. 2024. 71: Vowel Harmony in Greek. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 899–904.
Bengali	Indic	Indo-European	Eurasia	ben	X	X			regressive: mid vowels /e æ o ɔ/ raise one step, to /i e u o/ respectively, when the subsequent syllable contains a high vowel. Progressive: /a/ -> /e/ following a syllable with /i/, and to /o/ following a syllable with /u/.	Large (7-14)	height, some roundness on prog vh			regressive, progressive	David, Anne Boyle. 2015. *Descriptive Grammar of Bangla*. Berlin: De Gruyter. 22–31.
Romanian	Romance	Indo-European	Eurasia	ron	X	X			stressed vowels targeted, alternate between mid and low	Large (7-14)	height			regressive (stress-based)	Canalis, Stefano & Jesús Jiménez & Maria-Rosa Lloret & Margaret E. L. Renwick. 2024. 69: Vowel Harmony in Romance Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 872–892.
Korean	Korean	Koreanic	Eurasia	kor	X	X	X		based on previous RTR	Large (7-14)	"dark–light"			suffixal harmony progressive (root-outward), ideophone	Ko, Seongyeon. 2024. 63: Vowel Harmony in Korean. In: Ritter, Nancy A. &

														harmony root-internal	Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 806–815.
Halh Mongolian / Khalkha	Mongolic	Mongolic-Khitan	Eurasia	khk	X	X	X		roundness only applies to non-high vowels	Large (7-14)	ATR/RTR, roundness	for ATR, transparent: /i/. For roundness, opaque: high rounded vowels /ʊ/ and /u/		progressive (root-outward)	Svantesson, Jan-Olof. 2024. 60: Vowel Harmony in Mongolic Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 774–779.
Khinalug	Khinalug	Nakh-Daghestani an	Eurasia	kjj	X	X		X	roundness harmony triggered by stressed round vowel	Large (7-14)	backness, some roundness			progressive (root-outward), roundness regressive(?), stress-based	Khvtisiashvili, Tamrika. 2013. *Principal aspects of Xinaliq phonology and morphosyntax*. PhD dissertation. Salt Lake City: University of Utah. 36–38.
Lezgi / Lezgian	Lezgic	Nakh-Daghestani an	Eurasia	lez	X	X	X		triggered by stressed vowel	Average (5-6)	backness, roundness	The low and mid vowels /a, æ, e/ are neutral with respect to Labial Vowel Harmony		regressive (stress-based)	Haspelmath, Martin. 1993. *A Grammar of Lezgian*. Berlin: De Gruyter. 48–50.
Nivkh	Nivkh	Nivkh	Eurasia	niv	X	X	X		A vowel in an unstressed syllable can be mid or low only if the vowel in the preceding stressed syllable is also mid or low	Average (5-6)	height or ATR			progressive (only roots participate, stress-based)	Botma, Bert & Hidetoshi Shiraishi. 2024. 62: Vowel Harmony in Nivkh. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 799–805.

Sumi / Sumi Naga / Sema	Angami-Pochuri	Sino-Tibetan	Eurasia	nsm	X	X	X		Sesquisyllable harmonizes with following syllable's backness. Similar process with prefix kV-. Three harmonic classes.	Average (5-6)	backness			regressive	Teo, Amos B. 2014. *A phonological and phonetic description of Sumi, a Tibeto-Burman language of Nagaland*. Canberra: Asia-Pacific Linguistics College of Asia and the Pacific, The Australian National University. 30.
Lhasa Tibetan	Bodic	Sino-Tibetan	Eurasia	bod	X	X	X			Large (7-14)	height			dominant-recessive (bidirectional, stems and affixes control)	Chirkova, Katia. 2024. 58: Vowel Harmony in Sino-Tibetan Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmo*ny. Oxford: Oxford University Press. 729–740.
Qiang, Yadu	Na-Qiangic	Sino-Tibetan	Eurasia	cng	X	X		X	VH also in compounds	Large (7-14)	backness, height, ATR, roundness, rhotic			backness and height bidirectional(?), root-outward. Roundness bidirectional, root-outward?. Rhotic regressive.	Chirkova, Katia. 2024. 58: Vowel Harmony in Sino-Tibetan Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 729–740.
Manchu, Dawujiazi	Tungusic	Tungusic	Eurasia	mnc	X	X	X	X		Large (7-14)	RTR, some roundness	transparent in stem: /i, u/. Opaque in suffix: /u/. /y/ also neutral, don’t know what kind		progressive(?) (root-outward(?))	Li, Bing & Norval Smith. 2024. 61: Vowel Harmony in Tungusic Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 780–798.

Turkish	Turkic	Turkic	Eurasia	tur	X	X	X			Large (7-14)	backness, roundness	opaque: non- high unrounded vowels block rounding harmony		progressive (root-outward)	Bacanlı, Eyüp & Darin Flynn & Amanda Pounder. 2021. Vowel Harmony and Other Morphological Processes in Turkish. *Proceedings of the Workshop on Turkic and Languages in Contact with Turkic 5*. 26–40. AND Krämer, Martin. 2024. 21: Non-Alternating, Non-Participating, And Idiosyncratic Vowels. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 244–268.
Finnish	Finnic	Uralic	Eurasia	fin	X	X				Large (7-14)	backness (very marginal complete)	transparent: /i, e/		progressive (root-outward)	Fejes, László. 2022. A general characterisation of vowel harmony in Uralic languages. *Finnish Journal of Linguistics 35*. 7–50.
Meadow Mari	Mari	Uralic	Eurasia	mhr	X	X			/ə̆/ harmonizes when it is word-final, otherwise it is transparent	Large (7-14)	roundness, backness (in rounded vowels)	transparent: /ə̆/		progressive (root-outward)	Fejes, László. 2022. A general characterisation of vowel harmony in Uralic languages. *Finnish Journal of Linguistics 35*. 7–50.
Erzya	Mordvin	Uralic	Eurasia	myv	X	X			/e/ and /o/ harmonize and are in opposition	Average (5-6)	backness, roundness?	opaque: /a, i, u/	palatalization heavily intertwined with frontness. Palatalized consonants trigger frontness and vice versa,	progressive (root-outward)	Fejes, László. 2022. A general characterisation of vowel harmony in Uralic languages. *Finnish Journal of Linguistics 35*. 7–50.

													though backness harmony happens without consonants as well.		
Udmurt	Permic	Uralic	Eurasia	udm	X	X	X			Large (7-14)	backness	/i, e/		progressive (root-outward)	Fejes, László. 2022. A general characterisation of vowel harmony in Uralic languages. *Finnish Journal of Linguistics 35*. 7–50. AND Edygarova, Svetlana. 2022. Udmurt. In: Bakró-Nagy, Marianne & Johanna Laakso & Elena Skribnik (eds). *The Oxford guide to the Uralic languages*. Oxford: Oxford University Press. 507-522.
Lule Saami	Saami	Uralic	Eurasia	smj	X	X			complete harmony triggered by /ɔː/ in initial syllable, targets /ɑː/ in second syllable	Large (7-14)	complete, height (umlaut)			complete progressive, umlaut regressive	Fejes, László. 2022. A general characterisation of vowel harmony in Uralic languages. *Finnish Journal of Linguistics 35*. 7–50. AND Tamás, Ildikó. 2006. The Lule Saami vocalism. *Nyelvtudományi Közlemények 103*. 7–25.
Nganasan	Samoyedic	Uralic	Eurasia	nio	X	X		X	complete harmony causes diphthongization	Large (7-14)	roundness, restricted backness (trigger and target high), very limited complete	/ə/ can spoil harmony even from a position before both trigger and target		progressive (root-outward)	Fejes, László. 2022. A general characterisation of vowel harmony in Uralic languages. *Finnish Journal of Linguistics 35*. 7–50.
Hungarian	Ugric	Uralic	Eurasia	hun	X	X			back vowels neutral for	Large (7-14)	backness, roundness	transparent and opaque		progressive (root-outward)	Fejes, László. 2022. A general characterisation of vowel harmony in

									roundness harmony.						Uralic languages. *Finnish Journal of Linguistics 35*. 7–50.
Kolyma Yukaghir / Southern Yukaghir	Yukaghir	Yukaghir	Eurasia	yux	X	X	X	X	/u/ is harmonically front. Roundness operates only in non-high vowels. Optional harmony harmonizes /ə/ for backness and roundness	Average (5-6)	backness, roundness	transparent: short /i/		obligatory harmony limited to root. Optional harmony bidirectional (root-outward), but does not include inflectional suffixes, only derivational suffixes and proclitics.	Nikolaeva, Irina. 2024. 66: Vowel Harmony in Yukaghir. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 832–839.
Arapaho	Algonquia n	Algic	North America	arp	X	X	X	X	prog harmony targets /ɪ/ to /ɯ/, triggered by ɔ. Regressive harmony also triggered by ɔ, targets /ɛ/ to /ɔ/. /b, tʃ, n, s, t, j/ block prog harmony, regressive harmony also blocked by /θ/.	Small (2-4)	backness(?)	none	/b, tʃ, n, s, t, j/ block prog harmony, regressive harmony also blocked by /θ/.	progressive, regressive	Rice, Keren. 2024. 53: Vowel Harmony in North American Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 658–690.
Yurok	Yurok	Algic	North America	yur	X	X				Average (5-6)	rhoticity	transparent: high vowels		bidirectional (root-outward)	Rice, Keren. 2024. 53: Vowel Harmony in North American Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 658–690.
Garifuna	Antillean Arawakan	Arawakan	North America	cab	X	X			loanwords ending in non-nasal consonants get an epenthetic vowel, which is either /i/ or	Average (5-6)	backness			progressive (root-outward)	Quesada, J. Diego. 2017. *Gramática de la lengua garífuna*. Sonora: Universidad de Sonora. 46.

									/u/ depending on whether the last vowel of the root is front or not						
Diné Bizaad / Navajo	Athapaska n	Athabaskan -Eyak-Tlingit	North America	nav	X	X	X	X	adjacent vowels. Two types of assimilation. VCV assimilates /a/ and /o/. VV assimilates /i/ and /o/	Small (2-4)	backness, height		non-velar consonants block VCV, /t/ and velars block assimilation of /i/	bidirectional (root-outward)	Kari, James M. 1976. *Navajo Verb Prefix Phonology*. New York: Garland Publishing. 61–79.
Hanis / Coos	Coosan	Coosan	North America	csz	X	X	X	X	/e/ and /a/ assimilate each other	Average (5-6)	complete?	/i, u, ə/		regressive (suffix control), progressive (root-outward)	Frachtenberg, Leo J. 1922. Coos. In: Boas, Franz (ed). *Handbook of American Indian languages: Volume 2*. Washington: Government Printing Office. 297–430. AND Rice, Keren. 2024. 53: Vowel Harmony in North American Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 658–690.
Tol	Tol	Jicaquean	North America	jic	X	X	X	X		Average (5-6)	height	/a/		root-outward	Holt, Dennis. 1999. *Tol (Jicaque)*. München: Lincom. 14.
Huastec	Mayan	Mayan	North America	hus	X	X	X	X		Average (5-6)	complete			regressive (suffix control)	Kondić, Snježana. 2012. *A Grammar of South Eastern Huastec, a Mayan Language from Mexico*. PhD dissertation. Sydney: University of Sydney. 50–54.

Zoque, Chimalapa	Mixe-Zoque	Mixe-Zoque	North America	zoh	X	X	X	X		Average (5-6)	height			progressive (root-outward)	Johnson, Heidi Anna. 2000. *A Grammar of San Miguel Chimalapa Zoque*. PhD dissertation. Austin: University of Texas. 32–35.
Mazahua, Central	Otomian	Otomangue an	North America	maz	X	X	X	X		Small (2-4)	backness, nasal, complete		glottals cause complete harmony	progressive (root-outward)	Spotts, Hazel. 1953. Vowel Harmony and Consonant Sequences in Mazahua (Otomí). *International Journal of American Linguistics 19, 4.* 253–258.
Southern Pomo	Pomoan	Pomoan	North America	peq	X	X	X	X		Average (5-6)	height, complete	none	glottal stop causes complete harmony	regressive	Walker, Neil Alexander. 2013. *A Grammar of Southern Pomo: An Indigenous Language of California*. PhD dissertation. Santa Barbara: University of California at Santa Barbara. 111–130.
Nez Percé	Sahaptian	Sahaptian	North America	nez	X	X	X	X		Average (5-6)	ATR?			dominant-recessive	Nelson, Katherine Elizabeth. 2013. The Nez Perce vowel system: A phonetic analysis. *Proceedings of Meetings on Acoustics 19*. AND Krämer, Martin. 2003. *Vowel harmony and correspondence theory*. Berlin: De Gruyter. 209–215.
Coeur d'Alene	Interior Salish	Salishan	North America	crd	X	X	X	X		Average (5-6)	ATR		regressive harmony is triggered by pharyngeal resonants, uvular stops and fricatives, and /r/.	regressive, progressive	Doak, Ivy G. 1992. Another Look at Coeur d'Alene Harmony. *International Journal of American Linguistics 58, 1.* 1–35.

													faucal consonants are opaque to this regressive harmony. Pharyngeal consonants opaque for progressive pharyngeal harmony		
Tunica	Tunica	Tunica	North America	tun	X	X	X	X	harmony targets low vowels	Large (7-14)	backness, roundness	non-low vowels	glottals spread harmony. Other consonants opaque		Krämer, Martin. 2003. *Vowel harmony and correspondence theory*. Berlin: De Gruyter. 23.
Cupeño	Northern Uto-Aztecan	Uto-Aztecan	North America	cup	X	X	X	X	vowels in unstressed syllables adjacent to stressed high vowels /i/ and /u/ to assimilate to those vowels.	Average (5-6)	height/complete			bidirectional, root-outward (stress-based)	Hill, Jane A. 2005. A *Grammar of Cupeño*. Los Angeles: University of California Press. 41–46.
Washo	Washo	Washo	North America	was	X	X	X		in some dialects, trigger must be stressed	Average (5-6)	height/complete	none		regressive	Jacobsen, William H., Jr. 1964. *A Grammar of the Washo Language*. PhD dissertation. Berkeley: University of California at Berkeley. 52, 300–303.
Wintu	Wintuan	Wintuan	North America	wnw	X	X	X		applies to morphophoneme V	Average (5-6)	complete			progressive	Pitkin, Harvey. 1984. *Wintu Grammar*. Los Angeles: University of California Press. 25, 45.
Guazacapán Xinca	Xincan	Xincan	North America	xin	X	X	X			Average (5-6)	height	opaque: /a/		progressive(?)(root-outward) language has no eligible prefixes.	Rogers, Chris. 2018. Xinkan Vowel Harmony Revisited. *Anthropological Linguistics 60, 4*. 320–345.

Valley Yokuts, Chauchila	Yokuts	Yokutsan	North America	yok	X	X	X	X	target /i/ assimilates to trigger /u/. Used to be rounding harmony for non-high as well	Average (5-6)	roundness (dependent on height)	non-high vowels		progressive (root-outward)	Weigel, William Frederick. 2005. *Yowlumne in the twentieth century*. PhD dissertation. Berkeley: University of California at Berkeley. 3, 102–108.
Seediq	Atayalic	Austronesian	Papunesia	trv	X	X		X	pre-stress vowel assimilates to stressed vowel if they are separated by /h/ or glottal stop. Otherwise, pre-stress vowel is /u/	Average (5-6)	complete		pre-stress vowel assimilates to stressed vowel if they are separated by /h/ or glottal stop.	regressive (stress-based)	Holmer, Arthur J. 1996. *A Parametric Grammar of Seediq*. PhD dissertation. Lund: Lund University. 24–28.
Tajio	Celebic	Austronesian	Papunesia	tdj	X	X		X	three degrees of backness. complete vh affects infix -ngV- and is determined by one of three prefixes	Average (5-6)	backness, complete			backness regressive (root-outward). complete progressive (prefix control, affecting infix), regressive (root-outward, affecting ordinal prefix)	Mayani, Luh Anik. 2013. *A Grammar of Tajio: A language spoken in central Sulawesi.* PhD dissertation. Cologne: Universität zu Köln. 36, 53–54.
Kapampangan	Central Luzon	Austronesian	Papunesia	pam	X	X		X	one prefix harmonizes to first vowel of root	Average (5-6)	complete			regressive (root-outward)	Blust, Robert. 2013. *The Austronesian Languages*. Canberra: Asia-Pacific Linguistics. 258.
Amarasi	Central Malayo-Polynesian	Austronesian	Papunesia	aaz	X	X		X	any final mid vowel assimilates to the height of a previous high vowel after metathesis	Average (5-6)	height			progressive	Edwards, Owen. 2020. *Metathesis and unmetathesis in Amarasi*. Berlin: Language Science Press. 91, 177.
Chamorro	Chamorro	Austronesian	Papunesia	cha	X	X	X	X		Average (5-6)	backness, height			progressive (stress-based)	Topping, Donald M. 1968. Chamorro Vowel Harmony.

															Oceanic Linguistics 7, 1. 67–79.
Central Tagbanwa	Greater Central Philippine	Austronesian	Papunesia	tgt	X	X		X	only prefixes and infixes affected	Small (2-4)	complete			regressive (root-outward), progressive (prefix control)	Gasser, Emily. 2024. 76: Vowel Harmony in Austronesian Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 947–962. AND Scebold, Robert A. 2003. *Central Tagbanwa: A Philippine language on the brink of extinction: Sociolinguistics, grammar, and lexicon*. Manila: Linguistic Society of the Philippines. 29.
Javanese	Javanese	Austronesian	Papunesia	jav	X	X		X	only root affected	Average (5-6)	RTR			regressive	Gasser, Emily. 2024. 76: Vowel Harmony in Austronesian Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 947–962. AND Adisasmito-Smith, Niken. 1999. Influence of Javanese Vowel Patterning on Indonesian: An Acoustic Investigation. *14th International Congress of Phonetic Sciences.* 1109–1112.

Sundanese	Malayo-Sumbawan	Austronesian	Papunesia	sun	X	X		X		Large (7-14)	nasality		nasals trigger, glottals transparent, others opaque	progressive	Gasser, Emily. 2024. 76: Vowel Harmony in Austronesian Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony.* Oxford: Oxford University Press. 947–962. AND Müller-Gotama, Franz. 2001. *Sundanese*. München: Lincom. 6–7.
Kimaragang Dusun	North Borneo	Austronesian	Papunesia	kqr	X	X	X	X	/o/ harmonizes to /a/ when the immediately following vowel is /a/, this then spreads iteratively	Small (2-4)	complete	opaque: high vowels		regressive	Kroeger, Paul R. 1994. Vowel Harmony, Neutralization and Inalterability in Dusun vs. Murut. *Seventh International Conference on Austronesian Linguistics*. 1–5.
Pazeh	Northwest Formosan	Austronesian	Papunesia	pzh	X	X		X	limited to one prefix mu-, whose vowel assimilates to schwa	Small (2-4)	complete			regressive (root-outward)	Gasser, Emily. 2024. 76: Vowel Harmony in Austronesian Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony.* Oxford: Oxford University Press. 947–962. AND Blust, Robert. 1999. Notes on Pazeh Phonology and Morphology. *Oceanic Linguistics 38, 2.* 321–365.
Batak Karo	Northwest Sumatra-Barrier Islands	Austronesian	Papunesia	btx	X	X	X	X		Large (7-14)	RTR/height			regressive	Woollams, Geoff. 1996. *A Grammar of Karo Batak, Sumatra*. Canberra: Research School of Pacific and Asian Studies,

															Australian National University. 18, 32.
Mwotlap	Oceanic	Austronesian	Papunesia	mlv	X	X		X	complete vh affects adjacent vowel	Large (7-14)	RTR, complete			RTR dominant-recessive (regressive), complete progressive	François, Alexandre. 2001. *Constraintes de Structures et Liberté dans l'organisation du Discours: Une description du Mwotlap, langue océanienne du Vanuatu*. PhD dissertation. Université de la Sorbonne (Paris IV). 75, 93–114. AND François, Alexandre. 2005. A typological overview of Mwotlap, an Oceanic language of Vanuatu. *Linguistic Typology 9, 1*. 115–146.
West Coast Bajau	Sama-Bajaw	Austronesian	Papunesia	bdr	X	X		X	complete: when /e/ occurs in the penultimate syllable, /e/ must occur in the final syllable, and same with /o/.	Average (5-6)	complete, height			complete progressive (root-outward), height regressive (suffix control)	Miller, Mark T. 2007. *A Grammar of West Coast Bajau*. PhD dissertation. Arlington: University of Texas at Arlington. 36, 45, 54–55.
Selayarese	South Sulawesi	Austronesian	Papunesia	sly	X	X		X	"Mid vowels anywhere in a word are lowered before an immediately following /a/." They go from mid to mid-low.	Average (5-6)	height	transparent: nasalized mid vowels		regressive	Mithun, M. & H. Basri. 1986. The Phonology of Selayarese. *Oceanic Linguistics 25, 2.* 210–254.
Saaroa	Tsou	Austronesian	Papunesia	sxr	X	X		X	high vowels take part. Two types: /ɨ/ to /i/ and /u/ to /ɨ/	Small (2-4)	backness/complete	opaque, not sure which.		regressive (root-outward)	Pan, Chia-jung. 2012. *A Grammar of Lha'alua, an Austronesian Language of Taiwan*. PhD dissertation. Townsville: James

															Cook University. 28–29, 42–44.
Umbu-Ungu	Chimbu-Wahgi	Nuclear Trans New Guinea	Papunesia	ubu	X	X	X	X		Average (5-6)	height, backness, complete			progressive (root-outward) and regressive (suffix control)	Head, June. 2011. *A grammar of Umbu-Ungu*. Ukarumpa: SIL. 3–7.
Amele	Mabuso	Nuclear Trans New Guinea	Papunesia	aey	X	X	X	X	limited vh. Suffix control in verbs, stem control in nouns	Average (5-6)	complete			progressive (suffix control), regressive (suffix control), progressive (root-outward)	Roberts, John R. 2016. *Amele RRG Grammatical Sketch*. SIL International. 71–74.
Mian	Ok	Nuclear Trans New Guinea	Papunesia	mpt	X	X	X	X	limited vh. /i, ɛ, o/ participate	Average (5-6)	complete			regressive, progressive	Fedden, Sebastian Olcher. 2011. *A Grammar of Mian*. Berlin: De Gruyter. 28, 44–46.
Yagaria	Siane-Yagaria	Nuclear Trans New Guinea	Papunesia	ygr	X	X	X	X	schwas assimilate to non-reduced vowels	Average (5-6)	complete		all consonants except /r/ and /ɣ/ block.	regressive	Haiman, John. 1980. *HUA: A Papuan Language of the Eastern Highlands of New Guinea*. Amsterdam: John Benjamins. 27–32.
Kaera	Alor-Pantar	Timor-Alor-Pantar	Papunesia	jka	X	X	X	X		Average (5-6)	complete	only first unstressed vowel of stem triggers		regressive (root-outward, stress-based)	Klamer, Marian. 2024. 75: Vowel Harmony in Papuan Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 935–946.
Ngkontar Ngkolmpu / Ngkâlmpw / Kanum	Kanum	Yam	Papunesia	kcd	X	X	X	X	restricted to one prefix, can have one of three vowels, [ɛ], [a] or [ɔ]	Large (7-14)	backness (three classes: front, back and central)	only first vowel of stem triggers		regressive (root-outward)	Carroll, Matthew. 2017. *The Ngkolmpu Language with special reference to distributed exponence*. PhD dissertation. Canberra: Australian National University. 54–55.

Mehinaku	Central Arawakan	Arawakan	South America	mmh	X	X			harmony based on allophones	Average (5-6)	complete			bidirectional (root-outward)	De Felipe, Paulo Henrique Pereira Silva. 2020. *Fonologia e Morfossintaxe da língua Mehináku (Arawak*). PhD dissertation. Campinas: Universidade Estadual de Campinas. 101–108.
Wayuunaiki / Wayuu / Goajiro / Guajiro	Guajiro-Paraujano	Arawakan	South America	guc	X	X	X	X		Average (5-6)	backness, roundness			backness regressive (root-outward). Roundness bidirectional (root-outward)	Nikulin, Andrey. 2024. 55: Vowel Harmony in South American Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 700–711.
Tariana	Japura-Colombia	Arawakan	South America	tae	X	X				Large (7-14)	complete		root-initial harmony requires root to start with /h/	progressive (prefix control), regressive (stress-based)	Aikhenvald, Alexandra Y. 2003. *A Grammar of Tariana, from Northwestern Amazonia*. Cambridge: Cambridge University Press. 32, 44–45.
Ye'kwana	Cariban	Cariban	South America	mch	X	X	X	X	targets /ə/, which assimilates to and triggered by /o/	Large (7-14)	roundness? Because non-rounded vowels opaque	opaque: non-rounded vowels		bidirectional (root-outward)	Cáceres, Natália. 2011. *Grammaire fonctionnelle-typologique du ye'kwana, langue caribe du Venezuela*. PhD dissertation. Lyon: Université Lumière Lyon 2. 65–67. AND Nikulin, Andrey. 2024. 55: Vowel Harmony in South American Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford*

															Handbook of Vowel Harmony. Oxford: Oxford University Press. 700–711.
Cayuvava / Cayubaba	Cayuvava	Cayuvava	South America	cyb	X	X	X	X	triggered by nasal vowels and consonants	Large (7-14)	nasality		nasals trigger	bidirectional (root-outward)	Crevels, Mily & Pieter Muysken. 2023. 6: Cayubaba. In: Epps, Patience & Lev Michael (eds). 2023. *Amazonian Languages, Volume 1, Language Isolates I: Aikanã to Kandozi-Shapra: An International Handbook*. Boston: De Gruyter. 263–300.
Chiquitano	Chiquitan o	Chiquitano	South America	cax	X	X	X	X	limited vh.	Average (5-6)	complete, height?			progressive (root-outward)	Krüsi, Martin & Dorothy Krüsi. 1978. Phonology of Chiquitano. *Work Papers of the Summer Institute of Linguistics 1972–1976*. 53–93.
Mocoví	Qom	Guaicuruan	South America	moc	X	X	X	X		Small (2-4)	height, roundness			height regressive, roundness bidirectional	Gualdieri, Cecilia Beatriz. 1998. *Mocoví (Guaicurú): Fonologia e Morfossintaxe*. PhD dissertation. Campinas: Universidade Estadual de Campinas. 27, 78–81.
Kakua / Cacua	Kakua-Nukak	Kakua-Nukak	South America	cbv	X	X	X	X		Average (5-6)	complete, nasality			progressive (root-outward)	Bolaños, Katherine. 2016. *A Grammar of Kakua*. PhD dissertation. Amsterdam: Universiteit van Amsterdam.
Nivaĉle / Nivaclé	Mataguay an / Matacoan	Mataguaya n / Matacoan	South America	cag	X	X	X	X	limited vh.	Small (2-4)	complete		harmony occurs across a glottal stop, not across consonants	progressive, regressive	Gutiérrez, Analía. 2016. The variable prosodic parsings of Nivaĉle glottal stop. *LIAMES: Línguas Indígenas*

													specified for place (all other consonants)		*Americanas 16, 2*. 323–347.
Mochica	Mochica	Mochica	South America	omc	X	X	X		limited: harmony triggered by genitive inflection and locative case suffix	Average (5-6)	height			regressive (suffix control)	Eloranta-Barrera Virhuez, Rita Silvia. 2020. *Mochica: grammatical topics and external relations*. PhD dissertation. Leiden: Rijksuniversiteit te Leiden. 114, 129–131.
Hup	Naduhup	Naduhup	South America	jup	X	X	X	X		Large (7-14)	complete		consonant cluster simplification always accompanies vowel harmony, and in fact appears to be a prerequisite for vowel harmony to occur	vowel copy onto unspecified morphemes progressive (root-outward), complete harmony regressive (root-outward)	Epps, Patience. 2008. *A grammar of Hup*. New York: De Gruyter. 42, 102–105.
Karajá	Karajá	Nuclear Macro-Je	South America	kpj	X	X	X			Large (7-14)	ATR	opaque: /a, ẽ, õ, ã/		dominant-recessive (regressive)	Ribeiro, Eduardo Rivail. 2012. *A grammar of Karajá*. PhD dissertation. Chicago: University of Chicago. 86, 101–116.
Maxakalí	Maxakalian	Nuclear Macro-Je	South America	mbl	X	X		X		Average (5-6)	nasality		voiceless consonants block, nasal consonants also trigger	bidirectional	Wetzels, W. Leo. 2009. Nasal harmony and the representation of nasality in Maxacalí. In: Calabrese, Andrea & W. Leo Wetzels (eds). 2009. *Loan Phonology*. Amsterdam: John Benjamins. 241–269.

Cubeo	Tucanoan	Tucanoan	South America	cub	X	X	X	X	no harmony within the root, just across morphemes	Average (5-6)	nasality		voiceless consonants block	progressive (root-outward)	Chacon, Thiago Costa. 2012. *The phonology and morphology of Kubeo: The documentation, theory, and description of an Amazonian language*. PhD dissertation. Mānoa: University of Hawai'i at Mānoa. 9, 86–107.
Paraguayan Guarani	Maweti-Guarani	Tupian	South America	gug	X	X		X		Large (7-14)	nasality		nasal consonants also trigger, though only regressive harmony.	regressive, limited progressive	Estigarribia, Bruno. 2020. *A Grammar of Paraguayan Guarani*. London: UCL Press. 26–27, 39–44.
Mundurukú	Munduruk u	Tupian	South America	myu	X	X				Average (5-6)	nasality		obstruents (stops and fricatives) block. (Sonorants (nasal consonants, approximant s) and laryngeals (also sonorants in this language) targeted)	regressive	Picanço, Gessiane Lobato. 2005. *Munduruku: Phonetics, phonology, synchrony, diachrony*. PhD dissertation. Vancouver: University of British Columbia. 17, 218–246.
Tuparí	Tupari	Tupian	South America	tpr	X	X	X			Average (5-6)	nasality	none	nasal consonants also trigger. Fricatives and affricates block. Voiceless stops sometimes block (and sometimes are targets) (Sonorants targeted)	progressive (roots and affixes). Also some regressive (pronominal prefixes nasalize prior to nasal material)	Singerman, Adam Roth. 2016. Nasal Harmony and Phonotactic Well-Formedness in Tupari. *International Journal of American Linguistics 82, 4.* 453–485.

Warao	Warao	Warao	South America	wba	X	X	X	X		Average (5-6)	nasality	none	voiceless consonants block. (all voiced sounds targeted)	progressive (root-outward)	Peng, Long. 2000. Nasal Harmony in Three South American Languages. *International Journal of American Linguistics 66, 1.* 76–97.
Yanomám, Yanomama (Papiu)	Yanomam	Yanomamic	South America	wca	X	X	X	X	triggers and targets of both types limited to clitics	Large (7-14)	height, complete			regressive (suffixal clitics affect other suffixal clitics).	Perri Ferreira, Helder. 2017. *Yanomama Clause Structure*. PhD dissertation. Nijmegen: Radboud Universiteit Nijmegen. 37, 66–72.
Chamacoco	Zamucoan	Zamucoan	South America	ceg	X	X	X	X	complete limited to certain affixes and clitics	Average (5-6)	nasality, complete		voiceless stops, affricates and sibilants /s/ and /ʐ/ can block nasal spread	nasal bidirectional (root-outward). complete regressive, progressive	Ciucci, Luca. 2020. Wordhood in Chamacoco. In: Aikhenvald, Alexandra Y. & R. M. W. Dixon & Nathan M. White (eds). *Phonological Word and Grammatical Word: A Cross-Linguistic Typology*. Oxford: Oxford University Press. 78–120.

B. Languages in the Phenomenon Sample that are not in the Core Sample

Language name / other name, dialect	Genus	Family	Macro area	Iso	GS	Reference
Buwal	Biu-Mandara	Afro-Asiatic	Africa	bhs	X	Viljoen, Melanie. 2009. *A Phonology of Buwal*. Yaoundé: SIL Yaounde.
Musey	Masa	Afro-Asiatic	Africa	mse	X	Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Burunge	Southern Cushitic	Afro-Asiatic	Africa	bds	X	Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.

Adyukru	Agneby	Atlantic-Congo	Africa	adj	X	Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Bijago / Bidyogo	Bijogo?	Atlantic-Congo	Africa	bjg	X	Hudu, Fusheini. 2023. The Vowels of West African Languages. *Journal of West African Languages 50*. 1–18.
Anaguta	Central Kainji	Atlantic-Congo	Africa	nar	X	Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Ega	Ega	Atlantic-Congo	Africa	ega	X	Connell, Bruce & Firmin Ahoua & Dafydd Gibbon. 2002. Ega. *Journal of the International Phonetic Association 32*. 99–104.
Gade	Gade	Atlantic-Congo	Africa	ged	X	Sterk, Jan P. 1977. *Elements of Gade Grammar*. PhD dissertation. Madison: University of Wisconsin.
Gbaya-Bossangoa	Gbaya-Manza-Ngbaka	Atlantic-Congo	Africa	gbp	X	Samarin, William J. 1966. *The Gbeya Language: Grammar, Texts, and Vocabularies*. Los Angeles: University of California Press. 28.
Ewe	Gbe	Atlantic-Congo	Africa	ewe	X	Deklu, Gladstone. 2021. *Ewe vowel harmony: implications for theories of underspecification*. PhD dissertation. St. John's: Memorial University of Newfoundland.
Hõne	Jukunoid	Atlantic-Congo	Africa	juh	X	Harley, Matthew. 2024. Vowel Systems in Nigerian Languages: Genetic Typology vs Areal Characteristics. *Pushing the Boundaries: Selected Papers from the 51-52 Annual Conference on African Linguistics*. 375–410.
Lobi	Lobiri-Jaane	Atlantic-Congo	Africa	lob	X	Becuwe, Jacques. 1982. *Eléments de phonologie et de grammaire du lobiri*. PhD dissertation. Paris: Institut national des langues et civilisations orientales.
Efik, Calabar	Lower Cross	Atlantic-Congo	Africa	efi	X	Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Fula / Fulani, Adamawa	Peul-Serer	Atlantic-Congo	Africa	ful	X	Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Esimbi	Tivoid	Atlantic-Congo	Africa	ags	X	Kalinowski, Cristin. 2009. Multidirectional Vowel Harmony in Esimbi. *BLS 35, 1*. 147–155.
Yemba / Dschang	Wide Grassfields	Atlantic-Congo	Africa	ybb	X	Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Mangbetu	Mangbetu	Central Sudanic	Africa	mdj	X	Demolin, Didier. 1992. *Le mangbetu: étude phonétique et phonologie*. PhD dissertation. Brussels: Université libre de Bruxelles.
Lese	Mangbutu-Efe	Central Sudanic	Africa	les	X	Lojenga, Constance Kutsch. 2024. 49: Vowel Harmony in Nilo-Saharan Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 610–624.
Shatt	Dajuic	Dajuic	Africa	shj	X	Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Fur	Furan	Furan	Africa	fvr	X	Lojenga, Constance Kutsch. 2024. 49: Vowel Harmony in Nilo-Saharan Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 610–624.
Ijo / Kolokuma	Ijoid	Ijoid	Africa	ijc	X	Akinlabi, A. 1995. ATR harmony in Kalabari Ijo. In: Emenanjo, E. 'Nolue & Ozo-mekuri Ndimele (eds). Issues in African languages and linguistics. Essays in honour of Kay Williamson. Aba: National Institute for Nigerian Languages. 70–81.
Katcha	Kadugli	Kadu	Africa	xtc	X	Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.

Tima	Katla-Tima	Katla-Tima	Africa	tms	X	Tabain, Marija & Padgett, Jaye & Schneider-Blum, Gertrud & Gregory, Adele & Beare, Richard. 2024. An acoustic study of ATR in Tima vowels: vowel quality, voice quality and duration. *Phonology. 41.* 1–28.
Nama	Khoe-Kwadi	Khoe-Kwadi	Africa	naq	X	Gordon, Matthew K. & Michael Fiddler. 2024. 46: Vowel Harmony: Statistical Perspectives on Typological Distribution. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 585–592.
Masalit	Maban	Maban	Africa	mls	X	Hellmuth, Sam & Mary Pearce. 2020. 13: North Africa and the Middle East. In: Gussenhhoven, Carlos, & Aoju Chen (eds). *The Oxford Handbook of Language Prosody*. Oxford: Oxford University Press. 195–206.
Busa / Bisa	Eastern Mande	Mande	Africa	bqp	X	Obeng, Samuel Gyasi. 1993. Vowel harmony in Bisa. *AAP (Afrikanistische Arbeitspapiere) 36.* 115–123.
Susu	Western Mande	Mande	Africa	sus	X	Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Dilling, Debri	Nubian	Nubian	Africa	dil	X	Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Tagoi	Rashad	Rashad	Africa	tag	X	Bashir, Abeer M. A. & Sharon Rose. 2024. 50: Vowel Harmony in Niger-Congo Languages of the Nuba Mountains. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 625–632.
Beria / Zaghawa	Eastern Saharan	Saharan	Africa	zag	X	Lojenga, Constance Kutsch. 2024. 49: Vowel Harmony in Nilo-Saharan Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 610–624.
Songhay / Songhai	Songhay	Songhay	Africa	dje, ddn	X	Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Tirma-Chai / Suri	South Surmic	Surmic	Africa	suq	X	Lojenga, Constance Kutsch. 2024. 49: Vowel Harmony in Nilo-Saharan Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 610–624.
Temein / Ronge	Temein	Temeinic	Africa	teq	X	Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Mangarrayi	Mangarrayi	Mangarrayi-Maran	Australia	mpc	X	Gordon, Matthew K. & Michael Fiddler. 2024. 46: Vowel Harmony: Statistical Perspectives on Typological Distribution. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 585–592.
Wagiman	Wagiman	Wagiman	Australia	waq	X	Pensalfini, Rob. 2024. 74: Vowel Harmony in Australian Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 925–934.
Mundari / Bhumij	Munda	Austroasiatic	Eurasia	unr	X	Osada, Toshiki. 1992. *A reference grammar of Mundari*. Tokyo: ILCAA, Tokyo University of Foreign Studies. 39–40.
Telugu	Dravidian	Dravidian	Eurasia	tel	X	Mahanta, Shakuntala & Paul Arsenault. 56: Vowel Harmony in Languages of India. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 712–722.
Georgian, Ingilo	Kartvelian	Kartvelian	Eurasia	kat	X	Butskhrikidze, Marika. 2024. 73: Vowel Harmony in Caucasian Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 918–924.
Avar	Avar-Andic-Tsezic	Nakh-Daghestanian	Eurasia	ava	X	Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Deori	Brahmaputran	Sino-Tibetan	Eurasia	der	X	Mahanta, Shakuntala & Paul Arsenault. 56: Vowel Harmony in Languages of India. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 712–722.
Limbu	Himalayish	Sino-Tibetan	Eurasia	lif	X	Tumbahang, Govinda Bahadur. 2007. *A descriptive grammar of Chhatthare Limbu*. PhD dissertation. Kirtipur: Tribhuvan University. 175.

Quileute	Chimakuan	Chimakuan	North America	qui	X	Rice, Keren. 2024. 53: Vowel Harmony in North American Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 658–690.
Ventureño	Chumash	Chumashan	North America	veo	X	Mamet, Ingo. 2008. *Ventureno*. München: Lincom Europe.
San Mateo del Mare Huave	Huavean	Huavean	North America	huv	X	Noyer, Rolf. 2013. A Generative Phonology of San Mateo Huave. *International Journal of American Linguistics 79, 1*. 1–60.
Karuk / Karok	Karuk	Karuk	North America	kyh	X	Rice, Keren. 2024. 53: Vowel Harmony in North American Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 658–690.
Keres, Acoma	Keresan	Keresan	North America	kjq	X	Rice, Keren. 2024. 53: Vowel Harmony in North American Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 658–690.
Klamath / Klamath-Modoc	Klamath-Modoc	Klamath-Modoc	North America	kla	X	Rice, Keren. 2024. 53: Vowel Harmony in North American Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 658–690.
Lenca, Chilanga	Lencan	Lencan	North America	len	X	Campbell, Lyle. 1976. The Last Lenca. *International Journal of American Linguistics 42, 1*. 73–78. AND Rogers, Chris & Barrett Hamp. 2020. A comparison of vowel harmony in Xinkan, Jicaquean, and Lencan. *Studies in Language 44, 2.* 327–362.
Mountain Maidu / Maidu (Northeast)	Maiduan	Maiduan	North America	nmu	X	Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Sierra Miwok	Miwok	Miwok-Costanoan	North America	csm, skd, nsq	X	Rice, Keren. 2024. 53: Vowel Harmony in North American Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 658–690.
Natchez	Natchez	Natchez	North America	ncz	X	Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Tlapanec	Subtiaba-Tlapanec	Otomanguean	North America	tcf	X	Rogers, Chris. 2024. 54: Vowel Harmony in Mesoamerican Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 691–699.
Chatino	Zapotecan	Otomanguean	North America	ctp	X	Rogers, Chris. 2024. 54: Vowel Harmony in Mesoamerican Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 691–699.
Takelma	Takelma	Takelma	North America	tkm	X	Rice, Keren. 2024. 53: Vowel Harmony in North American Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 658–690.
Agutaynen	Kalamian	Austronesian	Papunesia	agn	X	Gasser, Emily. 2024. 76: Vowel Harmony in Austronesian Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 947–962.

Ibanag	Northern Luzon	Austronesian	Papunesia	ibg	X	Dita, Shirley N. 2010. *A reference grammar of Ibanag*. Saarbrücken: Lambert Academic Publishing. 12.
Grand Valley Dani, Mugogo	Dani	Nuclear Trans New Guinea	Papunesia	dni	X	Stap, Petrus A. M. van der. 1966. *Outline of Dani Morphology*. PhD dissertation. Leiden: Rijksuniversiteit te Leiden.
Southern Kiwai	Kiwaian	Nuclear Trans New Guinea	Papunesia	kjd	X	Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Alamblak	Sepik Hill	Sepik	Papunesia	amp	X	Gordon, Matthew K. & Michael Fiddler. 2024. 46: Vowel Harmony: Statistical Perspectives on Typological Distribution. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 585–592.
Terena	Bolivia-Parana	Arawakan	South America	ter	X	Nikulin, Andrey. 2024. 55: Vowel Harmony in South American Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 700–711.
Bororo	Bororoan	Bororoan	South America	bor	X	Nikulin, Andrey. 2024. 55: Vowel Harmony in South American Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 700–711.
Canela Krahô	Je Setentrional	Nuclear Macro-Je	South America	ram	X	Gordon, Matthew K. & Michael Fiddler. 2024. 46: Vowel Harmony: Statistical Perspectives on Typological Distribution. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 585–592.
Gidar	Biu-Mandara	Afro-Asiatic	Africa	gid		Frajzyngier, Zygmunt. 2008. *A Grammar of Gidar*. Frankfurt: Lang.
Mofu / Mofu-Gudur, Zulgo	Biu-Mandara	Afro-Asiatic	Africa	mif		Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Musgu, Vulum	Biu-Mandara	Afro-Asiatic	Africa	mug		Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Barain / Barayin	East Chadic	Afro-Asiatic	Africa	bva		Pearce, Mary & Joesph Lovestrand. 2024. 48: Vowel Harmony in Chadic Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 603–609.
Dangla / Dangaleat	East Chadic	Afro-Asiatic	Africa	daa		Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Afar / Qafar	Lowland East Cushitic	Afro-Asiatic	Africa	aar		Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Dasenech / Dhaasanac / Galeba	Lowland East Cushitic	Afro-Asiatic	Africa	dsh		Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Gafat	Semitic	Afro-Asiatic	Africa	gft		Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Tigrinya	Semitic	Afro-Asiatic	Africa	tir		Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Ugaritic	Semitic	Afro-Asiatic	Africa	uga		Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.

Hausa	West Chadic	Afro-Asiatic	Africa	hau		Gordon, Matthew K. & Michael Fiddler. 2024. 46: Vowel Harmony: Statistical Perspectives on Typological Distribution. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 585–592.
Bafia	Bantu	Atlantic-Congo	Africa	ksf		Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Bolia / Ntomba	Bantu	Atlantic-Congo	Africa	bli		Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Budu	Bantu	Atlantic-Congo	Africa	buu		Boyd, Virginia. 2024. 52: Vowel Harmony in Bantu Niger-Congo Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 643–657.
Ewondo	Bantu	Atlantic-Congo	Africa	ewo		Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Gunu / Nugunu	Bantu	Atlantic-Congo	Africa	yas		Hyman, Larry. 2001. Vowel Harmony in Gunu. *Studies in African Linguistics 30, 2.* 147–170.
Lobala	Bantu	Atlantic-Congo	Africa	loq		Morgan, David. 1993. Vowel harmony, syllable structure, and the causative extension in Lobala: a government phonology account. *Journal of West African Languages 23, 1*. 41–63.
Luba-Kasai / Luba-Lulua	Bantu	Atlantic-Congo	Africa	lua		Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Luba-Shaba / Kiluba / Luba-Katanga	Bantu	Atlantic-Congo	Africa	lub		Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Luimbi	Bantu	Atlantic-Congo	Africa	lum		Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Luvale	Bantu	Atlantic-Congo	Africa	lue		Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Luyi	Bantu	Atlantic-Congo	Africa	lyn		Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Mongo	Bantu	Atlantic-Congo	Africa	lol		Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Mwera	Bantu	Atlantic-Congo	Africa	mwe		Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Ndonga	Bantu	Atlantic-Congo	Africa	ndo		Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Rimi	Bantu	Atlantic-Congo	Africa	rim		Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Rundi	Bantu	Atlantic-Congo	Africa	run		Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Rwanda, Kinyarwanda	Bantu	Atlantic-Congo	Africa	kin		Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.

Shona	Bantu	Atlantic-Congo	Africa	sna		Kaplan, Aaron & Rachel Walker. 2024. 23: What Constitutes Privileged Positions in Vowel Harmony? In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 291–314.
Subiya / Subia / Kuhane	Bantu	Atlantic-Congo	Africa	sbs		Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Swati	Bantu	Atlantic-Congo	Africa	ssw		Kockaert, Hendrik J. 1997. Vowel harmony in siSwati: An experimental study of raised and non-raised vowels. *Journal of African Languages and Linguistics 18, 2.* 139–156.
Tetela	Bantu	Atlantic-Congo	Africa	tll		Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Tunen / Banen	Bantu	Atlantic-Congo	Africa	tvu		Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Umbundu / South Mbundu	Bantu	Atlantic-Congo	Africa	umb		Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Chokobo	Central Kainji	Atlantic-Congo	Africa	cbo?		Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
C'lela	Central Kainji	Atlantic-Congo	Africa	dri		Rolle, Nicholas & Ọlanikẹ Ọla Orie. 2024. 51: Vowel Harmony in Non-Bantu Niger-Congo Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 633–642.
Janji	Central Kainji	Atlantic-Congo	Africa	jni		Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Lemoro, Sanga	Central Kainji	Atlantic-Congo	Africa	ldj		Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Itsekiri	Defoid	Atlantic-Congo	Africa	its		Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Egene / Engenni	Edoid	Atlantic-Congo	Africa	enn		Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Epie	Edoid	Atlantic-Congo	Africa	epi		Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Isoko	Edoid	Atlantic-Congo	Africa	iso		Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Okpe	Edoid	Atlantic-Congo	Africa	oke		Kisseberth, Charles W. & Michael J. Kenstowicz. 2024. 26: Vowel Harmony in Classical Generative Phonology. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 344–359.
Urhobo, Agbon	Edoid	Atlantic-Congo	Africa	urh		Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Uvbie / Uvwie	Edoid	Atlantic-Congo	Africa	evh		Omamor, Augusta Phil. 1988. Okpẹ and Uvwiẹ: a case of vowel harmony galore. *Journal of West African languages 18, 1*. 47–64.
Fongbe	Gbe	Atlantic-Congo	Africa	fon		Lefebvre, Claire & Anne-Marie Brousseau. 2002. *A Grammar of Fongbe*. Berlin: Mouton de Gruyter. 25–27.
Isala / Sisaala	Grusi	Atlantic-Congo	Africa	sil		Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.

Kasem	Grusi	Atlantic-Congo	Africa	xsm		Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Tampulma	Grusi	Atlantic-Congo	Africa	tpm		Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Yala / Iyala	Idomoid	Atlantic-Congo	Africa	yba		Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Ekpeye	Igboid	Atlantic-Congo	Africa	ekp		Clark, D.J. 1971. Vowel Harmony Systems in Ekpeye. *University of Ibadan Research Notes 4, 1*. 23–33.
Ika	Igboid	Atlantic-Congo	Africa	ikk		Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Izi	Igboid	Atlantic-Congo	Africa	izz		Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Ukwuani-Aboh-Ndoni, Ukwuani	Igboid	Atlantic-Congo	Africa	ukw		Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Gourmanchéma / Gurma, Kpana	Oti-Volta	Atlantic-Congo	Africa	gux		Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Mossi / More / Mooré	Oti-Volta	Atlantic-Congo	Africa	mos		Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Abron, Twi	Tano	Atlantic-Congo	Africa	abr		Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Anyi, Sanvi	Tano	Atlantic-Congo	Africa	any		Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Chumburung	Tano	Atlantic-Congo	Africa	ncu		Downing, Laura J. & Martin Krämer. 2024. 20: Phrasal Vowel Harmony. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 236–243.
Gonja, Hill	Tano	Atlantic-Congo	Africa	gjn		Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Nawuri	Tano	Atlantic-Congo	Africa	naw		Downing, Laura J. & Martin Krämer. 2024. 20: Phrasal Vowel Harmony. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 236–243.
Nzima / Nzema	Tano	Atlantic-Congo	Africa	nzi		Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Awak	Tula-Waja	Atlantic-Congo	Africa	awo		Blench, Roger. 2020. *Aspects of the phonology and grammar of the Yebu [=Awak] language in Nigeria*. Ms.
Monzombo / Monjombo	Ubangi	Atlantic-Congo	Africa	moj		Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Ngbandi	Ubangi	Atlantic-Congo	Africa	ngb		Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Nzakara	Ubangi	Atlantic-Congo	Africa	nzk		Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.

Kohumono	Upper Cross	Atlantic-Congo	Africa	bcs		Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Legbo / Leggbó	Upper Cross	Atlantic-Congo	Africa	agb		Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Yamba	Wide Grassfields	Atlantic-Congo	Africa	yam		Scruggs, T. R. 1980. Vowel harmony in Yamba. *Calgary Working Papers in Linguistics, 6 (Spring)*. 41–50.
Banyun / Bainounk	Wolof	Atlantic-Congo	Africa	bcz / bab		Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Gambai / Ngambay	Bongo-Bagirmi	Central Sudanic	Africa	sba		Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Sara / Sar	Bongo-Bagirmi	Central Sudanic	Africa	mwm		Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Mangbutu	Mangbutu-Efe	Central Sudanic	Africa	mdk		Lojenga, Constance Kutsch. 2024. 49: Vowel Harmony in Nilo-Saharan Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 610–624.
Mvuba	Mangbutu-Efe	Central Sudanic	Africa	mxh		Lojenga, Constance Kutsch. 2024. 49: Vowel Harmony in Nilo-Saharan Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 610–624.
Lugbara	Moru-Ma'di	Central Sudanic	Africa	lgg		Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Koalib / Rere	Heiban	Heiban	Africa	kib		Bashir, Abeer M. A. & Sharon Rose. 2024. 50: Vowel Harmony in Niger-Congo Languages of the Nuba Mountains. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 625–632.
Moro	Heiban	Heiban	Africa	mor		Bashir, Abeer M. A. & Sharon Rose. 2024. 50: Vowel Harmony in Niger-Congo Languages of the Nuba Mountains. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 625–632.
Kalabari	Ijoid	Ijoid	Africa	ijn		Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Nembe	Ijoid	Ijoid	Africa	ijs		Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Katla	Katla-Tima	Katla-Tima	Africa	kcr		Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Gwama	Koman	Koman	Africa	kmq		Hellenthal, Anne-Christie & Constance Kutsch Lojenga. 2011. *Phonology / Orthography Statement for the Gwama language*. SIL International.
Komo	Koman	Koman	Africa	xom		Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Uduk	Koman	Koman	Africa	udu		Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Grebo	Kru	Kru	Africa	grj		Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Maba	Maban	Maban	Africa	mde		Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.

Tura	Eastern Mande	Mande	Africa	neb		Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Bari	Eastern Nilotic	Nilotic	Africa	bfa		Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Kakwa	Eastern Nilotic	Nilotic	Africa	keo		Lojenga, Constance Kutsch. 2024. 49: Vowel Harmony in Nilo-Saharan Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 610–624.
Kuku	Eastern Nilotic	Nilotic	Africa	ukv		Lojenga, Constance Kutsch. 2024. 49: Vowel Harmony in Nilo-Saharan Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 610–624.
Mandari / Mundari	Eastern Nilotic	Nilotic	Africa	mqu		Lojenga, Constance Kutsch. 2024. 49: Vowel Harmony in Nilo-Saharan Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 610–624.
Nandi / Kinande	Eastern Nilotic	Nilotic	Africa	niq		Boyd, Virginia. 2024. 52: Vowel Harmony in Bantu Niger-Congo Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 643–657.
Otuho / Lotuxo	Eastern Nilotic	Nilotic	Africa	lot		Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Toposa	Eastern Nilotic	Nilotic	Africa	toq		Mahanta, Shakuntala. 24: Directionality in Vowel Harmony Systems. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 315–328.
Turkana	Eastern Nilotic	Nilotic	Africa	tuv		Mahanta, Shakuntala. 24: Directionality in Vowel Harmony Systems. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 315–328.
Kipsigis / Kipsikiis	Southern Nilotic	Nilotic	Africa	sgc		Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Acoli	Western Nilotic	Nilotic	Africa	ach		Mahanta, Shakuntala. 2008. *Directionality and locality in vowel harmony: with special reference to vowel harmony in Assamese*. PhD dissertation. Utrecht: Utrecht University. 18.
Adhola	Western Nilotic	Nilotic	Africa	adh		Lojenga, Constance Kutsch. 2024. 49: Vowel Harmony in Nilo-Saharan Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 610–624.
Jumjum	Western Nilotic	Nilotic	Africa	jum		Lojenga, Constance Kutsch. 2024. 49: Vowel Harmony in Nilo-Saharan Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 610–624.
Kumam	Western Nilotic	Nilotic	Africa	kdi		Lojenga, Constance Kutsch. 2024. 49: Vowel Harmony in Nilo-Saharan Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 610–624.
Kurmuk	Western Nilotic	Nilotic	Africa	kfv		Lojenga, Constance Kutsch. 2024. 49: Vowel Harmony in Nilo-Saharan Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 610–624.
Lango	Western Nilotic	Nilotic	Africa	laj		Odden, David. 2024. 16: Vowel Harmony and Coda, Moraic, or Geminate Consonants. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 171–182.
Luo	Western Nilotic	Nilotic	Africa	luo		Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Mabaan	Western Nilotic	Nilotic	Africa	mfz		Andersen, Torben. 1999a. Vowel quality alternation in Mabaan and its Western Nilotic history. *Journal of African Languages and Linguistics 20, 2*. 97–120.
Northern Burun, Mayak	Western Nilotic	Nilotic	Africa	bdi		Andersen, Torben. 1999b. Vowel Harmony and Vowel Alternation in Mayak (Western Nilotic). *Studies in African Linguistics 28, 1*. 1–30.

Kanembu	Western Saharan	Saharan	Africa	kbl		Lojenga, Constance Kutsch. 2024. 49: Vowel Harmony in Nilo-Saharan Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 610–624.
Kanuri	Western Saharan	Saharan	Africa	knc		Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Gadaba, Kondekor	Dravidian	Dravidian	Eurasia	gdb		Mahanta, Shakuntala & Paul Arsenault. 56: Vowel Harmony in Languages of India. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 712–722.
Acheron	Talodi	Talodi	Africa	acz		Bashir, Abeer M. A. & Sharon Rose. 2024. 50: Vowel Harmony in Niger-Congo Languages of the Nuba Mountains. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 625–632.
Lumun	Talodi	Talodi	Africa	lmd		Bashir, Abeer M. A. & Sharon Rose. 2024. 50: Vowel Harmony in Niger-Congo Languages of the Nuba Mountains. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 625–632.
Tocho	Talodi	Talodi	Africa	taz		Bashir, Abeer M. A. & Sharon Rose. 2024. 50: Vowel Harmony in Niger-Congo Languages of the Nuba Mountains. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 625–632.
Torona	Talodi	Talodi	Africa	tqr		Bashir, Abeer M. A. & Sharon Rose. 2024. 50: Vowel Harmony in Niger-Congo Languages of the Nuba Mountains. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 625–632.
Sungor / Assangori	Taman	Taman	Africa	sjg		Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Guugu Yimidhirr	Northern Pama-Nyungan	Pama-Nyungan	Australia	kky		Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Bilinarra	Western Pama-Nyungan	Pama-Nyungan	Australia	nbj		Pensalfini, Rob. 2024. 74: Vowel Harmony in Australian Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 925–934.
Mudburra	Western Pama-Nyungan	Pama-Nyungan	Australia	dmw		Pensalfini, Rob. 2024. 74: Vowel Harmony in Australian Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 925–934.
Nyangumarta / Nyangumarda	Western Pama-Nyungan	Pama-Nyungan	Australia	nna		Pensalfini, Rob. 2024. 74: Vowel Harmony in Australian Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 925–934.
Ritharrngu	Western Pama-Nyungan	Pama-Nyungan	Australia	rit		Pensalfini, Rob. 2024. 74: Vowel Harmony in Australian Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 925–934.
Warumungu	Western Pama-Nyungan	Pama-Nyungan	Australia	wrm		Bowern, Claire & Quentin Atkinson (eds). 2013. Vowel Harmony. In: Hunter-Gatherer Language Database. Austin: University of Texas at Austin. <https://huntergatherer.la.utexas.edu/grammar/feature/13>. Accessed on 15 July 2025.
Neo-Aramaic	Semitic	Afro-Asiatic	Eurasia	aii?		Khan, Geoffrey. 2024. 47: Vowel Harmony in Semitic Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 593–602.
Palestinian Arabic	Semitic	Afro-Asiatic	Eurasia	ajp		Khan, Geoffrey. 2024. 47: Vowel Harmony in Semitic Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 593–602.
Gorum-Parenga / Gorum	Munda	Austroasiatic	Eurasia	pcj		Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.

Ho	Munda	Austroasiatic	Eurasia	hoc		Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Santali	Munda	Austroasiatic	Eurasia	sat		Anderson, Gregory D. S. & Luke Horo & K. David Harrison. 2024. 57: Vowel Harmony in the Munda Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 723–728.
Koryak	Northern Chukotko-Kamchatkan	Chukotko-Kamchatkan	Eurasia	kpy		Kenstowicz, Michael J. 2024. 65: Vowel Harmony in Chukotko-Kamchatkan Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 824–831.
Gondi (Northern)	Dravidian	Dravidian	Eurasia	gno		Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Kuvi	Dravidian	Dravidian	Eurasia	kxv		Mahanta, Shakuntala & Paul Arsenault. 56: Vowel Harmony in Languages of India. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 712–722.
Pengo	Dravidian	Dravidian	Eurasia	peg		Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Etruscan	Etruscan	Etruscan	Eurasia	ett		Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
German	Germanic	Indo-European	Eurasia	deu		Hansson, Gunnar Ólafur & Richard Wiese. 2024. 68: Umlaut in Germanic Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 864–871.
Assamese	Indic	Indo-European	Eurasia	asm		Mahanta, Shakuntala. 2008. *Directionality and locality in vowel harmony: with special reference to vowel harmony in Assamese*. PhD dissertation. Utrecht: Utrecht University. 18.
Kalasha	Indic	Indo-European	Eurasia	kls		Smith, Norval. 2024. 10: Rhotic Vowel Harmony. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 100–109.
Kashmiri	Indic	Indo-European	Eurasia	kas		Mahanta, Shakuntala & Paul Arsenault. 56: Vowel Harmony in Languages of India. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 712–722.
Konkani	Indic	Indo-European	Eurasia	gom		Mahanta, Shakuntala & Paul Arsenault. 56: Vowel Harmony in Languages of India. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 712–722.
Magahi	Indic	Indo-European	Eurasia	mag		Mahanta, Shakuntala & Paul Arsenault. 56: Vowel Harmony in Languages of India. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 712–722.
Oriya / Odia	Indic	Indo-European	Eurasia	ory		Mahanta, Shakuntala & Paul Arsenault. 56: Vowel Harmony in Languages of India. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 712–722.
Romani, Iranian / Persian-Indic	Indic	Indo-European	Eurasia			Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Canadian French	Romance	Indo-European	Eurasia	fra		Canalis, Stefano & Jesús Jiménez & Maria-Rosa Lloret & Margaret E. L. Renwick. 2024. 69: Vowel Harmony in Romance Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 872–892.
Cantabrian	Romance	Indo-European	Eurasia	ast		Canalis, Stefano & Jesús Jiménez & Maria-Rosa Lloret & Margaret E. L. Renwick. 2024. 69: Vowel Harmony in Romance Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 872–892.

Central Sicilian	Romance	Indo-European	Eurasia	scn		Canalis, Stefano & Jesús Jiménez & Maria-Rosa Lloret & Margaret E. L. Renwick. 2024. 69: Vowel Harmony in Romance Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 872–892.
several Ibero-Romance varieties	Romance	Indo-European	Eurasia			Canalis, Stefano & Jesús Jiménez & Maria-Rosa Lloret & Margaret E. L. Renwick. 2024. 69: Vowel Harmony in Romance Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 872–892.
several Italo-Romance varieties	Romance	Indo-European	Eurasia			Canalis, Stefano & Jesús Jiménez & Maria-Rosa Lloret & Margaret E. L. Renwick. 2024. 69: Vowel Harmony in Romance Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 872–892.
several Sardinian varieties	Romance	Indo-European	Eurasia			Canalis, Stefano & Jesús Jiménez & Maria-Rosa Lloret & Margaret E. L. Renwick. 2024. 69: Vowel Harmony in Romance Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 872–892.
Swiss Lombard	Romance	Indo-European	Eurasia	lmo		Canalis, Stefano & Jesús Jiménez & Maria-Rosa Lloret & Margaret E. L. Renwick. 2024. 69: Vowel Harmony in Romance Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 872–892.
Valencian Catalan	Romance	Indo-European	Eurasia	cat		Canalis, Stefano & Jesús Jiménez & Maria-Rosa Lloret & Margaret E. L. Renwick. 2024. 69: Vowel Harmony in Romance Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 872–892.
Kangjia	Mongolic	Mongolic-Khitan	Eurasia	kxs		Svantesson, Jan-Olof. 2024. 60: Vowel Harmony in Mongolic Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 774–779.
Oirat / Oirad-Kalmyk-Darkhat	Mongolic	Mongolic-Khitan	Eurasia	xal		Svantesson, Jan-Olof. 2024. 60: Vowel Harmony in Mongolic Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 774–779.
Shira Yugur	Mongolic	Mongolic-Khitan	Eurasia	yuy		Svantesson, Jan-Olof. 2024. 60: Vowel Harmony in Mongolic Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 774–779.
Aghul	Lezgic	Nakh-Daghestanian	Eurasia	agx		Butskhrikidze, Marika. 2024. 73: Vowel Harmony in Caucasian Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 918–924.
Tabasaran	Lezgic	Nakh-Daghestanian	Eurasia	tab		Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Ersu	Na-Qiangic	Sino-Tibetan	Eurasia	ers		Chirkova, Katia. 2024. 58: Vowel Harmony in Sino-Tibetan Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 729–740.
Guiqiong	Na-Qiangic	Sino-Tibetan	Eurasia	gqi		Chirkova, Katia. 2024. 58: Vowel Harmony in Sino-Tibetan Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 729–740.
Yongning Na	Na-Qiangic	Sino-Tibetan	Eurasia	nru		Chirkova, Katia. 2024. 58: Vowel Harmony in Sino-Tibetan Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 729–740.
Even	Tungusic	Tungusic	Eurasia	eve		Li, Bing & Norval Smith. 2024. 61: Vowel Harmony in Tungusic Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 780–798.
Evenki	Tungusic	Tungusic	Eurasia	evn		Li, Bing & Norval Smith. 2024. 61: Vowel Harmony in Tungusic Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 780–798.

Jurchen	Tungusic	Tungusic	Eurasia	juc		Li, Bing & Norval Smith. 2024. 61: Vowel Harmony in Tungusic Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 780–798.
Nanaj / Nanai	Tungusic	Tungusic	Eurasia	gld		Li, Bing & Norval Smith. 2024. 61: Vowel Harmony in Tungusic Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 780–798.
Orochen	Tungusic	Tungusic	Eurasia	orh		Li, Bing & Norval Smith. 2024. 61: Vowel Harmony in Tungusic Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 780–798.
Solon	Tungusic	Tungusic	Eurasia	evn		Li, Bing & Norval Smith. 2024. 61: Vowel Harmony in Tungusic Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 780–798.
Chuvash	Turkic	Turkic	Eurasia	chv		Washington, Jonathan North. 2024. 59: Vowel Harmony in Turkic Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 741–773.
Kazakh	Turkic	Turkic	Eurasia	kaz		Washington, Jonathan North. 2024. 59: Vowel Harmony in Turkic Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 741–773.
Turkmen, Chagatay	Turkic	Turkic	Eurasia	tuk		Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Uyghur	Turkic	Turkic	Eurasia	uig		Washington, Jonathan North. 2024. 59: Vowel Harmony in Turkic Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 741–773.
Yakut	Turkic	Turkic	Eurasia	sah		Washington, Jonathan North. 2024. 59: Vowel Harmony in Turkic Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 741–773.
Karelian	Finnic	Uralic	Eurasia	krl		Fejes, László & Péter Siptár & Robert M. Vago. 2024. Vowel Harmony in Uralic Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 840–863.
Ludic	Finnic	Uralic	Eurasia	lud		Fejes, László & Péter Siptár & Robert M. Vago. 2024. Vowel Harmony in Uralic Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 840–863.
some dialects of Estonian	Finnic	Uralic	Eurasia	ekk		Fejes, László & Péter Siptár & Robert M. Vago. 2024. Vowel Harmony in Uralic Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 840–863.
Veps	Finnic	Uralic	Eurasia	vep		Fejes, László & Péter Siptár & Robert M. Vago. 2024. Vowel Harmony in Uralic Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 840–863.
Votic	Finnic	Uralic	Eurasia	vot		Fejes, László & Péter Siptár & Robert M. Vago. 2024. Vowel Harmony in Uralic Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 840–863.
Hill Mari	Mari	Uralic	Eurasia	mrj		Fejes, László & Péter Siptár & Robert M. Vago. 2024. Vowel Harmony in Uralic Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 840–863.
Moksha	Mordvin	Uralic	Eurasia	mdf		Fejes, László & Péter Siptár & Robert M. Vago. 2024. Vowel Harmony in Uralic Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 840–863.
Pite Saami	Saami	Uralic	Eurasia	sje		Fejes, László & Péter Siptár & Robert M. Vago. 2024. Vowel Harmony in Uralic Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 840–863.
South Saami	Saami	Uralic	Eurasia	sma		Ylikoski, Jussi. 2022. South Saami. In: Bakró-Nagy, Marianne & Johanna Laakso & Elena Skribnik (eds). *The Oxford Guide to the Uralic Languages*. Oxford: Oxford University Press. 113–29.
Kamas	Samoyedic	Uralic	Eurasia	xas		Fejes, László & Péter Siptár & Robert M. Vago. 2024. Vowel Harmony in Uralic Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 840–863.

Khanty	Ugric	Uralic	Eurasia	kca		Fejes, László & Péter Siptár & Robert M. Vago. 2024. Vowel Harmony in Uralic Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 840–863.
Mansi	Ugric	Uralic	Eurasia	mns		Fejes, László & Péter Siptár & Robert M. Vago. 2024. Vowel Harmony in Uralic Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 840–863.
Tundra Yukaghir	Yukaghir	Yukaghir	Eurasia	ykg		Nikolaeva, Irina. 2024. 66: Vowel Harmony in Yukaghir. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 832–839.
Menominee	Algonquian	Algic	North America	mez		Krämer, Martin. 2024. 21: Non-Alternating, Non-Participating, And Idiosyncratic Vowels. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 244–268.
Degexit'an / Deg Xinag	Athapaskan	Athabaskan-Eyak-Tlingit	North America	ing		Rice, Keren. 2024. 53: Vowel Harmony in North American Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 658–690.
Eyak	Athapaskan	Athabaskan-Eyak-Tlingit	North America	eya		Rice, Keren. 2024. 53: Vowel Harmony in North American Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 658–690.
Hupa	Athapaskan	Athabaskan-Eyak-Tlingit	North America	hup		Rice, Keren. 2024. 53: Vowel Harmony in North American Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 658–690.
Kaska / Dene Zā́gé’	Athapaskan	Athabaskan-Eyak-Tlingit	North America	kkz		Rice, Keren. 2024. 53: Vowel Harmony in North American Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 658–690.
Slavey	Athapaskan	Athabaskan-Eyak-Tlingit	North America	den		Rice, Keren. 2024. 53: Vowel Harmony in North American Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 658–690.
Wailaki	Athapaskan	Athabaskan-Eyak-Tlingit	North America	wlk		Rice, Keren. 2024. 53: Vowel Harmony in North American Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 658–690.
Barbareño	Chumash	Chumashan	North America	boi		Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Samala / Ineseño	Chumash	Chumashan	North America	inz		Applegate, Richard P. 1971. Vowel Harmony in Chumash. *Berkeley Papers in Linguistics 1.* 3–12.
Konkow / Northwestern Maidu	Maiduan	Maiduan	North America	mjd		Rice, Keren. 2024. 53: Vowel Harmony in North American Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 658–690.
Nisenan	Maiduan	Maiduan	North America	nsz		Rice, Keren. 2024. 53: Vowel Harmony in North American Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 658–690.

Popti' / Jakaltek	Mayan	Mayan	North America	jac		Rice, Keren. 2024. 53: Vowel Harmony in North American Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 658–690.
Zoque, Chiapas	Mixe-Zoque	Mixe-Zoque	North America	zoc, zos, zor		Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Otomi, Mezquital	Otomian	Otomanguean	North America	ote		Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Eastern Pomo	Pomoan	Pomoan	North America	peb		Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Kashaya	Pomoan	Pomoan	North America	kju		Rice, Keren. 2024. 53: Vowel Harmony in North American Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 658–690.
Foothill North Yokuts, Wikchamni	Yokuts	Yokutsan	North America	yok		Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Balantak	Celebic	Austronesian	Papunesia	blz		Gasser, Emily. 2024. 76: Vowel Harmony in Austronesian Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 947–962.
Banggai	Celebic	Austronesian	Papunesia	bgz		Gasser, Emily. 2024. 76: Vowel Harmony in Austronesian Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 947–962.
Muna	Celebic	Austronesian	Papunesia	mnb		Gasser, Emily. 2024. 76: Vowel Harmony in Austronesian Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 947–962.
Pendau	Celebic	Austronesian	Papunesia	ums		Gasser, Emily. 2024. 76: Vowel Harmony in Austronesian Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 947–962.
Kambera	Central Malayo-Polynesian	Austronesian	Papunesia	xbr		Gasser, Emily. 2024. 76: Vowel Harmony in Austronesian Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 947–962.
Mongondow	Greater Central Philippine	Austronesian	Papunesia	mog		Gasser, Emily. 2024. 76: Vowel Harmony in Austronesian Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 947–962.
Tagal	North Borneo	Austronesian	Papunesia	mvv		Gasser, Emily. 2024. 76: Vowel Harmony in Austronesian Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 947–962.
Besemah	Malayo-Sumbawan	Austronesian	Papunesia	pse		Gasser, Emily. 2024. 76: Vowel Harmony in Austronesian Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 947–962.
Central Malay, Johor Malay	Malayo-Sumbawan	Austronesian	Papunesia	zlm		Gasser, Emily. 2024. 76: Vowel Harmony in Austronesian Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 947–962.
Madurese	Malayo-Sumbawan	Austronesian	Papunesia	mad		Gasser, Emily. 2024. 76: Vowel Harmony in Austronesian Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 947–962.

Sasak	Malayo-Sumbawan	Austronesian	Papunesia	sas		Gasser, Emily. 2024. 76: Vowel Harmony in Austronesian Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 947–962.
Bonggi / Banggi	North Borneo	Austronesian	Papunesia	bdg		Gasser, Emily. 2024. 76: Vowel Harmony in Austronesian Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 947–962.
Labuk-Kinabatang Kadazan	North Borneo	Austronesian	Papunesia	dtb		Gasser, Emily. 2024. 76: Vowel Harmony in Austronesian Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 947–962.
Timugon Murut	North Borneo	Austronesian	Papunesia	tih		Gasser, Emily. 2024. 76: Vowel Harmony in Austronesian Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 947–962.
Tindal Dusun / Kadazan Dusun	North Borneo	Austronesian	Papunesia	dtp		Gasser, Emily. 2024. 76: Vowel Harmony in Austronesian Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 947–962.
Ajie / Anjie / Anjië	Oceanic	Austronesian	Papunesia	aji		Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
As	Oceanic	Austronesian	Papunesia	asz		Gasser, Emily. 2024. 76: Vowel Harmony in Austronesian Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 947–962.
Atchin	Oceanic	Austronesian	Papunesia	upv		Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Batta / Batanta	Oceanic	Austronesian	Papunesia			Gasser, Emily. 2024. 76: Vowel Harmony in Austronesian Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 947–962.
Loniu	Oceanic	Austronesian	Papunesia	los		Gasser, Emily. 2024. 76: Vowel Harmony in Austronesian Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 947–962.
Nembao / Amba	Oceanic	Austronesian	Papunesia	utp		Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Sakao	Oceanic	Austronesian	Papunesia	sku		Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Salawati, Butlih	Oceanic	Austronesian	Papunesia	xmx		Gasser, Emily. 2024. 76: Vowel Harmony in Austronesian Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 947–962.
Ulithian, Sonsorol	Oceanic	Austronesian	Papunesia	uli		Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Yapese	Oceanic	Austronesian	Papunesia	yap		Gasser, Emily. 2024. 76: Vowel Harmony in Austronesian Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 947–962.
Yaur	Oceanic	Austronesian	Papunesia	jau		Gasser, Emily. 2024. 76: Vowel Harmony in Austronesian Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 947–962.
Ulumanda'	South Sulawesi	Austronesian	Papunesia	ulm		Gasser, Emily. 2024. 76: Vowel Harmony in Austronesian Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 947–962.
Wahgi	Chimbu-Wahgi	Nuclear Trans New Guinea	Papunesia	wgi		Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.

Komnzo	Kanum	Yam	Papunesia	tci		Klamer, Marian. 2024. 75: Vowel Harmony in Papuan Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 935–946.
Añú / Paraujano	Guajiro-Paraujano	Arawakan	South America	pbg		Nikulin, Andrey. 2024. 55: Vowel Harmony in South American Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 700–711.
Yucuna	Japura-Colombia	Arawakan	South America	ycn		Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Agawaio-Ingariko, Ingarikó	Cariban	Cariban	South America	ake		Nikulin, Andrey. 2024. 55: Vowel Harmony in South American Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 700–711.
Hixkaryana	Cariban	Cariban	South America	hix		Kaun, Abigail & Adam G. McCollum. 2024. 5: Rounding Harmony. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 61–67.
Kari'ña / Carib / Galibi Carib	Cariban	Cariban	South America	car		Nikulin, Andrey. 2024. 55: Vowel Harmony in South American Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 700–711.
Kashuyana / Kaxuiâna / Werikyana	Cariban	Cariban	South America	kbb		Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Kuhikuru	Cariban	Cariban	South America	kui		Nikulin, Andrey. 2024. 55: Vowel Harmony in South American Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 700–711.
Pilagá	Qom	Guaicuruan	South America	plg		Nikulin, Andrey. 2024. 55: Vowel Harmony in South American Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 700–711.
Toba	Qom	Guaicuruan	South America	tob		Nikulin, Andrey. 2024. 55: Vowel Harmony in South American Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 700–711.
Iyojwa'aja' / Riverine Chorote	Mataguayan / Matacoan	Mataguayan / Matacoan	South America	crt		Nikulin, Andrey. 2024. 55: Vowel Harmony in South American Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 700–711.
Apinayé	Je Setentrional	Nuclear Macro-Je	South America	apn		Nikulin, Andrey. 2024. 55: Vowel Harmony in South American Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 700–711.
Mebengokre / Kayapó	Je Setentrional	Nuclear Macro-Je	South America	txu		Nikulin, Andrey. 2024. 55: Vowel Harmony in South American Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 700–711.
Southern Barasano	Tucanoan	Tucanoan	South America	bsn		Botma, Bert. 2024. 3: Nasal Harmony. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 37–48.

Tucano	Tucanoan	Tucanoan	South America	tuo		Botma, Bert. 2024. 3: Nasal Harmony. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 37–48.
Awetí	Maweti-Guarani	Tupian	South America	awe		Nikulin, Andrey. 2024. 55: Vowel Harmony in South American Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 700–711.
Guajajára / Tenetehara	Maweti-Guarani	Tupian	South America	gub		Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.
Sateré-Mawé	Maweti-Guarani	Tupian	South America	mav		Nikulin, Andrey. 2024. 55: Vowel Harmony in South American Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 700–711.
Tapieté	Maweti-Guarani	Tupian	South America	tpj		Nikulin, Andrey. 2024. 55: Vowel Harmony in South American Languages. In: Ritter, Nancy A. & Harry van der Hulst (eds). 2024. *The Oxford Handbook of Vowel Harmony*. Oxford: Oxford University Press. 700–711.
Ninam / Shiriana	Yanomam	Yanomamic	South America	shb		Ruhlen, Merritt. 2008. A global linguistic database. In: Starostin, S. 1998. StarLing database server. <https://starlingdb.org/cgi-bin/main.cgi?root=config&morpho=0>. Accessed on 14 July 2025.

C. Deviations from WALS genera counts in this study

In cases where Glottolog and WALS disagree with regard to where a certain language or group of languages belongs, including cases where WALS lacks certain languages or language families altogether, I have deferred to Glottolog. This has caused some differences between the number of genera in this study and the number of genera in WALS for certain language families. In addition, there are some languages and groups of languages that are listed as their own families in Glottolog, which WALS includes as parts of larger, and at times controversial, language families. This appendix lists both of these differences, starting with how the differing language families are seen in this study, including the total number of genera in those families, followed by how WALS sees them.

Atlantic-Congo language family: 56 genera. Instead of the top-level Atlantic-Congo family, WALS talks about the controversial Niger-Congo phylum and gives it 57 genera, including Kru, which Glottolog does not include in Atlantic-Congo.

Coosan language family: 1 genus. WALS counts Coosan as a genus belonging to the Oregon Coast language family.

Dajuic language family: 1 genus. WALS includes Dajuic as part of the Eastern Sudanic language family.

Eastern Jebel language family: 1 genus. WALS includes Eastern Jebel as part of the Eastern Sudanic language family.

Heiban language family: 1 genus. WALS includes Heiban as a genus of the Kordofanian language family.

Jicaquean language family: 1 genus. WALS does not categorize Jicaquean as a family and instead treats Tol as a language isolate.

Karuk language family: 1 genus. WALS counts Karuk as a genus of the Hokan family.

Katla-Tima language family: 1 genus. WALS counts Katla-Tima as a genus of the Kordofanian family.

Klamath-Modoc language family: 1 genus. WALS counts Klamath-Modoc as a genus of the Penutian family.

Lencan language family: 1 genus. WALS does not have data on Lencan.

Maiduan language family: 1 genus. WALS counts as Maiduan as a genus of the Penutian family.

Miwok-Costanoan language family: 2 genera. WALS counts Miwok and Costanoan as genera of the Penutian family.

Mongolic-Khitan: 2 genera(?). WALS counts Mongolic as a genus of the controversial Altaic language family.

Nilotic language family: 3 genera. WALS includes Eastern, Western and Southern Nilotic as genera of the Eastern Sudanic family.

Pomoan language family: 1 genus. WALS includes Pomoan as a genus of the Hokan family.

Rashad language family: 1 genus. WALS counts Rashad as a genus of the Kordofanian family.

Sahaptian language family: 1 genus. WALS includes Sahaptian as a genus of the Penutian family.

Surmic language family. 2 genera. WALS counts Majang and South Surmic as genera of the Eastern Sudanic family.

Talodi language family: 1 genus. WALS includes Talodi as a genus of the Kordofanian family.

Tamaic language family: 1 genus. WALS includes Tamaic as a genus of Eastern Sudanic family under the name Taman.

Temeinic language family: 1 genus. WALS counts Temeinic as a genus of the Eastern Sudanic family under the name Temein.

Timor-Alor-Pantar language family: 3 genera(?). WALS includes Alor-Pantar and East Timor as genera of the Greater West Bomberai family.

Tungusic language family: 1 genus. WALS includes Tungusic as a genus of the Altaic family.

Turkic language family: 1 genus. WALS includes Turkic as a genus of the Altaic family.

Wintuan language family: 1 genus. WALS includes Wintuan as a genus of the Penutian family.

Xincan language family: 1 genus(?). WALS does not have data on Xincan.

Yokutsan language family: 1 genus. WALS includes Yokutsan as a genus of the Penutian family.

D. Multiple Correspondence Analysis statistics

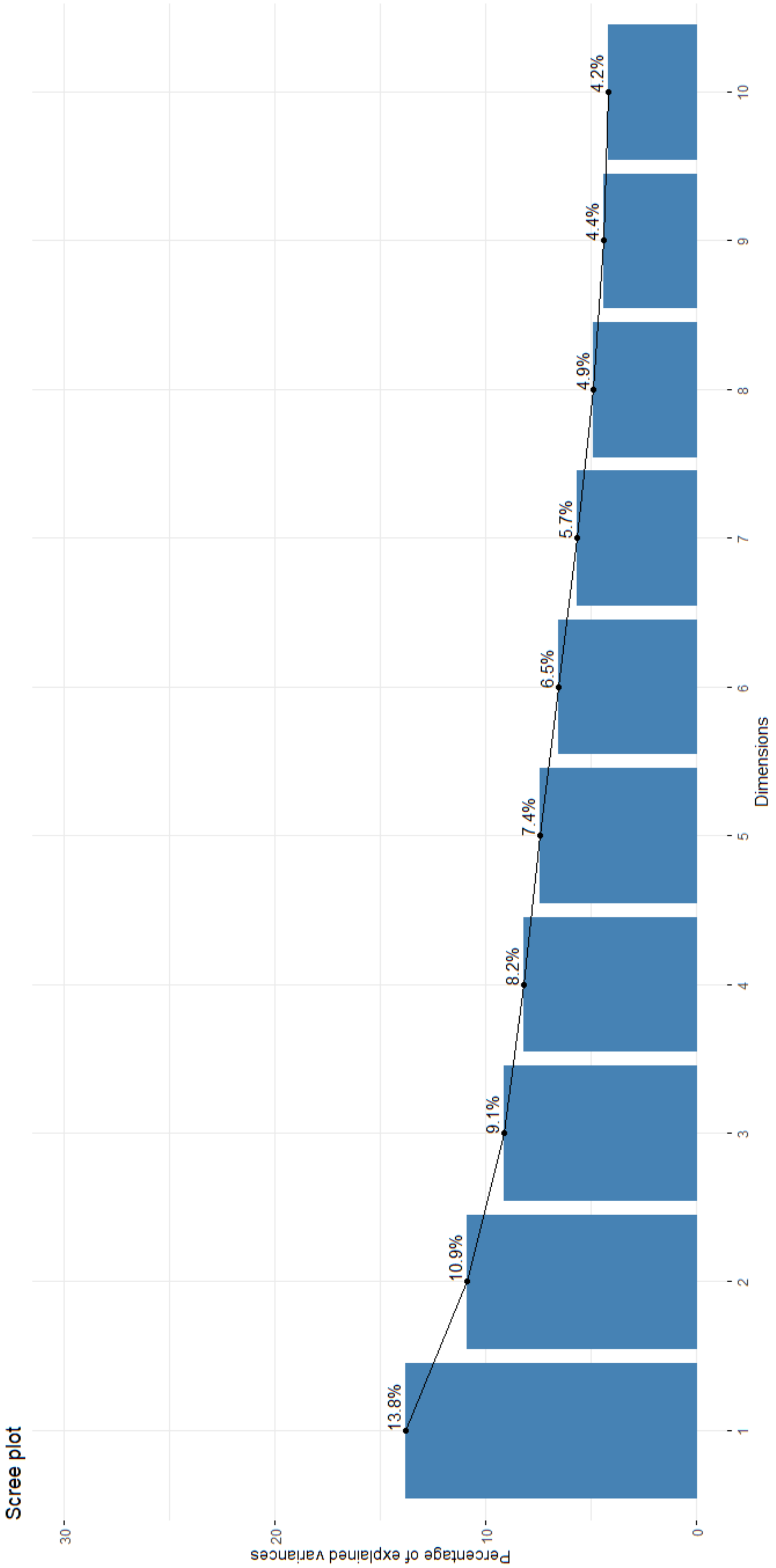

Figure 11. MCA scree plot. The first three dimensions explain 33.8% of the variance.

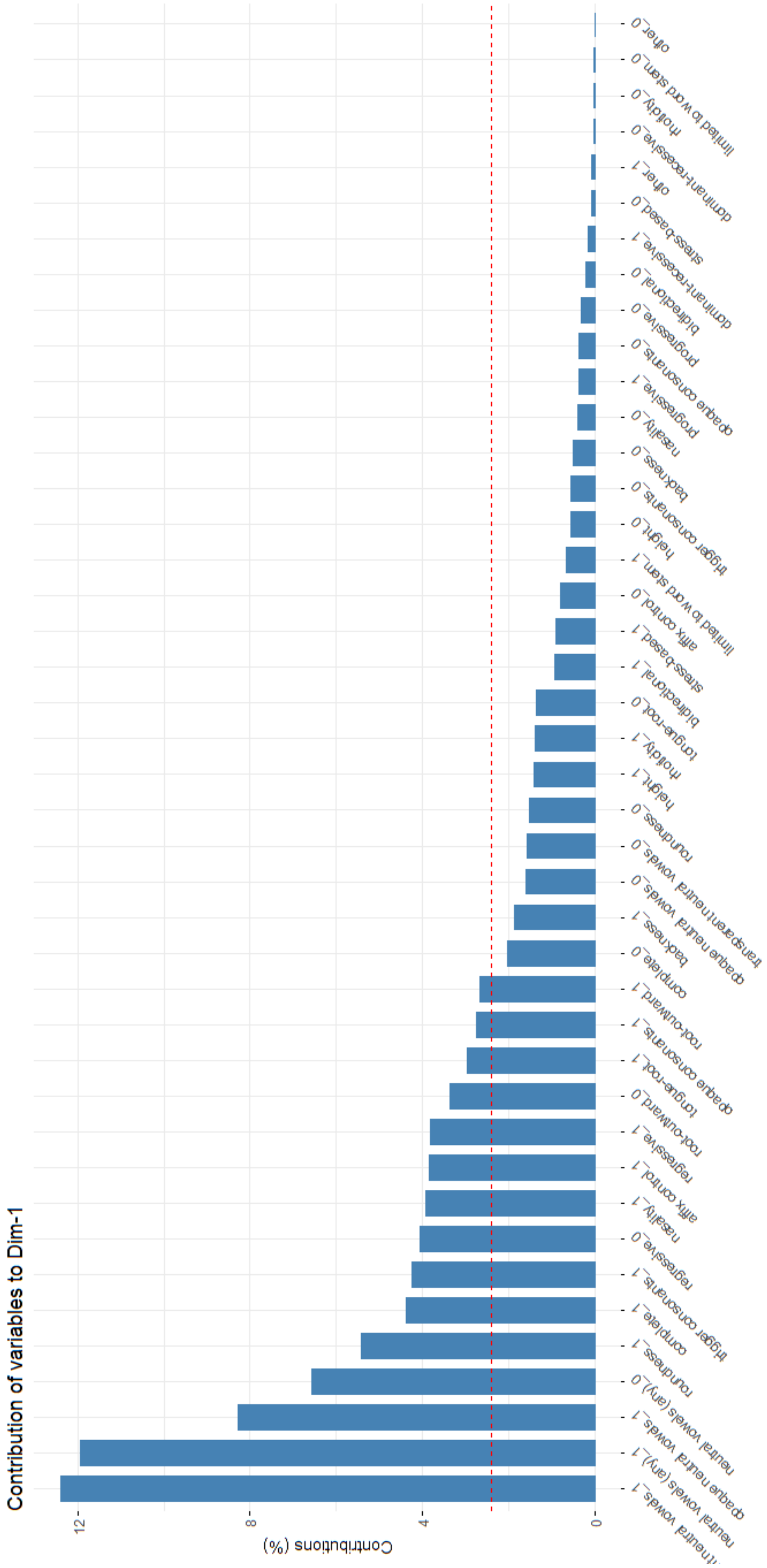

Figure 12. MCA dimension 1 contributions. The first feature is “transparent neutral vowels_1”, meaning the appearance of transparent neutral vowels.

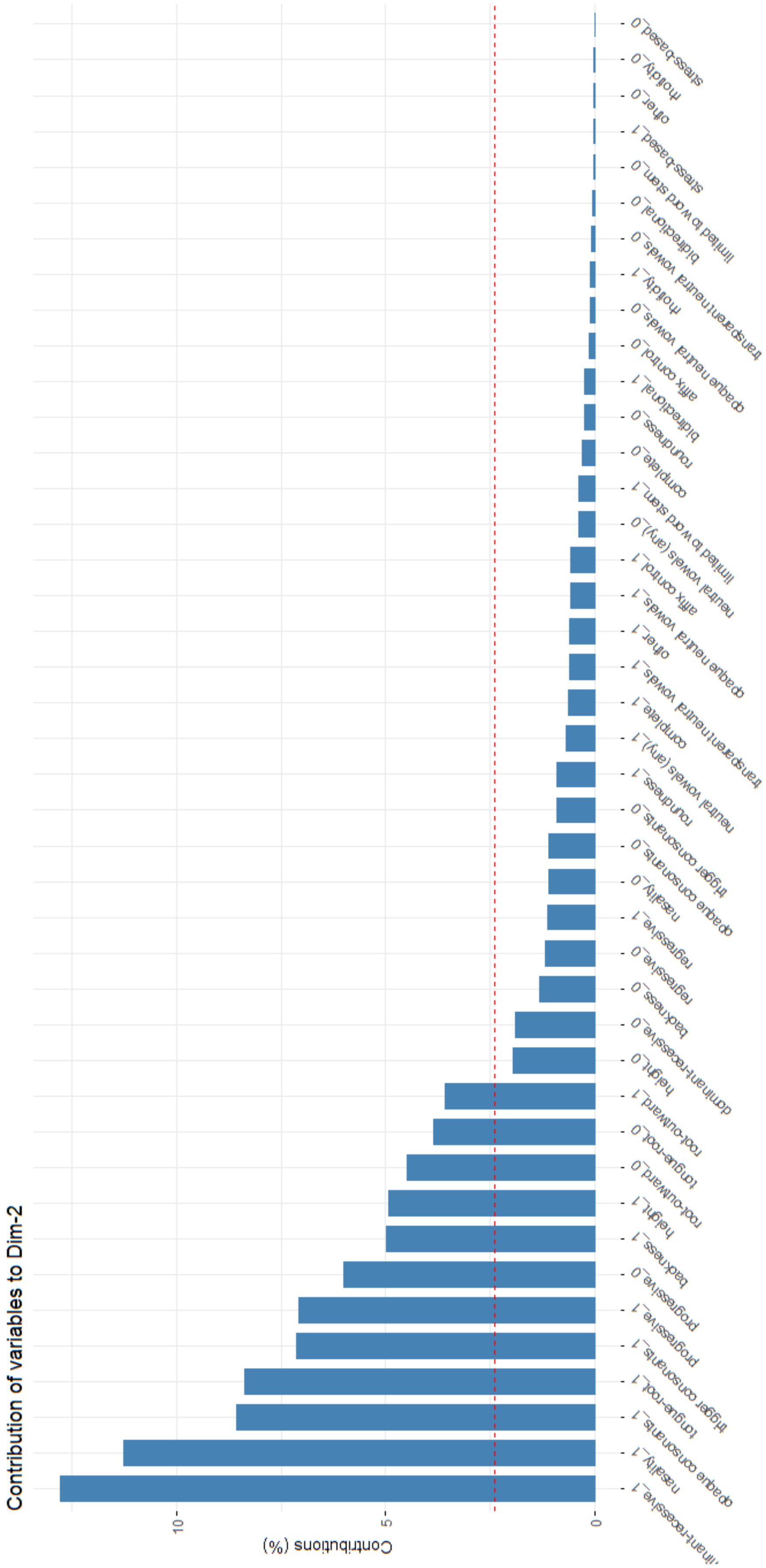

Figure 13. MCA dimension 2 contributions. The first feature is “dominant-recessive_1”, meaning the appearance of dominant-recessive control.