Cardinal Vowels

1. Classification of vowels (vocoids)

a) Vowels are produced in a relatively small area of the mouth — earlier writers talked of palatal vowels (the frontmost ones) and velar vowels (the furthest back). The tongue may be further to the front or to the back and higher or lower in the mouth (as shown in this video clip: http://www.phon.ox.ac.uk/~jcoleman/tongue.mov) and the lips may be more or less rounded. The shape of the area in which the tongue moves is usually idealised to form a quadrilateral (sometimes a triangle, as in the preceding video clip), on which the position of each different vowel sound can be marked by a dot. What the points marked on the vowel quadrilateral actually represent is open to dispute. As a first, working hypothesis, we will take the view espoused in many textbooks.

b) **The tongue-arching model**. Vowels can be classified according to (and so points on the quadrilateral represent) the position of the highest point of the tongue in forming the vowel. The first things one needs to know, therefore, when categorising vowels are:

(i) How high is the highest point of the tongue (the **height** of the vowel)? Is it **close** to the roof of the mouth, as for [i], i.e. with the tongue as near the roof of the mouth as it can get without causing friction, or **open** as for [ɑ], with the tongue as low in the mouth and the jaws as wide open as possible; or is it intermediate between these two, either **close-mid**, like [e] as in French "donner"; or **open-mid** like [ɛ] as in French "père"? Of course the majority of sounds do not correspond exactly to any of these, but using these categories allows us to describe them accurately.

(ii) How far forward or back is the highest point of the tongue? Is it **front** – corresponding to a palatal consonant – such as [i], [e], [ɛ] and [ɑ], or **back** – corresponding to a velar consonant – such as [u], [o], [ɔ] and [ɑ]; or **central**, like the [ɜː] sound in English "bird" or "hurt".

c) To help identify vowels in different languages, phoneticians use a series of reference vowels, called *cardinal vowels* with which to compare them. These consist of four vowels produced at each extremity of the vowel producing area: [i], [a], [ɑ] and [u], plus four in intermediate positions which *sound* equidistant between [i] and [a] at the front, and [u] and [ɑ] at the back. [e] and [ɛ] are intermediate at the front, and [o] and [ɔ] are intermediate at the back. These eight cardinal vowels are numbered as follows: 1 [i], 2 [e], 3 [ɛ], 4 [a], 5 [ɑ], 6 [ɔ], 7 [o], and 8 [u]. In addition, equidistant between [i] and [u] is the central, close vowel [ʉ].

d) The above are the **primary cardinal vowels.** There are others, secondary cardinals, which differ from the related primary ones in lip rounding.

Primary Cardinal Vowels			**Secondary Cardinal Vowels**	
	Front	*Back*	*Front*	*Back*
Close	i	u	y	ɯ
Close-mid	e	o	ø	ɤ
Open-mid	ɛ	ɔ	œ	ʌ
Open	a	ɑ	ɶ	ɒ

The vowel quadrilateral and the cardinal vowels are the work of Daniel Jones. His definitions of the primary cardinals may be found in *An Outline of English Phonetics,* chapter 8.

e) In short: (i) The CV's are an arbitrary set of reference vowels – arbitrary in the sense that there is no apparent reason why there should be eight rather than ten, twelve or any other number. (ii) They are **peripheral** vowels – they define the boundary of the space within which vowels can be produced. For this reason they hardly ever occur in real speech, or as the vowels of any language.

2. Problem areas

(i) Only cardinal vowels 1 and 5 have strictly articulatory definitions. It is not clear how far Jones intended that the "equal acoustic difference" between intermediate vowels is supposed to reflect articulatorily equal steps. Starting from X-ray photos of his own mouth he talks of "approximate tongue positions" and approximately equal intervals. We now know that the resemblance of tongue positions to the vowel quadrilateral is only very approximate; neither Jones's X-rays, nor those Ladefoged discusses in his *Course* really bear out the tongue-arching model.

(ii) So what does the quadrilateral represent? Catford (*Fundamental Problems in Phonetics* p. 169) considers that phoneticians have been making **proprioceptive** judgements based not just on the height of the tongue, but on its overall shape and configuration in the mouth.

3. Using the Cardinal Vowels

The idea is that in identifying the **quality** of each vowel in a particular language, one will compare it to the cardinal vowels, note its relationship to them, and then use the symbol of the nearest cardinal vowel as a basis from which to transcribe it. The relationship of the heard vowel to the nearest cardinal vowel is recorded by using the four subscript diacritics: ˕˔˕˖ and ˷. For example: [i̝] means "slightly more open (lower) than [i]", [o̟] means "slightly more advanced (fronter) than [o]", and [e̠] means "slightly more retracted (backer) than [e]". These diacritics can be combined or multiplied e.g. [a̟-], [o++], etc. This impressionistic use of the cardinal vowels plus diacritics is rarely seen in phonetics textbooks. Once a body of impressionistic notes has been made, it becomes convenient to dispense with diacritics transcriptions

whenever possible, especially in print. But you cannot proceed straight to a simplified transcription at once: it is necessary to record each vowel quality precisely before deciding on appropriate simple symbols to use in a simplified, systematic transcription.

As well as the peripheral cardinal vowels, the IPA also provides symbols for less peripheral sounds: [ɪ], [ʊ], [ə] and [ɐ], and diacritics [¨] (centralized: makes a front vowel symbol backer and a back vowel symbol fronter) and [ˣ] (mid-centralized: means, "nearer to the mid-centre of the vowel space"). These symbols are not as precisely defined as the cardinal vowels, but are very useful additional symbols.