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SYMBOL EQUIVALENCE IN PHONETICS

> "'A thing is identical with itself.' There is no finer example of a useless proposition, which yet is connected with a certain play of the imagination. It is as if in imagination we put a thing into its own shape and saw that it fitted." (Wittgenstein 1958:84)

I. TYPES OF EQUIVALENCE

A basic principle of the International Phonetic Alphabet is to use one symbol for one sound: When two sounds occurring in a given language are employed for distinguishing one word from another, they should whenever possible be represented by two distinct letters without diacritical marks. (PIPA 1984:1) Roach (1989:70) states even more forcefully, Only one way of representing a given sound should be allowed on the [IPA] chart. However, each symbol is by the use of diacritical marks, equivalent to other symbols, for example, ʉ = ü, v̥ = f. The following is an analysis of the meaning of equivalence in phonetic symbolism, and a demonstration of how equivalence may be used to show relationships between sounds and produce narrow transcription. (Phonetics is in larger type or [ ]) It is observed that each sound may be defined by various combinations of these symbols to produce equivalencies and similarities. Equivalencies are shown to be 1) stipulated, 2) tautologies or identities, 3) circularities, 4) question begging, 5) synthetic or descriptive. The descriptive and definitional equivalencies show how the relationships and the combinations of symbols may be used to produce greater phonetic accuracy and narrow transcription. In this way, IPA symbolism is extended in its use and its full heuristic power is manifested. Extensive equivalencies are given for each IPA (1989) vowel and consonant.

First, the notion of *equivalence* must be clarified. Equivalence may be analyzed into a number of types:

1. Stipulation

This is arbitrary, such as, *Let unstressed* o = ə. As stipulative, it is devoid of descriptive content. One symbol merely stands for another. Nothing new is known about the sound, o. It is like giving a cat a new name. In phonemics, as opposed to phonetics, an abstract or ideal symbol is stipulated to represent all allophones and instances of a sound in a broad transcription (cf. Standwell 1991:138-139).

2. Tautology or Identity

Tautologies are less than synonyms. They are empty stipulations. Thus, symbolic logicians say that they say nothing about anything. No two sounds can be identical and still be two sounds. Wittgenstein (1958:84) pointed out that it is singularly uninformative to say of something that it is identical with itself. Twins are not identical, but similar. There is no absolute equality. Therefore, identity becomes similarity (≈), (= > ≈) if it is to be intelligible.

3. Circularity

By *analytic* in the philosophy of science, is meant that the predicate is contained in the subject. No empirical evidence is needed for its assertion because it is true by definition. The denial of the predicate results in a contradiction, e.g., *Phonetics is the study of speech sounds*, *Speech is sounds*, *Pharyngeal constriction = retracted tongue root*. Or, where C refers to a consonant, $C^{Y} = C$, $C = C$, $C^{W} = C$.

4. Begging the Question

A form of circularity or equivalence is to assume what is to be proved. Phonemics would beg the question by using universal, broad transcription to obtain narrow transcription. To always use ə for a reduced vowel, or generic /r/, begs the question as to their actual phonetic values.

5. Synthetic Statement

According to the philosophy of science, these are empirical statements requiring experience and evidence for their assertion. In order to know what the Chinese ç is like, we must listen, observe the articulation, and gather experimental evidence. The denial of the predicate, does not result in a contradiction. *ɟ is a voiced, palatal plosive*, is a synthetic statement.

6. Descriptive Equivalence

Descriptive statements are synthetic statements. What is described in phonetics are symbols or statements which are operationally defined to give as much precise descriptive information about a sound as possible.

Category-mistakes result when one type of equivalence is confused with another. i may be stipulated or analytically defined as being equivalent to ɪ. But ɪ may be perceived to have a different sound quality than i such that they are not equivalent. We may distinguish i from ɪ in narrow transcription. Similarly, i may be distinguished from ɪ. Thus, although these two symbols may be *defined* as being equivalent, they may be *described* as being different.

In actual transcription there is less subtle confusion because ɪ is often used interchangeably with i, meaning that the reader would not know which pronunciation is the correct one. An examination of five dictionaries produced the following variations for *city* : siti, sɪtɪ, sɪ.ti, sɪ́ti, sɪtɪ/i. Jones (1973) gives for British *play*, pleɪ, instead of plei, [it] for *it*, but he proceeds to use i also for i (Jones 1967: xliv). Kenyon & Knott (1949: 331) render *pity* as pɪtɪ, instead of pɪti. Ladefoged (1975: 53) gives seif for *safe*, not seɪf, but he says *bid* can be translated as bid, instead of bɪd. Catford (1988: 40), for the German *ich*, gives iç instead of ɪç. Einarsson (1945) uses ɪ for i, and i for ɪ in the transcription of Icelandic. Huang (1969: 2) is incorrect in holding that ɪ does not exist in Chinese. It appears, for instance, in *Ch'in* tɕɪ^{n}. ɪ is not equivalent to i , and a fortiori, neither is ɪ equivalent to i. We may, however, use ɪ̝ for a raised ɪ, and i̞ for a lowered i, where there is no equivalence.

Phonetic descriptive equivalence requires a standard symbolism based upon intersubjective phonetic research. For this purpose the IPA (1989) chart is used, which is widely available. In addition, an extended IPA vowel chart is given, as it is intended to provide more information and precision than is available with the IPA (1989) chart (Shibles 1993 a, b, c).[1]

II. Symbol Equivalence

Each vowel may in some sense be described, and so defined, in terms of every other vowel. It is in these senses that the symbols may be seen to be equivalent. These equivalencies reveal: a) the connections of sounds (or articulations) to symbols, b) the relationships between symbols, c) the relationships between the sounds (or articulations). Each symbol reduces to concrete acoustic, articulatory, or other features which are thus related to each other. By *equivalence* is not meant equality or identity (=), but that close similarity (≈) prevails based on certain features of the sounds. Each equivalence may then be explicated for the insight it may give toward more accurate acoustic description, better understanding of the articulations involved, display of the relationships to other symbols, clarity for the language learner, etc.

Ladefoged (1975: 65) states, There is no such thing as a single correct form of transcription of English; different styles are appropriate for different purposes. Because in the philosophy of science there are no literal or essentialistic definitions, to define is to take a model or metaphor. Thus, equivalencies provide such alternative possibilities. A knowledge of the possible equivalents for a particular sound gives the phoneticist or language learner choice as to which equivalence best represents the sound in question, as the following example illustrates.

The plosives, p, t, k, are labeled unvoiced aspirates, and b, d, g are their voiced, unaspirated counterparts. They may be stipulatively defined this way such that *p is an unvoiced aspirate,* is a tautological equivalent. Alternatively, they may be described this way on the basis of empirical evidence. The definition is not the same as a description. On the definition that p = aspirated and voiceless, and that b = unaspirated and voiced, unaspirated p equals b̥, [p^{-h} = b̥]; aspirated b = voiced p, [b^{h} = P], etc. McKenna (1988:39) states

[1] For "Symbols and Abbreviations" and "Vowel Charts" see p. 53-55 in this volume.

in regard to German, *It would seem that the [t] of* treu *is completely unaspirated, and the [d] of* den *completely devoiced—the end result of both operations being, auditorily, the same.* In practice, however, it may be observed that a sound can be closer to p^{-h} than to b̥, because the p quality is retained. In this case, p^{-h} is not descriptively equivalent to b̥, [p^{-h} _ b̥]. If other characteristics are added to the plosives such as lip pressure, lip protrusion, force, duration, etc., these plosives may lack equivalence as well. We may accordingly consider the description of plosives in various languages.

In Mandarin Chinese, *Ta* (Wade romanization) = d̥a, *T'a* = t^{-h}a, but d̥ _ t^{-h}. d̥ may have the quality of d more than of t. In Bavarian, we may not be able to distinguish between s or z̥, b̥ or p^{-h}, e.g., between *Packen* and *backen*. In Irish, *ispín* ɪʃ.b̥/p^{-h}in, b̥ and p^{-h} may be indistinguishable. In Swiss, *dann* may be d̥ɛːn or tɛːn. It may be hard to tell the difference between d̥ and t^{-h}. [̥] can mean not just voiceless, but partially voiced. In Icelandic, which has a special kind of syllabic aspiration, Einarsson (1945) gives ɛ^{h}p'lɪ for what may rather be rendered as ɛ.h.b̥.li. In *saddur*, d̥ ≈ t^{-h}, in *lamb* b̥ ≈ p^{-h}.

Ladefoged (1975: 26, 64) wrote, *There are...disagreements among texts on phonetics on how to transcribe sounds.* The exploration of equivalents reveals the different kinds of nuance a certain basic or Cardinal symbol may reflect. The distinctions are more fine than sounds which are closely related, such as that in the Swiss (Jestetten) variations of *ich*, which are ɪʃ, ɪʒ and ɪx. Each feature description and diacritic may be used to find functional equivalencies, just as differences of pronunciation may be exposed when the orthography of one language is used to render another. For example, rendering English by the Russian Cyrillic alphabet, or Chinese characters. Hausa *so* may be heard as: sŏ, so^{ʔ}, or so˺. Swedish *te* "tea" may be rendered as teʌ̆ or teˆ. Chinese an̆˺ ≈ an ≈ a^{n}. Arabic "one" waːhɪd̪ may be rendered by d̪ rather than by d̥ or d. Dutch χ is not equivalent to Arabic χ. The former is often more gutteral. In regard to h-sounds, Benware (1986: 27) wrote, *There are as many 'h-sounds' as there are vowels.* Bithell (1952: 113) had earlier noted, *There is a question...whether h is a fricative, consonant or a vowel.*

The expansion of the IPA symbolism provides one method by means of which some controversies in phonetics may be resolved. Given a range of equivalencies, a transcriber may choose the most fitting alternative and then compare with the choices of others. This may also serve the purpose of establishing a range of possible pronunciations. The analysis of the symbols may then show the specific differences between them.

The following equivalent or similar forms are given for use in either normal or narrow transcription. These equivalents are based largely on actual (IPA-S) transcription of various languages (*Realphonetik*). For example, the phonetic transcription is given as [i], which should be [j, i̯e, i , ɪ], etc. Where languages are transcribed with a simple Cardinal, it is rather found to be the case that one or another of the simultaneities was in fact the more correct transcription. Each alternate may be examined for its descriptive import, and the most appropriate one may be selected. The list is based on definitional equivalence as well as actual transcription. In a few cases the actual languages have been specified as illustrations. Some similarities occur only in fast speech. It is intended that researchers add their own examples as well so as to build a standard reference corpus. This may then serve as a checklist to see which alternatives would be best in a certain case. For vowels, the cardinal number is given first. (=) means: a) is defined as, b) is very similar, or c) is somewhat similar. _ means *is not equal, or not similar to.*

The following examples show:

1. Expanded Cardinal number equivalent.
2. Definitional equivalents.
3. Simultaneous-sound equivalents.
4. Equivalents based on diacritical modification.
5. Similarities based on diacritical modification.
6. Similar forms characteristic of particular languages.
7. Equivalents and similarities based upon actual transcription experience.
8. Examples of the use of the symbol for various languages.

For additional definitions of the symbols see also Pullum & Ladusaw (1986), and Catford (1988). For an inventory list of the sounds occurring in the major languages of the world, see Maddieson (1984). (V = vowel, C = consonant, # = Cardinal number, M = Maddieson 1984.)

III. Equivalents or Similarities

A. Vowels

#	Vowel	=	≈ Alternative Similarities for Narrow Transcription
1	i =	y	j, i̯v ≈ j̇v, i̭e ≈ i͜e, ≈ $^{\text{i}}$e ≈ i$^{\text{e}}$, i̞ = i͡ɪ, iˤ, i̤, i, i (Ik, Jap.)
1.5	ɪ	ʏ	ɪ _ i, ɪ = i̥, œ̆ = ɪ, ɪ̞ = i͡ɪ, ɪˤ (M:249), Å [ˤ], (CCD) gives range ɪ to ə.
2	e	ø	e͜ʌ = e᷄ː (Swedish); ε͜i̯, eˤ, e̥ (Ik)
2.5	e̝	ø̝	For languages having e̝, see (M:249-250).
3	ε	œ	ε͡a ≈ æ (Swedish *päron* and AP *pear*), æ̆, ε̆˞ = εˀ
3.5	æ	œ̝	æ̈ ≈ ɐ (definitional), ≈ ε, æ͡ɤ (Swiss), æ _ ae
4	a	ɶ	Used generically for the range a to ɑ. ɑˤ (Lancashire, Picardie Fr.), ḁ, a̤
5	ɑ	ɒ	= ʁ (soft), ä (AP), ɑ͡ɒ (Irish), ɒ̝ (Glaswegian, Swiss).
5.5	ɔ̝	ʌ̝	= ɐ.

6	ɔ	ʌ	= o͡a, o͡ɑ, Å ŏ, ɔ̃ˤ (!Xu), ɔ̃˺ (Chinese), ɑ͡ɒ (Irish),
			ɑ̟ (Glasgow,Swiss)
6.5	o̟	ɤ̟	ɵ = ö̟, AP *or* [o̟ɹ], o̟ (Irish)
7	o	ɤ	o = very round o (Icelandic, Scot., Turkish) (Payne 1990 uses o),
			o = less round o, o _ o, ŏ = ɔ̆, o = ɔ̣ = o˺ = ŏˀ = Cᵒ = Cˠ,
			o̤ (M:258: Tamang), o̥ (M:257: Ik)
7.5	ʊ	ɯ̟	≈ ʌ̈/œ̈, ŭ, u ,au = aw, Cᵚ = Cᵘ (Japanese)
8	u	ɯ	u̟ (Fr.), uˤ, ṳ, u̥, ṵ, ou ≈ ow, Vu Å Vw, ŭ Å ʊ
9	y		i, i͡u = j͡u, əi͡u, y ≈ ü, = ü̟ = ṳ, u (pal.), ≈ ü, y̆ ≈ ɪ, (range i to ɯ)
9.5	ʏ		ɪ, ɪ͡ʊ ≈ ʊ̈, ʏ̆, (range ɪ to ɯ̟)
10	ɸ		e,e͡o j ≈ i̯ɸ, ɚ ≈ ɸɹ (AP *bi̱rd*), ɸ _ ∅ (Similar but different symbols.)
			(range e to ɤ)
10.5	ɸ̟		e̟ , e̟o̟ (range e̟ to ɤ̟)
11	œ		ɛ, ɛ͡ɔ ≈ ʁ̟, ʁ̟, œ̆̈ = ŭ, ≈ (Scot.) ɨ, (range ɛ to ʌ)
11.5	œ̟		æ, æ͡ɔ̟ (range æ to ʌ̟)
12	ɶ		a, a͡ɒ (Rarely used), (range a to ɑ)
13	ɒ		ɑ, ≈ ʁ (Danish), ŏ, ɔˤ, ɑ, ɒː (Bavarian, Fr., Scot.)
13.5	ʌ̟	ɔ̟	ʌ̟̈= ɐ, ə, ɛ̟̈, Ger. ʌ > ʌ or ʌ, *Nase* nɑzʌ; *Seo* = ʃʌ (Irish)
14	ʌ	ɔ	≈ (Initial) ʔ, = stressed ɘ (Tranel 1987:38). a̟˔ , ≈ ă, = ɵ = ö
14.5	ɤ	o̟˛	ɤ̟̃ (M:257: Zoque)
15	ɤ	o	≈ ʊ, ʁ, ʌ̟, vel. ʌ, ă, ɹ˺, ʌˠ, ŏ, œ
15.5	ɯ̟	ʊ	Variation of ɯ. Japanese, Chinese, Korean, Turkish, Russian, Scots
			Gaelic; London dial. (Gimson 1966: 129)
16	ɯ	u	ɨ, i, u (Japanese), consonantal tense ɯ (So. Bantu), ɯ̆̈˺ (Chinese)
17	ɨ	i	= ɯ̈, (ɨ is a redundant symbol.)
			ɯ̈ West Midlands (Orton & Dieth 1971: 1271)
18	ʉ	ü	= ÿ, (ʉ is a redundant symbol.)

B. Mid-Central Vowels

(All are generically and inconsistently used, unnecessary, and controversial.)

ə   ë̞, ø̈ , ɤ̞̈, o̞   etc. Position varies.

ɵ   ø̞, e̞ , ɤ̞̈ , ö̞. Some regard this as round equivalent of ə.

ɜ   ɛ̈, œ̈, ʌ̈, ɔ̈   Roundness unspecified.

ɵ   ö̞, ø̞, ë̞ , ɤ̞̈   ɵ _ θ (Similar looking but different symbols.)

ɐ   æ̈, ʌ̞̈, ă, ä   Said to be unround. Position varies. Typically used for German *-er* endings. A *reduced [a]* (*Duden* 1974:11).

[˞] Rhoticity may be added to any symbol, e.g., ɛ˞, ɚ. ɚ was omitted as such from the 1989 IPA chart. Because ɛ˞ is often rounded, it is frequently equivalent to œ̈˞. The rhoticity symbol is generic, so does not specify the particular /r/ referred to.

It is also controversial to distinguish the mid-central vowels by stress. Shriberg & Kent (1982: 48) give the following:

Stressed	Unstressed
ʌ	ə
ɝ	ɚ
ɜ	ə

IPA-1989 defines ɜ as an unspecified *additional mid central vowel*. It may therefore be used to represent any other symbol. For this reason it may be regarded as a metasymbol. Mid-central vowels, including ʉ and ɨ, are not needed because they are redundant and because they are typically used generically rather than given a specific phonetic value. Thus, they are empty, unnecessary, and so inelegant symbols. For example, ə, by both tautological definition, as well as actual transcription, reduces in every case to another vowel. ɚ = ɛ͡ɹ (unstressed), ɝ = ɛ͡ɹ (unstressed). German transcription uses ɐ for *-er which is more descriptively rendered as* a͡ʁ, e.g., *der* deːa͡ʁ. ʉ is simply ü or ÿ, whichever seems closest to the actual sound. Therefore, the Cardinal vowels 17 and 18 may be omitted for the sake of accurate description, as well as for simplicity.

C. Consonants (Equivalents and Similarities for Alternate Transcriptions)

b   = p-h, b̚ ≈ p̚, b ≈ p-ʰ, b̥ ≈ p-ʰ (Swiss), b ≈ b̥, b͡p = b̥ (Gaelic, Holmer 1962:16), (fast speech) b ≈ p, b̥ = bᵊ, b̥ = b̚, b = p̌, bʰ = b̤, b̥ = (whispered b) b̤, bʰ (Welsh, Zulu)

ɓ   Implosive b, (Bantu, Sindhi, Vietnamese, Xhosa), = β̬̆, ʔb (Fula), ɓ (vel.) (Igbo) ʙ Voiced, trilled bilabial

b' Ejective b, (Not on IPA chart.)

d d̆ _ t-ʰ, d̥h ≈ t (Swiss), d̥ = ɾ, d^ = d̩, d ≈ t̬-ʰ, d̠ ≈ t̬ ≈ d, d ≈ t̠ (Arabic), d̠ ≈ t̠ d̩ (Köln, Swiss), d̠ = d̩, d > d̠ (AP *wi<u>d</u>th*), d̥ (Chinese), ď (Farsi). On an analogy b : ʙ :: d : d̩. We can create an approximant d̞ (Ger. dial. Riesenbeck).

ɗ Implosive d,t Gullah, Hausa, Hindi)

ɖ ʈ, d̩ (Buckinghamshire, Gaelic, Hindi, Oxford, Sanskrit, Swedish)

d͡ʒ _ dʒ

d͡ʃ _ dʃ

f v̥ʰ, f̩ (Russian)

f' Ejective f. Not on IPA chart. (M:235: Kambardian), f (Bantu)

ɸ = β̥, b̩, ɸ (hissed, Japanese), (AP *ca<u>mpf</u>ire*), v̩, ≈ w (Anglo-Irish)

ɸ' Ejective ɸ. Not on IPA chart. (M:235: Yuchi)

β ≈ ʋ, = ɸ̬, b̩ (Bavarian, Frankfurt), (AP *o<u>b</u>vious*), w͡v (Grandgent 1892:10), b̚

g g ≈ k-ʰ (Swiss), ≈ k̬-ʰ, ŋg = ŋᵍh (Chinese), g̊̆̚ = [ᵍ] = [ˠ] = ɟ̩, g (Swedish), g̚ (in double consonants g̚.g), g̩ (Russian)

g' Ejective g. Not on IPA chart. (M:217: !Xu)

ɠ Implosive g, k̑

ɢ q

ʛ Implosive d, ɖ

h ph ≈ pʰ, hʰ (strong asp.), h = ʰ, (aspiration, and consonant lengthener), d.h ≈ d̩h (Hindi), h = ɦ̥ (If unvoiced, as in Japanese, vowels become h, creating a different h for each vowel.), h (Japanese), ḥ (Turkish), h (Burmese)

ħ = ʕ̥, eħ ≈ ejĕ (Farsi), ħ = (more fricative) h (Arabic), ≈ χ (non-gutteral)

ʜ ʢ̥

ɦ h̬, (AP *a<u>h</u>ead*), ɦ _ ɪ́.

ʔ This can represent any vowel quality. In RP dial. ʔ = ʌ̆, ɪ̆, ă, ɒ̆, ≈ (initial plosive), ʌ̈, ᴧ. Sound varies with following vowel: ʔ͡V, ≈ [.] separate syllable, ʔ̚ (Burmese), ʔ-ʰ, V̚ ≈ ˀ, C̚ ≈ ʔ (Chinese), ʔb (Fula), ʔ ≈ V (velar), (cf. Danish *stød*) syllabic break [.] (cf. Hausa) ʕ [ˤ] = (pharyngealized), = ɦˤ = ɑˀ, = ʁ̞, ɦ̞, ħ̞, ≈ ɑ, ɑ̞, ʔ̞, ʔˤ (M:215), (Controversial: see Laufer & Condax 1981:50 ff.)

ʡ Epiglottal plosive, ʢ̥

ʢ Voiced epiglottal fricative, ʜ, ɑ͡ʢ (Doke 1926, Zulu)

c k̹, ɟ̊, = t͡ɕ (PIPA:41), t͡ç, t͡ʃ, ç̹, ʝ̊, tɕ (PIPA 1984:41), t̠

c' Ejective c

ƈ Implosive c, = ʄ

ʄ Implosive ɟ, = ƈ

ɟ i̯, d̥j, ç̬ (affric.), ç, ɡ̟, ʝ̠ (tense) (Columbian Spanish), d̹ (in AP *educate*), ɡ˖, d̹

dʒ (See above), _ dʒ, (AP *judge*)

dʃ _ dʃ, (Arran Gaelic)

k k-h ≈ ɡ̊, k ≈ q, k̬-h ≈ g, k-h = k, k ≈ kʰ, k-h = k̚, = ç, = q (+ front vowel), k-h (Hausa), k̹ (Japan.), kˣ (Cockney), k͡χ (Dutch, Swiss)

k' Ejective k, ≈ k-h, kʷ = k = k͡w

ƙ Implosive k (Hausa) = ɠ̊

l l̥ _ l, l ≈ ɾ (Icelandic); Vl ≈ Vo ≈ Vw (e.g., British dial. *all* [ow]); -ɾ ≈ l; al > au, aw, (Swiss); l̥ (AP *clean*, Fr., Icelandic), approximant l̞ ≈ ɔ (Indonesian), l̥̚ (Thai), l̪ (AP *health*, Span.); l ≈ ɾ̥, ɾ̞, ɾ

ɭ l͡r/, (Eng. Midlands *girls*, Marathi, Norweg., Swed.)

ʟ ≈ ɫ (velar), (cf. Irish symbol ʟ), unilateral approximant

ʎ ≈ lj, lʲ (Russian), = li (Ital., Spanish), ʎ̥ (Ladefoged 1968:29: Burma)

ɫ = lˠ, lˤ, (ɫ is ambiguous between velar and pharyngeal l), ≈ ɑ, ɒ; ɔl > ɒ, (= vel. or phg, e.g., in Ger. Rhein. *Kamisol*), ɫ (non-alv. pharyngeal, Dutch)

ɬ l̥ʒ, ≈ t͡l, ≈ h͡l, (Irish, Suto, Xhosa, Welsh, Zulu), ɬ̥ (Icelandic), ɬː (M:234: Greenland), ≈ ʃ (Welsh)

ɮ = ɬ̬, ɦ͡l, (Irish, Xhosa, Zulu)

m = n (bilabial), range m to n (CCD:1987), m̥ (Bengali), m̩ (Cantonese, Swahili), m̚ (Turkish), m (Bantu)

ɱ = m̪ (Duckworth, et al. 1990:276), ɱ (Bantu), (AP *nympf*)

n	n˺ ≈ n̥ (Burmese), n ≈ ñ, n̺ = n+ (Payne 1990), (cf. [˜]), n˺ (Japan.), n̥ (Bantu), n̥͡h (Icelandic), n (pharyngeal, Dutch), ṇ (Swahili, Tswana)
ɴ	ɴç > i (Japanese), (Bantu), = ɳ, nasal release (e.g., p^N)
ɳ	= ṇ, n͡r (/r/ varies), (Marathi, E. Norway, Punjabi, Scot.)
ɲ	n͡j (Xhosa), ≈ nj, ≈ n^j (Russian), ɲ̊ (Burmese), (Fr., Ital., Polish, Span.)
ŋ	ŋ̊ (Icelandic), ŋ̆˺ (Japan.), ŋ̩ (Bavarian, Cantonese, S. Sotho, Thai), n͡g, g̃, ŋ (pal. and velar, Irish), range ŋ to n, ŋŋ (Ger. dial., Kiel)
p	≈ b˺, p ≈ p^h (Ladefoged 1975:44), = b̥, = $b̥^h$, p^{-h} = p (whispered), p^{-h} = p˺, p˺ = b˺
p'	Ejective p
ƥ	Implosive p,= ɓ̥, (Igbo)
q	q˺ = k˺, q ≈ k (+back vowel), q̩ ≈ k, = ɢ̥, q̩ (phg., Arabic), q^{-h} (Portuguese)
q'	Ejective q, (M:217)
ʠ	Implosive q,ʛ
r	= trilled d, r _ r, ≈ ɣ (Icelandic), r^{-tr} = l (Span.), l͡r (Puerto Rico), ≈ d, ≈ ð, ≈ ɾː, r^{-tr} = üː, r = Vː (e.g., ɑː, ɸː), r̥ (forceful) > ʃ (Swedish), r^j and r̥ (Russian), r > χ (Swiss), $r̥^{h\text{-}tr}$ (Icelandic), (strong trill, Arabic, Scot.), r͡ɯ (vel. Irish)
ɾ	_ ɾ, d (both one tap) (Irish), (tap) r, d̥, t^{-h}, ř/ɾ˺ and ɾ͡l (Japanese), ɾ̥ (RP), ɾ ≈ d
ɺ	(voiced alveolar lateral flap), d͡ɭ, (Japan., Tswana)
ɽ	(Czech.; Grassington, Engl.; Hausa, Hindi, Japan, Oslo, Swahili, Swedish), _ ɽ̩, ɾ̥
ɹ	ɹ _ ɹ, $j^ɹ$ ≈ jɛɹ ≈ jɹ, $h^ɹ$ ≈ hɛɹ, ^{ɹ} = ɹ˺, ɣ˺, ɣ, a͡ɣ (Danish), ɹ˺/ɹ̩ = $ɑ^ɹ$, ɑ, ɹ̩ (Irish), ɹ̩ (AP), ɹ̆ (Japan.), ɹ͡l (Ibo, Korean, Zulu), ɹ̵ (Scot.)
ʁ	(Fr., Ger., *-er* > ʁ), ʁ͡ɹ, ≈ ɣ, ɰ, ɑ, œ̢, ɐ, ɣ > ʁ (Arabic), = χ̬, = ɡ̩, = j͜ʌ, = ʌ = ɹ˺, = j͡ɹ, ≈ ɣ˔ (Arabic, Swabian), ʁ͡x and ʁ̣ (Alsace), ʁ > ˤ (Swabian), ʁ˺ (Rhein), ʁ̩ (Danish), (Northumbrian *burr* = ʁ Å w)
ɻ	(Bengali; Bristol, Engl.; Dutch, Swedish), ≈ l (Chinese, Finnish), ɻ̆˺ (Chinese), ɹ̩
ʀ	≈ χ, ʀ̥ = ʁ, ≈ ɡ, ʀ̩ (Léon 1983:9), (Köln)
[V˞]	Generic rhotic quality added to any vowel. Advisable to substitute a specific /r/.
r^{-tr}	(Added here to IPA), (Irish), r to r^{-tr} (Malay)

s s = z̥, ≈ ˢz̥ (Köln), s = z (Ger. dialects), s̪ (Arran Gaelic), s (vel.:Arabic, Irish), s (whistled: Efik, Shona), s (Amharic, M:229), ṣ (Cambodian, Japan.), sˢ (Russian), s⁻ˢ and š (Swiss)

s' Ejective s (M:235). Not IPA

ʃ = s̻, ʃ (Fr.), (grooved vs. slit), ʃˢ (*Duden* 1974:13), s͡ʃ (Gullah, Turner 1973:246)

ʂ = r͡s, = ẓ̊, = rʃ, = /r/, sẓ ≈ ʂɯ, ˢ̧ (whistle, Swedish), ≈ ʃ (Swedish), ʂ (hiss, Span., Dalbor 1969:92)

ɧ (Controversial). = ʃ͡x (Swedish, Zulu)

ç (Ger., Norweg.) = j̥, sj, i̥ = iː, x̟, (AP *hue*), j (strongly whispered), ç (Swedish), ɕ

ʝ ç̬, j ‗ ɟ

ɕ (Chinese, Dutch, Köln), ʑ̊, ç̟ , t͡ʃ, ≈ t̪ʃ (Japanese), ç͡ʃ, ʃ (pal., Polish), s͡j (*Duden* 1974:11), ʂ͡ɕ (Ladefoged & Wu 1984:271)

t t = t⁻ʰ (Swiss), t˺ = d˺, t = d, tʰ ≈ d̥, t⁻ʰ = ɾ, t = t(Payne 1990), t⁻ʰ = t˺, tʰ ≈ d̥ᵗ, approximant t = t̞, t ≈ d (Chinese), ṭ (Arabic), t̪ (Irish, Liverpool), tˢ (Cockney), t̻ (Irish)

tʃ t͡ʃ = c, = ç, ≈ t̠, ≈ tˢ, tʃ (palatal, Irish), t͡ʃ ‗ tʃ (Controversial)

t' Ejective t

Implosive ƭ, = ɗ̥, (Igbo), ≈ a click

ʈ (Buckinghamshire, Hindi, Norweg.) = r͡t, = ʴt, = /r/t, ʈ⁻ʰ =ɖ, = r⁻ᵗʳt, ɹt, (AP *try*)

ʈ' Ejective ʈ

θ t̪ʰ (interdental), = s̪, = ð̥, = ð̥, groove vs. slit, θ ‗ ɵ ‗ ∅

ð z̪, ≈ d̪, ≈ l (Danish), = θ, θ⁻ʰ, θ̬, d̪

v v̥ = v̆ (Bavarian), v̥ = f, f̬, f̬⁻ʰ, v͡w, v, v̥ (Icelandic)

ʋ [Bavarian, Dutch (cf. Mees & Collins 1982:6), Finnish, Hindi, Irish, Zulu], ≈ β, w, v͡w, v̞, endolabial (Kahananui & Anthony 1974:xvii, cf., Catford 1977: 144-145)

ʍ ɸʰ, hw̥, h, hw, ʜ͡w, x͡w, h͡ɸ, ɸʷ, ɸ͡w, ɸ

w w˺≈ ŭ, u̯a, uɒ, w͡V, u͡V, Vw ≈ Vu, uɔ (AP *water* uɔtɹ) (e.g., au ≈ aw), ʋ, ow Å ou, w ‗ w, w (Japan.), w̥ (RP, Icelandic), w̃ (Breton, M:246),

	velar vs. pal. w, onglide or offglide, w̩, [ʷ] = (labialized), [ʷ] = [ ], w > β (Bavarian, Irish), o͜a, u͜i = wi, u.ɛ = uwɛ
ɥ	(Fr., Span.) (voiced labial-palatal approximant), ≈ w, *consonantal ü* (*Duden* 1974:11), ɥ, wi
x	ɣ̊, xua ≈ ħwa, ç > x (German), χ˔, ɡ˔, ɔh
ɣ	uvular and velar in Arabic, ɣ̥ (Ger. dial.), ɡ̞, ɣ_ ɤ, = ɡ̀, ğ, [ˠ] (velarized), ɤ (with friction), x̬, ʁ̞
ɰ	ɣ (non-fric.), w ≈ ɯ, (Burma)
χ	ʀ, ≈ ʁ̞, ħ, ḥ, k͡χ (Swiss), x̣, ʁ̞, strong χ (Dutch), χː (!Xu)
j	[ʲ] (palatization), ≈ jɸ, ˀi, jV, i̯V, Vi̯ ≈ ᵛj. ejɛ ≈ eɛ, ija ≈ iːa (Hausa), i͡o, j ≈ i
z	ž ≈ s, z̥ ≈ s⁻ʰ (Bavarian), z̥ = š (Swiss), ʂ (Payne 1990), zˠ = z͡ɯ (Chinese), z̠ (Arabic), ẓ (Alsace Ger.), z whistled (Bantu), z (whistled, Doke 1954:33)
ʒ	= ʑ, = ʃ̬, (strong) ç (Swedish), ʒ (Fr.), ʒ̊ (Bavarian)
ʐ	[Buckinghamshire, Castilian Spanish (Dalbor 1969)] ʂ̬, ʒ˔, /r͡s (Mandarin)
ʑ	(Ewe, Frankfurt Ger., Fula, Japan., Norweg., Polish), ç̬, ʒ (pal.), ʑ (Canepari 1983)

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