The IPA and a theory of phonetic description

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The International Phonetic Alphabet (the IPA) is a set of symbols that is intended to represent all the distinctive sounds of the world's languages in terms of well defined phonetic categories. This paper will consider how well it succeeds in this aim, and the extent to which it can be considered a theory of phonetics.

What is meant by 'the distinctive sounds of a language'? There are several assumptions implicit in this notion. The first might be that a language is composed of a set of discrete sounds; but, as every phonetician knows, this is obviously untrue. Acoustic data, such as the spectrogram of the Korean word jaju 'booing' in Figure 1, shows that there are no boundaries between the segments. There is no way to separate the consonants from the vowels. A dramatic change in the formants occurs at the point indicated by the vertical line. At this moment the front cavity, which is increasing in size as the body of the tongue moves back for the vowel u, becomes sufficiently large to accommodate the resonance associated with the second formant. From then on the downward movement is that of the second formant rather than the third, as it was at the time just to the left of the arrow. But this point cannot be said to be the boundary between j and ꭒ. The downward movement is a major part of what characterizes j, and most of this occurs later.
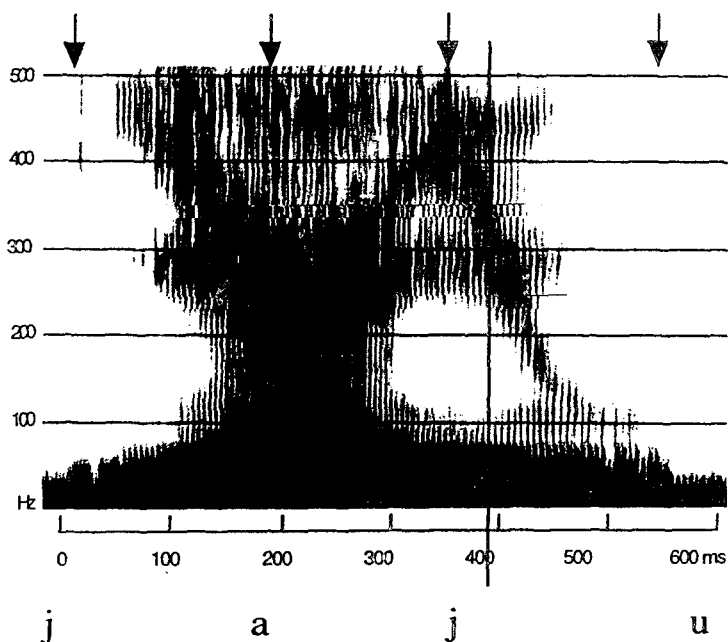

Figure 1. A spectrogram of the Korean word **jaju** 'booing'.

Although we cannot mark the boundaries between segments, Figure 1 does allow us to find their centers. At the points marked by the arrows above the figure there are either steady states or turning points in the formant trajectories. These points allow us to determine the minimum number of segments that there are. It might also seem (Nolan 1995) that we can tell how many segments there are in a particular word because there are only a limited number of places in that word where changes can occur. Thus the English word 'big' can be said to have three segments because it can be changed at the beginning into 'fig' or 'pig', in the middle to 'bag' or 'bug', or at the end to 'bin' or 'bit'. Similarly, 'brink' can be changed into 'blink', 'blank', 'plank', etc., showing that it has five. But this line of argument has problems. Changing the end of plæŋk 'plank' will necessarily involve a change of what we regard as two segments. There is no way of changing the ŋ without also changing the k. Once it is changed to, for example, plænt 'plant' (involving a change of ŋk to nt), it can be changed to plænd 'planned', changing just one of the last two segments and thus verifying the notion of five segments; but the separability of ŋk is not obvious. It can be justified only considering more complex phonological arguments. Nor, to take another example, is it clear that 'pig' and 'big' each have only three segments. It would be possible to regard 'pig' as having four segments, phɪg. Then the change from 'pig' to 'prig' would be regarded as changing phɪg to pɹɪg. Our reasons for considering 'pig' to have three segments and not four are phonological, not phonetic. We often cannot determine how many segments there are in a word by looking at phonetic data such as spectrograms. Segments are the products of a phonological analysis.

When considering the use of the IPA symbols, it does not really matter whether we regard the segments they represent as convenient descriptive fictions determined by our phonological analysis, or as real units that speakers manipulate. But in judging the success of the IPA as a way of describing the distinctive sounds of languages we still have to consider what we mean by distinctive. Do we mean simply contrasting within the language? Or are we concerned with whether a particular sound in one language is distinct from that in another? There is never any problem in finding a set of symbols that will represent all the distinct sounds, the phonemes, in a single language. It is possible to find distinct symbols or combinations of symbols for even a language such as !Xóõ, a Khoisan language spoken in the Kalahari desert, which has 83 different ways of beginning a syllable with a click and 33? other consonants. But a more subtle problem arises when we try to say whether a sound in one language is distinct from that in another. Is the pʰ in English pʰul 'pool' the same as the pʰ in Korean pʰul 'grass'? Most observers would say that they are not the same; and if I used my English pronunciation when trying to say the Korean word, I would be regarded as having a foreign accent. But can we prove that they are distinct sounds?

It is not at all easy to show that there is a measurable difference between two sounds in different languages. For the case in point we would have to measure relevant properties of the two sounds in comparable words in English and Korean.

We could assume that the differences are in the actions of the glottis and measure the Voice Onset Time (VOT). We could also quantify the phonation type in terms of the spectral slope or the relative amplitudes of the formants. We would have to record the two words as produced by at least 20 speakers of each language, so as to be sure that we were capturing properties of the language, and not just those of individual speakers. The Korean and English speakers should be matched for sex, age and size (height and weight), which would certainly be a challenging task. It is unlikely that the differences are due to physical differences between speakers of English and speakers of Korean, but this is always a possibility. Disner (1983) showed that there were systematic differences between the seven vowels of Italian and the seven vowels of Yoruba, and Ladefoged (1983) speculated that these differences could be due to the different facial characteristics of Italian and Yoruba speakers. At the end of our investigation of 20 matched speakers of Korean and English we might be able to show that the pʰ in English pʰul 'pool' is not the same as the pʰ in Korean pʰul 'grass'. But it is clear that this is not the kind of difference that the IPA was set up to try to capture.

Korean also offers us an example of a problem the IPA has in meeting its goals. Having considered the word pʰul 'grass', we can now ask what is the best IPA representation of the word p*ul 'horn'? As is well known, the Korean so-called fortis stops are unique among the world's languages; there is nothing like them anywhere else. I have here and elsewhere (Ladefoged 1971, Ladefoged 1993, Ladefoged and Maddieson 1996) used an asterisk to indicate this particular phonetic quality. This is not an offically sanctioned IPA symbol, but the IPA does not provide any way of marking this sound as distinctive from those of other languages. It can of course distinguish the three sets of Korean stops by transcribing them as, for instance, pʰ, p', b, etc. with the fortis stop being marked by a following apostrophe, But this symbol is officially reserved for ejectives, sounds that occur in, for example, the American Indian language Lakhota. In this language the word p'o 'foggy' begins a voiceless bilabial ejective, a very different sound from that used in Korean p*ul 'horn', in whichthe glottalic airstream mechanism does not build up pressure behind the articulatory closure.

Thus far we have seen two ways in which the IPA is incomplete. It cannot (and, as we will see, should not) symbolize small, language specific, differences in parameters such as VOT; and it does not have distinct symbols for some really distinctive sounds. There are a number of other cases of this latter type that we will discuss in an attempt to find out why they have not been included. But first we should note that there are cases of distinctive sounds that occur in only a limited number of languages for which IPA symbols *have* been specially created. Why has this occurred?

The prime example of the latter category — a special symbol for a sound of a particular language — is the symbol ɧ for the so-called labial velar fricative in Swedish. This is an especially interesting case because it seems fairly clear that labial velar fricatives are impossible to produce; sounds with two sources for a fricative

noise cannot occur (Ladefoged and Maddieson 1996:329). Nevertheless the IPA chart includes a symbol for labial velar fricatives. They were thought to occur in some Swedisd dialects, but now it appears that the situation (somewhat simplified) is that some Swedish dialects have a velarized palato-alveolar fricative in their phonological inventory where others have a palatalized bilabial fricative and variants of these sounds; but no dialect has a labial fricative that is simultaneously a velar fricative. The alphabet devised for the study of Swedish dialects in the nineteenth century provided a symbol that has been used for all the dialectal variants, each of which could be described using other IPA symbols and diacritics. This special Swedish symbol was incorporated in the version of the IPA produced in 1949 largely because of the influential Swedish phoneticians at that time.

Until recently (International Phonetic Association 1989) the IPA included another example of a special symbol for a sound that occurred in a particular language. The Japanese syllabic nasal ɴ was recognized as being different from all other sounds, despite the fact that it is typically a velar nasal ŋ. This sound occurs in words such as ni.p.po.n 'Japan', which can be divided into four mora, as indicated by the periods (the IPA symbol for a syllable division). Because the syllabic nasal has a special place in Japanese phonology (it does not occur before a vowel; it is always a single mora by itself), it came to have a special symbol. At the 1989 Kiel convention the International Phonetic Association decided that from a phonetic point of view there was nothing unusual about this sound (however unusual it might be phonologically), and withdrew recognition from the symbol ɴ.

Further examples of unique sounds that occur in a limited number of languages are not hard to find. Passy (1899) and Catford (1992) have described a bidental fricative in the Shapsug dialect of the North Caucasian language Adyghe, in which friction is caused by air passing between the clenched teeth. Everett (1982) described a sound in the Mura language Pirahã in which the tongue tip contacts the alveolar ridge and then moves forward so that it protrudes out of the mouth, pointing down towards the chin. Ladefoged and Everett (1996) described a sound in the Chapakuran languages Wari' and OroWin in which an alveolar stop is released with a groove in the center of the tongue in such a way that the lips may be set vibrating. None of these sounds has been given a special symbol in the IPA.

So what does it take to get a special symbol for a sound in the IPA? A cynical answer is that it takes a phonetician who speaks the language and is on the Council of the International Phonetic Association. The IPA is a collection of symbols that has to be approved by a vote of this body. But perhaps a better answer is to think of the IPA as a somewhat ill-formed theory of phonetics. A theory in this sense is something that tries to account for a body of data, in this case the range of sounds that languages use. The core of a phonetic theory is a set of categories that define possible sounds. Within this theory, the IPA is the way of defining the symbols that show the relations among the categories. Thus p is a shorthand way of designating the intersection of the categories voiceless, bilabial, and plosive; m is the intersection of the categories voiced, bilabial, and nasal; and so on.

THE INTERNATIONAL PHONETIC ALPHABET (revised to 1993, corrected 1996)

CONSONANTS (PULMONIC)

	Bilabial	Labiodental	Dental	Alveolar	Postalveolar	Retroflex	Palatal	Velar	Uvular	Pharyngeal	Glottal
Plosive	p b			t d		ʈ ɖ	c ɟ	k g	q ɢ		ʔ
Nasal	m	ɱ		n		ɳ	ɲ	ŋ	N		
Trill	B			r					R		
Tap or Flap				ɾ		ɽ					
Fricative	ɸ β	f v	θ ð	s z	ʃ ʒ	ʂ ʐ	ç ʝ	x ɣ	χ ʁ	ħ ʕ	h ɦ
Lateral fricative				ɬ ɮ							
Approximant		ʋ		ɹ		ɻ	j	ɰ			
Lateral approximant				l		ɭ	ʎ	L			

Where symbols appear in pairs, the one to the right represents a voiced consonant. Shaded areas denote articulations judged impossible.

CONSONANTS (NON-PULMONIC)

Clicks		Voiced implosives		Ejectives	
⊙	Bilabial	ɓ	Bilabial	ʼ	Examples:
ǀ	Dental	ɗ	Dental/alveolar	pʼ	Bilabial
!	(Post)alveolar	ʄ	Palatal	tʼ	Dental/alveolar
ǂ	Palatoalveolar	ɠ	Velar	kʼ	Velar
ǁ	Alveolar lateral	ʛ	Uvular	sʼ	Alveolar fricative

OTHER SYMBOLS

ʍ Voiceless labial-velar fricative	ɕ ʑ Alveolo-palatal fricatives
w Voiced labial-velar approximant	ɺ Alveolar lateral flap
ɥ Voiced labial-palatal approximant	ɧ Simultaneous ʃ and x
H Voiceless epiglottal fricative	
ʢ Voiced epiglottal fricative	Affricates and double articulations can be represented by two symbols joined by a tie bar if necessary. k͡p t͡s
ʡ Epiglottal plosive	

VOWELS

Where symbols appear in pairs, the one to the right represents a rounded vowel.

SUPRASEGMENTALS

ˈ	Primary stress	
ˌ	Secondary stress	ˌfoʊnəˈtɪʃən
ː	Long	eː
ˑ	Half-long	eˑ
�‿	Extra-short	ĕ
ǀ	Minor (foot) group	
‖	Major (intonation) group	
.	Syllable break	ɹi.ækt
‿	Linking (absence of a break)	

DIACRITICS   Diacritics may be placed above a symbol with a descender, e.g. ŋ̊

̥	Voiceless	n̥ d̥	̤	Breathy voiced	b̤ a̤	̪	Dental	t̪ d̪
̬	Voiced	s̬ t̬	̰	Creaky voiced	b̰ a̰	̺	Apical	t̺ d̺
ʰ	Aspirated	tʰ dʰ	̼	Linguolabial	t̼ d̼	̻	Laminal	t̻ d̻
̹	More rounded	ɔ̹	ʷ	Labialized	tʷ dʷ	̃	Nasalized	ẽ
̜	Less rounded	ɔ̜	ʲ	Palatalized	tʲ dʲ	ⁿ	Nasal release	dⁿ
̟	Advanced	u̟	ˠ	Velarized	tˠ dˠ	ˡ	Lateral release	dˡ
̠	Retracted	e̠	̴	Pharyngealized	tˤ dˤ	̚	No audible release	d̚
̈	Centralized	ë	̴	Velarized or pharyngealized	ɫ			
̽	Mid-centralized	e̽	̝	Raised	e̝ (ɹ̝ = voiced alveolar fricative)			
̩	Syllabic	n̩	̞	Lowered	e̞ (β̞ = voiced bilabial approximant)			
̯	Non-syllabic	e̯	̘	Advanced Tongue Root	e̘			
˞	Rhoticity	ɚ ɚ	̙	Retracted Tongue Root	e̙			

TONES AND WORD ACCENTS

LEVEL			CONTOUR		
е̋ or	˥	Extra high	ě or	˄	Rising
é	˦	High	ê	˅	Falling
ē	˧	Mid	e᷄	˄	High rising
è	˨	Low	e᷅	˄	Low rising
ȅ	˩	Extra low	e᷈	˩	Rising-falling
↓		Downstep	↗		Global rise
↑		Upstep	↘		Global fall

The IPA chart shown in figure 2 is a one page account of a general phonetic theory. We can begin our discussion of this theory by noting that it is easy to show that nearly all the terms in the chart are needed in order to account for phonemic differences within languages. In this paper we will limit the discussion to consideration of possible places of articulation. Figure 3 shows languages that contrast the places of articulation in the consonant chart. There are contrasts between either voiceless stops or fricatives (or sometimes both) at nearly all the possible pairs of places of articulation. Thus the labiodental fricative f contrasts with the bilabial fricative ɸ in Ewe, a Niger-Kordofanian language. Malayalam, a Dravidian language, has six contrasting places of articulation for stops and nasals. Toda, another Dravidian language, has the same contrasts but also has additional contrasts among voiceless fricatives. The only blanks in the chart are almost certainly accidental in the sense that we have not yet found a language that exhibits the contrast, although there could well be one. Retroflex, palatal, uvular and pharyngeal sounds are all comparatively rare and it is not surprising that there are no known languages contrasting some pairs of these places of articulation. Nevertheless, the fullness of the matrix in Figure 3 demonstrates the necessity for all the places of articulation in the IPA consonant chart.

The next question is whether the IPA categories for place of articulation are not only necessary but also sufficient to characterize all the distinct sounds that occur in languages. Ladefoged and Maddieson (1996), in their survey of the sounds of the world's languages, find that they need to consider a greater number. In a chart similar to that in Figure 3 they list 17 places of articulation, 6 more than the 11 given in the IPA consonant chart. Part of the increase is due to the different aims pursued by Ladefoged and Maddieson. They are concerned with more than the phonemic distinctions that occur within languages. They also "take note of differences between languages." They want to describe "those segmental events that distinguish one language or accent from another and which are also sufficiently distinct to serve as potential conveyers of lexical contrasts for speakers of other languages." (Ladefoged and Maddieson 1996:3.) How distinct segments have to be in order to meet the criterion of being potentially able to form lexical contrasts is not clear; it is essentially a judgment call.

One of the extra possibilities listed by Ladefoged and Maddieson is epiglottal. There is no judgment needed here as epiglottal fricatives contrast with pharyngeal fricatives in at least one language, Agul (North Caucasian). The IPA allows this possibility by listing epiglottal fricatives among a collection of 'other symbols' showing sounds that could not easily be placed on the chart. (It is not clear why they could not have been placed on the chart; there could easily have been another column 'Epiglottal', which would have had three entries, one more than there now are for 'Pharyngeal'.)

	BILABIAL	LABIODENTAL	DENTAL	ALVEOLAR	POSTALVEOLAR	RETROFLEX	PALATAL	VELAR	UVULAR	PHARYNGEAL
	p ɸ	f	t̪ θ	t s	t̠ ʃ	ʈ ʂ	c ç	k x	q χ	ʡ ʕ
LABIODENTAL f	Ewe									
DENTAL t̪ θ	Malayalam	Toda								
ALVEOLAR t s	Malayalam	Toda	Malayalam							
POSTALVEOLAR t̠ ʃ	Hindi	Toda	Toda	Toda						
RETROFLEX t̠ ʂ	Malayalam	Toda	Malayalam	Malayalam	Toda					
PALATAL c ç	Malayalam	Hungarian	Malayalam	Malayalam	Logba	Malayalam				
VELAR k x	Malayalam	Gaelic	Malayalam	Malayalam	Hindi	Malayalam	Malayalam			
UVULAR q χ	Quechua	German	Urdu	Quechua	Urdu		Jaqaru	Quechua		
PHARYNGEAL ʡ ʕ	Agul	Arabic	Dahalo	Dahalo	Dahalo			Dahalo	Agul	
GLOTTAL ʔ h	Hawaiian	Arabic	Dahalo	Dahalo	Dahalo	Kuvi	Margi	Hawaiian	Ubykh	Agul

Figure 3. A matrix showing languages that have contrasts between either voiceless stops or fricatives (or sometimes both) at the various places of articulation listed in the IPA consonant chart.

The other five extra possibilities listed by Ladefoged and Maddieson can be handled by diacritics, small marks that can be added to a symbol to change its value. In a section below the main consonant chart, the IPA lists 31 diacritics. These include ways of indicating whether an articulation is apical or laminal. Ladefoged and Maddieson point out that it is not clear whether there are contrasts between apical and laminal articulations at the same place on the upper surface of the mouth, but it is plain that some languages typically have laminal dental articulations and others have apical dental articulations; similarly some languages have apical alveolar articulations and others have laminal alveolar articulations. It seems unlikely that there could be lexical contrasts of these kinds.

One of Ladefoged and Maddieson's other additions can be handled by the diacritic indicating that an articulation is made further forward. This diacritic can be used to mark the distinction between dental and interdental articulations. Caliifornian English speakers — and many other speakers of Western General American dialects — typically pronounce the initial consonant of words such as 'thin, thanks' with an interdental articulation in which the tip of the tongue protrudes between the teeth. Speakers of most forms of British English have a dental articulation for these sounds, keeping the tip of the tongue behind the upper teeth. This difference is never used contrastively within a language, and it is not at all clear that it is ever likely to be so.

Another diacritic, the one indicating that an articulation is made further back, can be used to differentiate between the two kinds of retroflexion observed by Ladefoged and Maddieson, the post-alveolar articulation in Indo-Aryan languages such as Hindi, and the more retracted articulation involving the under side of the tongue used in Dravidian languages such as Malayalam. This is another contrast that is never used to distinguish words within a language, although in this case the articulations are sufficiently distinct to produce an easily audible difference that might well be contrastive in some language.

Linguo-labials, the remaining additional place of articulation noted by Ladefoged and Maddieson, occur in Tangoa and other languages spoken in Vanuatu. They are formed by an articulation using the blade of the tongue and the upper lip. Tangoa has stops, nasals and fricatives with this articulation, contrasting with both bilabial and alveolar articulations. The IPA includes a diacritic specifically for these sounds. It is a little hard to consider this diacritic as a mark that can be added to a symbol to change its value in the same way a other diacritics. The change in articulation from a dental or alveolar stop to a linguo-labial stop is comparable with the the difference between a dental or alveolar stop and a palatal stop. One suspects that if linguo-labials had been as common as retroflex, palatal, or uvular sounds, they would have had their own unitary symbols.

There are reasons for and against including diacritics in a system of phonetic representation such as the IPA. A reason for including them is that they are convenient ways of showing classes of sounds. All sounds with a small circle

beneath them are voiceless; all sounds with the diacritic ʲ are palatalized. Many people in the International Phonetic Association have argued that the IPA should go further in this direction, and recognize the diacritic ˇ, which has been widely used to mark (and thus group together) the palato-alveolar sounds ʃ, ʒ, tʃ, dʒ, writing them instead as š, ž, č, ǰ.

At least at first glance a reason for not using diacritics is that their use goes directly against the IPA principle of having a separate symbol for each distinctive sound. But as our knowledge of linguistic phonetic events increases, it becomes more and more apparent that this principle should be dropped. There are several hundred distinct sounds used in the world's languages, and there is no way in which this principle — one symbol one sound — can be maintained in an alphabet such as the IPA.

There is, however, another disadvantage to the use of diacritics that must be recognized. A diacritic can be added to any symbol, and we thus lose the notion of the IPA being all *and only* the symbols that are needed for specifying the distinctive sounds that occur in the languages of the world. Our phonetic theory is becoming too powerful in that diacritics can be used to specify impossible sounds such as laminal uvulars or voiceless voiced segments. To some extent it has always been the case that the IPA theory is too powerful, and efforts have been made to remedy the problem by noting on the chart that certain articulations are judged to be impossible. But the possibility of adding diacritics in an unrestricted way is alarming. The best solution would be for the International Phonetic Asociation to drop both the principle requiring it to aim for a separate symbol for each distinctive sound, and the principle requiring it to avoid diacritics. In return it should adopt a set of statements specifying the symbols that each diacritic can modify.

Achieving this aim will be difficult. The IPA is organized and approved by the Council of the International Phonetic Association, a group of 30 very diverse phoneticians with widely different beliefs about some aspects of the IPA. Some are linguists, some language teachers, some speech communication engineers, and some speech pathologists. They do not all share my desire to regard the IPA as embodying a theory of phonetic description confined to what goes on in languages. The Council is also very conscious of the fact that it is the guardian of a tool used by many people who are not professional phoneticians. All this leads to a justifiable reluctance to change anything. It is vital for the IPA to be a stable set of symbols whose core is not changed. Addition of a few extra symbols or diacritics for rare sounds will not affect the majority of users; but a change in the underlying principle on which the IPA is based may have far ranging effects. For my part I would like to see alternative possibilities allowed, such as recognizing š, ž, č, ǰ as well as ʃ, ʒ, tʃ, dʒ. But I doubt it will happen. Democracy always has its problems.

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