A Consideration of the Consonant Chart in the International Phonetic Alphabet

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Abstract

In this paper we outline various problems with the current IPA consonant chart, based on the study of an ever-increasing number of languages. We propose a revised version of the chart, which has many similarities with the pre-1989 version of the chart, but which at the same time shows innovations. We particularly focus on the laryngeal sounds; the epiglottal and pharyngeal sounds; the retroflexes; the sibilant fricatives; and the semi-vowels. We hope that our discussion will be useful to both researchers and pedagogues, and we hope that our proposed revisions are logical from the phonetic and phonological points of view.

Index Terms: IPA chart, consonants, revision

1. Introduction

Human speech sounds are complex, with some sounds (such as vowels) existing more in a gradient space, and some sounds (such as some consonant contrasts) being more categorical. Stops and fricatives might be said to be more categorical, in that if a speech sound involves full blockage of airflow, it is a stop; and if the sound involves sustained noise shaped by the oral cavity, it is a fricative. There cannot be said to be an intermediate state where the sound is between a stop and a fricative in acoustic or articulatory terms. At the same time, one could argue that some contrasts of place are more gradient, since one could describe a sound as being "more velar" or "more uvular", or "more palatal".

Given such complexity in speech sounds, it is perhaps not surprising that over the decades, the chart of the International Phonetic Alphabet (IPA) has been revised several times, as phoneticians' understanding of speech is improved, partly through the use of instrumental techniques, and partly through the study of a greater variety of languages – historical IPA charts are given at https://www.internationalphoneticassociation.org/content/ipa-chart. We assume that the reader is familiar with the most recent chart of the IPA. However, throughout this paper we will refer to the 1951 chart of the IPA (which is also available at the above website), since this was the most recent chart before the significant reforms of the Kiel Convention in 1989 [1].

In this paper we consider some problems with the current IPA consonant chart, based on current knowledge of articulations in a variety of languages, and based on our own classroom experience of the most confusing aspects of the chart when teaching these sounds. We offer a possible alternative solution to the consonant chart, and while we recognize that our suggestions are not perfect, we hope that it is conceptually clearer and more accurate than the current chart, and that it will stimulate further discussion around the chart.

2. Some issues with place of articulation

We begin by considering some problems with the consonant chart in terms of place of articulation:

2.1. Glottal

The Glottal column contains only a voiceless "plosive" and two "fricatives", with every other cell greyed out because the articulations are impossible (e.g. a glottal lateral). The existing symbols are problematic in terms of their voicing, in that the glottal stop [ʔ] almost never involves full closure (and nothing that could really be termed a "burst", as other plosives almost always have). Therefore, it may not be appropriate to place [ʔ] with other "voiceless" consonants. Glottal stop also does not pattern with other voiceless plosives in blocking the spread of nasality or vowel features in phonological harmony. The characteristic lack of a full closure is consistent with the frequent patterning of [ʔ] as a prosodic feature rather than a consonant phonologically, e.g. in weight-sensitive stress systems [2]. A recent survey found a similar phonetic realization for glottal "fricatives" [h ɦ], whereby the voicing for both sounds is largely predictable by context: the voiced glottal fricative is more common intervocalically, and the voiceless more common at word edges. Although this conditioning environment can be said to apply for other stop and fricative places of articulation (e.g. [p b]), the glottals are different in that contrasts between /h/ and /ɦ/ are controversial and likely reflect phonetic and phonological features other than voicing [3]. This is in stark contrast to the many languages that are known to have contrasts in stop or fricative voicing.

At the same time, the glottal "fricatives" are problematic as fricatives, if we consider frication to be turbulent noise that is generated by a constriction in the vocal tract. For glottal "fricatives", noise is generated when the vocal folds are held apart – this is closer to the definition of an approximant. In addition, acoustically the intensity of the noise is not comparable to the intensity of the oral fricatives. Indeed, the glottal /h/ is often described as the voiceless version of the adjacent vowel. Overall, the glottal fricatives are not easily defined from an articulatory or even an acoustic point of view. Instead, it is perhaps more appropriate to say that [h ɦ] is glottal spreading, and [ʔ] (which is very often not a stop) is glottal constriction [3, 4].

Studies involving direct imaging of [ʔ] have also shown that glottal constriction is usually produced with supraglottal laryngeal constriction, especially of the ventricular folds but also of general epilaryngeal constriction. If this supraglottal constriction is deemed criterial for producing a glottal stop, then perhaps it should be relabeled "laryngeal" instead of "glottal" [5]. This would be a return to a label used in the early days of the IPA (e.g. in 1900, 1903, 1905, and 1921) [6] and would find

support in phonological feature geometric classifications that place the glottal sounds under a "Laryngeal" node [7, 8].

Perhaps more importantly, glottal consonants pattern differently from other consonants in many phonological processes across the world's languages. For instance, in Sundanese, a process spreading nasalization across the word is blocked by a non-nasal consonant – however, glottals are transparent for this purpose (i.e. they do not behave as a consonant in this regard) [9, 10]. Similarly, glottals characteristically stand out from other consonants in allowing complete harmony (i.e. vowel copying) between vowels in adjacent syllables, e.g. in Mesoamerican languages [11, 12]. Glottals also behave as transparent segments, unlike other consonants, in child language phonology [13]. Even in English, the allomorphic rule assigning the indefinite article to a noun phrase treats the /h/ as transparent (i.e. as a non-consonant) for some speakers – e.g. /ən hɪstɔɹɪk əvent/. All of these observations are in line with the above-mentioned feature geometry approach to phonology, where glottal sounds are located within their own node "Laryngeal", quite separate from the node "Place".

For all of the above reasons, we suggest that the glottal column be labelled "Laryngeal". This is in line with the Laryngeal Articulator Model [5] that treats glottal stop as involving multiple laryngeal structures. However, in order to respect the unusual status of these sounds with respect to all of the other consonants in the chart, we add a thicker line between the laryngeal column and the rest of the consonant chart, in order to highlight the fact that although laryngeals often pattern as consonants, there are many occasions where they are transparent to phonological processes that apply to (all) other consonants. In addition, we have marked cell boundaries with dotted rather than solid lines, in order to denote that the standard supralaryngeal manner definitions are not relevant for laryngeals. At the same time, we place [h ɦ] in the approximant row, to denote that the articulatory gesture involves spreading. There is thus a visual distance between [ʔ] and [h ɦ] which is indicative of the continuum of laryngeal constriction.

In line with proposals and subsequent discussion following the Kiel Convention [4, 14], we have considered simply removing the laryngeals from the consonant chart altogether, and placing them on their own separate line outside of the chart – this choice would particularly highlight the problems with the "stop" and "fricative" manners of articulation. However, we felt that this choice would be more problematic in terms of backward compatibility of the chart, and would also deny the laryngeals a status of (albeit imperfect) consonants. For this reason we choose the thicker line as the more backward compatible option.

Our draft revision of the IPA chart is included in the Appendix to this paper.

2.2. Pharyngeal and Epilaryngeal

In the present IPA chart, the column "Pharyngeal" has only two symbols listed, namely the voiced and voiceless fricatives [ħ ʕ]. However, the voiced pharyngeal [ʕ] is more often realized as an approximant rather than a fricative. Indeed, the chart allows the possibility of a pharyngeal approximant, as well as a voiceless pharyngeal plosive, and also a trill, tap or flap.

At the same time, the voiceless and voiced epiglottal fricatives [ʜ ʢ], and the epiglottal plosive [ʡ] are listed under "Other symbols" beneath the main consonant chart. It should be noted that the epiglottal plosive [ʡ] has been characterized as a pharyngealized glottal stop [5].

We propose to merge the categories pharyngeal and epiglottal into a single column, labelled "Pharyngeal and Epilaryngeal" (see Appendix). Note that we write "Epilaryngeal" instead of "Epiglottal", to highlight the role that the superior larynx plays in producing lower-pharyngeal/epiglottal constriction [5]. The voiceless stop in this column is [ʡ], with no voiced stop counterpart, in line with the view that it is an epilaryngeal (or 'pharyngealized glottal') stop. We propose two trills for this column, voiceless [ʜ] and voiced [ʢ], in line with the typical realization of these two epiglottals (see for example Figure 5.23 on page 168 of [15] which shows clear trilling for [ʜ] in the North Caucasian language Agul). We note that this will be the first voiceless member of the trill manner row (though they occur quite often phonetically as variants of the voiced trills). The voiceless pharyngeal fricative [ħ] occupies the fricative cell in this column, and the voiced pharyngeal [ʕ] occupies the approximant cell in this column.

2.2.1. A short note on the uvular and velar places of articulation

We recognize that the uvular fricatives, like pharyngeals, are also often not realized as fricatives: the voiceless [χ] is often realized as a voiceless trill, and the voiced [ʁ] is often realized as an approximant. However, we do not propose any changes at this stage, and acknowledge that the post-velar region of the consonant space is still comparatively poorly understood. Despite the existence of languages (such as in the Caucasus and in parts of the Americas) that treat velar and uvular stops as separate phonemes [15], we note the usefulness of treating velar-uvular as a continuum, varying according to vowel context, or according to language-internal forces [16]. Indeed, Catford's [17] reference to velar and uvular being an "octave" apart can serve as a useful analogy for the gradient nature of this contrast.

On a final short note regarding the velar place of articulation, we wonder if it is entirely accurate to include the velar lateral [ʟ] as a speech sound, given that empirical investigation of Mee has suggested that this sound is highly variable, and could in most cases be characterized simply as the sequence /gl/ [18]. Similar variability has been noted for Mid Waghi and Archi [15, chapter 6]. It is also not clear how the posterior portion of the tongue can maintain a velar closure at the same time as the sides of the tongue allow lateral airflow [cf. 19].

2.3. Retroflex

In terms of place of articulation, the "retroflex" stands out as being particularly odd. This is the one lingual "place" of articulation that is not actually a place – it refers to an idealized tongue configuration (perhaps characterized as sub-apico post-alveolar) that may, or may not, be necessary to produce the particular sounds in this column. We have re-labelled this column as "postalveolar" in order to be more consistent in the naming of the columns, but have kept the same symbols. In our teaching experience, it is difficult to explain the retroflex "place" of articulation and to distinguish it from postalveolar. More importantly, to our ears, it is also almost impossible to hear the difference between a properly retroflex sub-apico postalveolar, and an apical post-alveolar; indeed, a perfectly acceptable "retroflex" sound may be produced simply by retracting the tongue tip into the correct region, without necessarily retroflexing the tongue. Several Indo-Aryan languages such as Hindi, Nepali, and Bengali, which are often described as having retroflex consonants, can be analysed as

having retracted alveolars (non-retroflex postalveolars) instead [15, 20, 21]. Similar observations have also been made for Australian Aboriginal languages [29]. For further discussion of variability in retroflex production, the reader is referred to [30].

2.4. Palato-alveolar and alveolo-palatal

There are two "places" of articulation that existed in the 1951 version of the chart that were removed in 1989. A column "palato-alveolar" containing only the fricatives [ʃ ʒ] was removed, as was a column "alveolo-palatal" containing only the fricatives [ɕ ʑ]. The fricatives [ʃ ʒ] were re-labelled as "postalveolar", and are now the only sounds that occur in that column. As we discussed above, the distinction between "postalveolar" and "retroflex" is problematic, since a stop, nasal or lateral sound that is produced at the postalveolar place of articulation, with a retroflexed tongue tip, is auditorily very difficult to distinguish from a sound produced at that same place of articulation, but without a retroflexed tongue tip.

At the same time as [ʃ ʒ] were moved to postalveolar, [ɕ ʑ] were demoted to the Other Symbols category, despite how common these sounds are in many languages of the world, particularly in the languages of East and Southeast Asia. One possibility is to re-introduce the column alveolo-palatal to include [ɕ ʑ], and to also include the stops, nasals and laterals [ʈ ɖ ɳ ɭ], which are used by many scholars of Chinese and other languages. The stop symbols [ʈ ɖ] are also used by authors who consider the palatals [c ɟ] to be more akin to the sequence [kj] rather than the sequence [tj] (i.e. they see the palatal symbols as being more akin to a fronted velar than a properly [alveolo-] palatal sound, the latter being typically associated with extensive affrication of the stops). Whilst the inclusion of an alveolo-palatal place of articulation might be helpful for authors who wish to distinguish [ʈ ɖ] from [c ɟ] along these lines, our main concern is that there is no such auditory distinction between the sounds [ɲ ʎ] and [ɳ ɭ]. We cannot hear a reliable difference between a palatal nasal or lateral, and an alveolo-palatal nasal or lateral. In the case of nasals, this may in part be because the acoustics of nasal consonants are determined by the backmost point of contact for the consonant, rather than the frontmost point of contact, with both a regular palatal and an alveolo-palatal involving a very large degree of tongue-palate contact (although we acknowledge that formant transitions into the vowel do involve the cavity anterior to the constriction) [22].

In the case of laterals, a lack of difference between [ʎ] and [ɭ] may be due to insufficient degrees of freedom in the tongue tip-blade-body complex: the lowering of the jaw and/or narrowing of the tongue required for lateral production may lead to the constraint that the central tip/blade closure cannot be located further back than the pre-palatal region, without leading to retroflexion and the production of /ɭ/ instead of a palatal lateral. In addition, to our knowledge no phonetician has ever proposed an alveolo-palatal glide that is separate from the palatal /j/, yet this could be considered a logical extension to a system that has alveolo-palatal stops, nasals and laterals.

We therefore consider the addition of the alveolo-palatal place of articulation a controversial addition to the chart, and (apart from the fricatives) we think it should at most include the stop manners of articulation. However, even the individual authors of this submission cannot agree on the inclusion of alveolo-palatal stops, and we therefore do not include them in the chart, in large part because their inclusion would involve a re-consideration of the value of the regular palatals [c ɟ]. We return to the issue of how best to describe the contrast between [ʃ ʒ] and [ɕ ʑ] when we consider the overall system of fricatives further below.

3. Fricatives

A particularly difficult aspect of the chart is the fricatives, more precisely the coronal fricatives. The problems can be divided into two categories: one relating to the place-of-articulation distinctions, the other relating to the paradigm of manner differences.

3.1. Problems with place

That place of articulation is a problem for coronal fricatives is shown by the confusion surrounding the terms alveolo-palatal and palato-alveolar (traditionally [ɕ] and [ʃ] respectively), with the latter being re-labelled "postalveolar" in the modern version of the chart. We believe this terminological confusion arises largely because place of articulation is not a sufficient criterion for describing and differentiating these sounds – the extent of grooving (constriction width as well as length) and airflow rate are just as crucial. For instance, in a real-time MRI study of 10 speakers, Yoshinaga et al. [23] found that Japanese palatal [ç] and alveolo-palatal [ɕ] had almost identical places of articulation. Using articulatory modelling, they found that these sounds were differentiated once constriction width and airflow rate were considered.

The question of constriction location, width/length and flow-rate is intimately tied to the question of whether a sound is a sibilant or not. It is well understood that the English fricatives [s z ʃ ʒ] are sibilants, and it has been suggested that an important aspect of their articulation is the central groove directing airflow towards the teeth – the end result being an increased intensity of spectral noise prominence [24]. It is also generally understood that the English fricatives [f v θ ð] are non-sibilants, in the sense that they are not as loud, and in the sense that there is no central groove directing airflow towards the teeth (indeed, this may be impossible for sounds that are labio-dental and dental). Moreover, the sibilant versus non-sibilant distinction is well established in English morpho-phonological rules.

However, when it comes to the other fricatives in the chart, it is not so clear what is sibilant and what is non-sibilant. Yoshinaga et al. [23] initially considered [ɕ] as sibilant and [ç] as non-sibilant based on previous literature. But they subsequently found it difficult to determine an articulatory/acoustic basis for this description, in that the jet of air produced by the constriction reached the edge of the upper incisors in the models for both sounds. This is just one study, and the important point is that there is not the volume of work on non-English fricatives that is needed in order for phoneticians to better understand this class of speech sounds. As expert phoneticians, none of us can confidently say which of the non-English fricatives on the chart is sibilant and which is non-sibilant; we feel that in the absence of a great volume of articulatory and acoustic studies, phonological evidence from a variety of languages is the best evidence we could expect in this regard (but see below for another possible approach to the question of sibilance).

Finally, it might be noted that [ʂ] may or may not involve retroflexion of the tongue tip, as noted above regarding the plosives at the postalveolar place of articulation.

3.2. Problems with manner

The other important problem with the fricatives is that not all fricatives can be derived through articulatory lenition from the corresponding stop place of articulation; and by extension, they cannot themselves be lenited to an approximant at the same place of articulation. If we consider [s], it has a very different tongue shape from [t] (including but not limited to the grooving described above). Indeed, when we speak of a lenited [t] in Australian English, we use the lowering diacritic beneath the stop symbol [t̞]. By extension, one does not speak of /s/ being lenited to /ɹ/. Similar observations could be made for [ʃ ʂ ɕ]. By contrast, the other fricatives operate very well in the stop-fricative-approximant lenition continuum, namely (working with the voiced obstruents for this example) [ʝ ʒ ʑ], [ɣ ʏ ɰ] and [ʁ ʁ̞]. One would even include dental [d̪ ð ð̞] in this set.

Thus, one could treat the class of sibilants as fricative sounds that cannot be derived by articulatory lenition from a corresponding stop, or strengthening from a corresponding approximant. Indeed, phonological accounts of lenition argue that lenition of stops invariably results in non-sibilant fricatives [25, 26]. Sibilant sounds are produced with a very special tongue configuration that may include significant grooving.

In order to respect the fact that sibilants cannot be derived by articulatory lenition from stops, we mark these sibilant fricatives on the chart with a special double line around the set, in order to offset them. We include the alveolo-palatal and palato-alveolar places of articulation in this new set, as per the pre-1989 chart, but are very conscious that these place labels do not fully describe the articulations of all speakers. For any speech sound, there is a tremendous amount of inter-speaker variability in terms of active articulator used and in terms of precise place of articulation – careful examination of individual data in any articulatory study cannot fail to highlight this. In the case of fricatives, differences between speakers are all the more salient, as this is a class of sounds where the spectral shape of the output noise generated at the constriction is crucial, and the location/shape of this constriction may be highly dependent on individual morphology. However, the acoustic output is highly consistent across speakers despite differences in articulatory input, and as is ultimately the case in all phonetics, it is the acoustic output that is most important.

Finally, it is important to point out that lip rounding plays a role in the production of the palato-alveolars [ʃ ʒ]. This has been remarked upon in many articulatory-to-acoustic modelling studies and even mentioned in textbooks [27, page 159]. This is particularly relevant in the consideration of the difference between these sounds and the alveolo-palatal [ɕ ʑ]: many speakers can produce [ɕ ʑ] as the unrounded version of [ʃ ʒ], despite Catford's [17] suggestion that [ɕ] can be treated as [ʃ] + [j]. The extent to which our knowledge of fricative production (articulatory and acoustic) is imperfect cannot be overstated.

4. Some problems with the manners of articulation

4.1. Approximants

The current chart contains a row for approximants, which includes the semi-vowels [j ɥ], as well as the rhotics [ɹ ɻ] and the labiodental [ʋ]. Curiously, the labio-velar [w], one of the most common consonant sounds in the languages of the world [31], was demoted to "Other Symbols" in the 1989 revision to the chart. Previously it was located in the "Bilabial" column, in the row "Frictionless Continuants and Semi-vowels", sharing a cell with the labio-palatal [ɥ]. [w] also appeared in brackets in the velar column in the same row, and [ɥ] appeared in brackets in the palatal column. Significantly, this row was at the bottom of the chart, closest to the vowel chart, as a signal that the semi-vowels were acoustically, articulatorily and phonologically linked to the vowels. Indeed, the vowel chart pre-1989 was clearly aligned with the palatal and velar columns of the consonant chart, sending a very clear signal of the relationship between the vowels and the palatal and velar approximants.

Conceptually, we would suggest that it would be wise to return to the pre-1989 situation regarding the semi-vowels, especially so given that (with the addition of the velar glide [ɰ]) we now recognize four semi-vowels that can be derived from/related to the four high (corner) vowels – namely [j ɥ ɰ w], derived from [i y ɯ u] respectively. We have therefore adopted this approach in our proposed chart in the Appendix. However, we go further, in that our chart lists a separate row for "Semi-vowels" below the row for approximants. We do this to explicitly show the relationship between the vowels and the semi-vowels – however, we note that the two rows (semi-vowels and approximants) could be combined, and the non-semi-vowels simply offset with a double line, as was done with the sibilant fricatives. This solution would be entirely possible, since (at present) combining the two rows would not result in any overlap of cells. However, if one were to introduce a separate symbol for the lenited bilabial fricative [β̞], as is found in Spanish, then in that case there would be a bilabial derived from vowels (the semivowel [w]) and a bilabial derived from regular lenition (the approximant [β̞]).

Finally in this section, we briefly need to consider the rhotics [ɹ ɻ] under the approximants label. Although we do not propose any changes to these symbols/sounds, we do note that discerning the difference between them is very difficult in practice. The first author simply tells students that [ɻ] sounds darker than [ɹ], presumably reflecting a balance of energy weighted towards the lower part of the spectrum. In principle [ɻ] should be produced further back in the oral cavity than [ɹ], and according to the LAPSyD database, there is only one language that contains a contrast between the two sounds, Wiyot (https://lapsyd.huma-num.fr/lapsyd/index.php?data=view&code=602). It has moreover been suggested that [ɹ] and [ɻ] often involve frication: for example in Beijing Mandarin Chinese the onset/initial postalveolar rhotic varies between approximant and fricative realizations (see discussion in [28]). Indeed, in the previous version of the chart, [ɹ] appeared in both the fricative and the frictionless continuants [i.e. approximants] row. This is another example of where the boundary between fricative and approximant is blurred (in contrast to the boundary between stop and fricative).

4.2. Some notes on other symbols not already mentioned

Here we briefly discuss some individual symbols that strike us as problematic in some way. We do not necessarily suggest that these symbols should be removed – however, we wish to bring these problems to the foreground, so that there is a better appreciation of the inaccuracies and difficulties of the chart.

Firstly, it is curious that there is a special symbol for the voiceless labial-velar fricative [ʍ], which could equally well be represented by [w̥]. We do not suggest that the symbol should be removed, but instead simply note that it is a relic of the history of the IPA chart, which was in its early days heavily influenced by the study of the European languages. What is particularly strange, however, is that the sound is labelled as a

fricative, when its counterpart [w] is labelled as an approximant. Does this mean that the noise is supra-laryngeal only? Or is the noise source both glottal and supra-laryngeal? Is it a spread-glottis or breathy-voiced version of the approximant, i.e. [w̤], as found in some North American and south-east Asian languages? Is it simply a sequence of [h] plus [w], as in English? None of this is quite clear.

Another symbol that clearly shows the bias of the early days of the IPA is [ɧ], described as a simultaneous [ʃ] and [x]. Students find this sound very challenging and in our experience most instructors skip over it, saying that it only occurs in Swedish, and that even there it varies greatly dialectally [15]. A sound that occurs in only one language and shows a lot of variation should cause (phonetic) concern, and to our ears the Swedish sound may best be described as a labialized/rounded velar fricative [x̫] or [xʷ] (i.e. with a rounded diacritic beneath the fricative or with a labialization superscript). The symbol [ɧ] is perhaps best removed from the chart since it suggests a sound that does not exist.

Another symbol that is listed under “Other Symbols” is the "alveolar lateral flap" [ɺ]. It is posited as a phoneme in 30 languages in LAPSyD, particularly in languages of South America and Papua New Guinea, where articulatory and acoustic phonetic description is scarce. Notably, however, there are no languages that contrast this sound with the retroflex flap [ɽ] or with the retroflex lateral [ɭ]. Moreover, allthough [ɭ] is not classified as a flap, it is possible to produce this sound as a flap with the *tongue tip* moving forward during closure. To flap the sides of the tongue would involve an unrealistic degree of control (cf. [ʟ] above). It therefore seems that the "alveolar lateral flap" needs to be re-considered.

5. Conclusions

Our proposal for a revised version of the chart is shown in the Appendix. Whilst we hope that it is an improvement on the present chart, we also hope that our discussions in this paper have shown that it is far from perfect. We hope that we have highlighted some of the problems that are inherent to the nature of the IPA chart. It is sometimes assumed that the chart is perfect, and in some way analogous to the chart of chemical symbols or the chart of astronomical objects. However, since the IPA chart is based on human behaviour, this cannot be so. So much about articulation is assumed by a symbol, even when that assumption is idealistic or even at times false. The use of symbols leaves little room for phonetic underspecification, unless the symbols themselves are underspecified (a discussion we have not entered into). We have tried to point out some of the issues with the chart, in the hope that users will not take its theoretical assumptions for granted. As eloquently noted by an anonymous reviewer, "we are just trying to carve up a continuum in one way versus another into categories and there will always be remaining problems and issues".

6. Acknowledgements

We would like to thank Pascal Perrier and Pierre Badin for discussion on issues of tongue control, and our anonymous reviewers for crucial feedback.

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Appendix: *Proposed revision to IPA Consonant Chart.*

	Bilabial	Labiodental	Dental	Alveolar	Postalveolar	Palato-alveolar	Alveolo-palatal	Palatal	Velar	Uvular	Epilaryngeal Pharyngeal	Laryngeal
Plosive	p b			t d	ʈ ɖ			c ɟ	k g	q ɢ	ʡ	ʔ
Nasal	m	ɱ		n	ɳ			ɲ	ŋ	ɴ		
Trill	ʙ			r						ʀ	ʜ ʢ	
Tap/flap		ⱱ		ɾ	ɽ							
Fricative	ɸ β	f v	θ ð	s z	ʂ ʐ	ʃ ʒ	ɕ ʑ	ç ʝ	x ɣ	χ ʁ	ħ	
Lateral fricative				ɬ ɮ								
Lateral Approximant				l	ɭ			ʎ	ʟ			
Approximant		ʋ		ɹ	ɻ						ʕ	h ɦ
Semi-vowels	w | ɥ							j (ɥ)	ɯ (w)			