
The PronSci Rectangle charts: Phonetic Guide

Guide to the phonetics of the
PronSci Rectangle charts
for British and American English

This document should be read with a key to the charts to hand.

Keys are downloadable from the PronSci website

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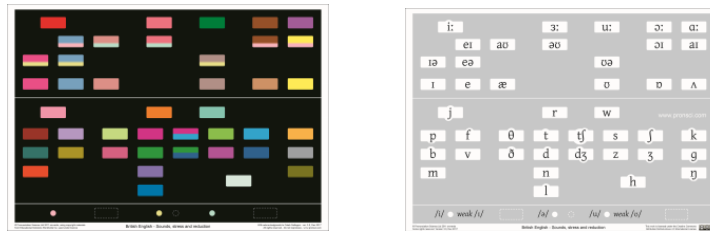
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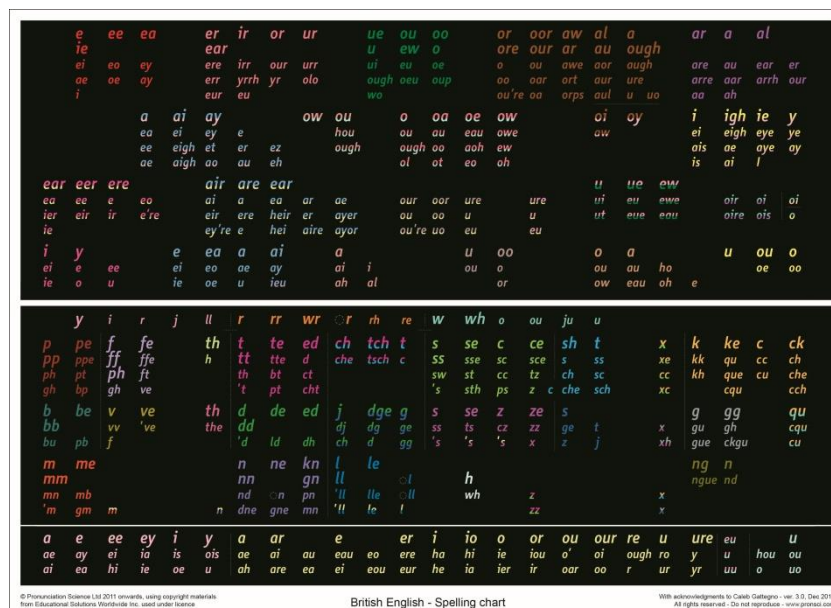
Background

In the PronSci charts for English, there are:

- Rectangle charts, both in colour and in black & white with IPA symbols:



- Spelling charts (Fidels), whose layouts reflect the Rectangle charts:



- Word charts (sixteen in the full set):



The three types of chart exist in both American (rhotic¹) and British (non-rhotic) versions. In the sixteen Word charts, the same words appear on each set but some words are spelled differently.

This document discusses some of the phonetic issues in the design and use of the Rectangle charts. There is a more informal description of the layout in three PronSci videos, starting with the overall design principles at www.youtube.com/watch?v=iRCeA8bJTIg.

¹ In rhotic Englishes, there is an r-colouring given to vowels which precede a written letter <r>.

Varieties of English

The British English Rectangle chart primarily reflects the accent variously called ‘modern RP’², ‘Southern British English’ or ‘BBC English’.

The American English chart primarily reflects what is called ‘General American’, ‘Network English’, etc.

However, the exact sound value given to the colours is up to the teacher to decide. So the ‘British’ chart also works satisfactorily for the inventory of sounds found in the non-rhotic dialects of English spoken in other parts of Britain and the standard non-rhotic dialects spoken in Australia, South Africa, New Zealand and elsewhere.

The American chart works for different rhotic dialects within North America, including Canadian English.

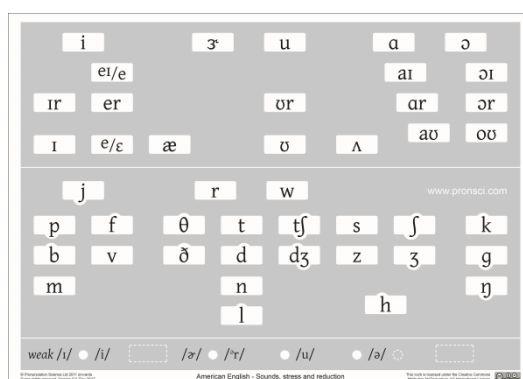
Minor differences can be dealt with by the teacher as they appear. For example, if you are teaching in Australia then you will want to designate some of the rectangles that are coded as diphthongs within RP as monophthongs in Australian English. Also, there will be no need to distinguish weak front and central vowels (schwi and schwa) in words like *Lenin* (the Soviet leader) and *(John) Lennon*.

Similarly, in many parts of America no distinction is made between the vowels coded using white /ɑ/ and ochre /ɔ/³, so these rectangles can be given the same sound value in these parts of the country. Canadian spelling variants are represented on the American English Spelling chart.

The charts can also be used for teaching English as a Lingua Franca, ELF.

The arrangement of the Rectangle charts

On the Rectangle charts, sounds are represented by rectangles that are either coloured or contain IPA symbols. The first feature of the arrangement of the two Rectangle charts is their division into three sections. The top section contains full (strong) vowels, the middle section contains consonants, and the bottom section contains weak vowels represented by dots.

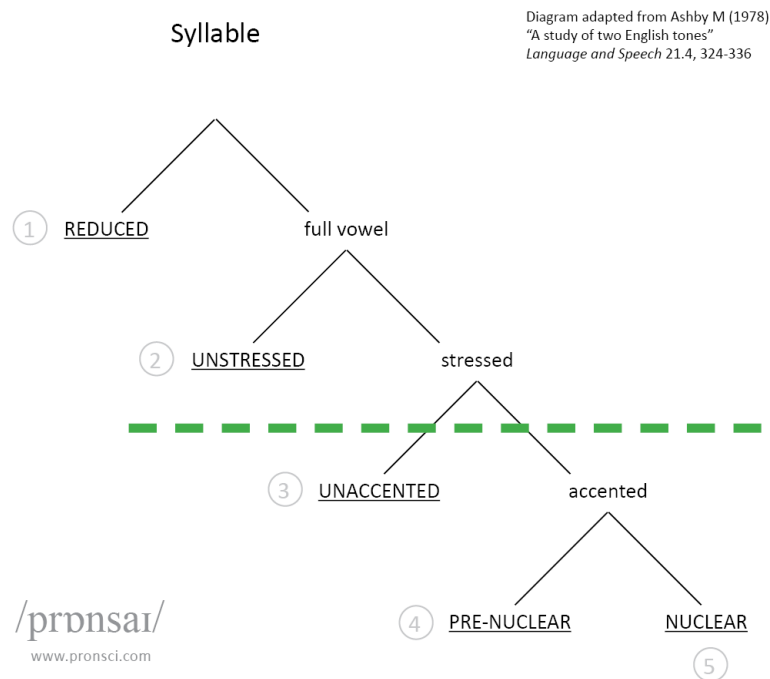


² RP is short for ‘received pronunciation’.

³ For transcribing American English, we have adopted the IPA symbols used by the Longman Pronunciation Dictionary (Wells 1990). In the key to the Fidel, supplied with any charts purchased, we also list the symbols used in the Merriam-Webster and American Heritage dictionaries for users familiar with these. Note that while Wells uses /eɪ/ and /e/ for the vowels in *face* and *bed*, others use /e/ and /ɛ/ respectively (and we have shown these possibilities on the key). Wells uses a length mark (a colon) for the ‘tense’ vowels /i:/ /ɜ:/ etc, but this is usually omitted when only American English is concerned.

With this simple division, the designs can be used as standard phonemic charts containing full inventories of the sounds of the language. The arrangements have various advantages over the arrangements of other phonemic charts that are available, which we describe elsewhere.

However, the designs also uniquely support a more comprehensive view of the English sound system, which discriminates between the three types of vowel that can appear in a syllable: a weak, reduced vowel (labelled '1' in the diagram below), a full but unstressed vowel ('2'), and a full, stressed vowel, which may be given further prominence if it is accented ('3', '4' and '5').



Used this way, the top section of the chart is used for full, stressed vowels (3, 4 and 5), and all unstressed vowels are pointed in the bottom section: full, unstressed vowels (2) using the placeholder rectangles and reduced vowels (1) using the dots.



The pointing of words using these advanced features allows (1) the sounds of a word, and (2) its stress pattern, to be accurately portrayed simultaneously. The up and down movements of the pointer reflect the latter: up for the vowel in a stressed syllable, down for a vowel in an unstressed syllable (whether a full vowel or a reduced one).

Weak vowels

Splitting the vowels across the top and bottom sections supports our articulatory approach to teaching pronunciation. The weak (or 'reduced') vowels at the bottom of the chart are different from strong (or 'full') ones in a number of ways that help learners to produce them authentically and easily:

- Sometimes the weak vowels are hardly ‘vowels’ at all, and are better regarded, as Catford (e.g. 1977, 2001) proposed, as the result of ‘open transitions’ between two consonants. In open transitions, a ‘vocalic’ sound appears between the articulation of the preceding and following consonants as a by-product of their articulations, as opposed to a true vowel being inserted, with its own separate articulatory gesture⁴.
- Even when weak vowels are actively articulated, for example at the end of a word like *tuna*, they are shorter in duration than strong vowels.
- Weak vowels require less ‘respiratory drive’⁵ to produce than strong vowels, particularly for a child who is learning his mother tongue.

The distinction between schwa as an open transition and schwa as the minimal sound needed to create a syllable can be drawn by using the filled and ‘unfilled’ schwa dots at the bottom of the chart. The latter is conceptually not a circle, but a dot of the same colour as the background to the chart. Consult the *Using the Advanced Features of the PronSci English Rectangle Charts* document for how it can be used.

There are three weak, low energy ‘vowels’ represented in the bottom area of the chart for British English, and four for American English. On the left, the light pink **schwi**⁶ represents any weak [i]- or [ɪ]- type sound, for example in the second syllable of the words *happy* and *rabbit*, respectively.

In the centre of the British chart and on the right side of the American one, pale yellow **schwa** represents word-final schwa and the dashed dot represents most open transitions between consonants, for example in the second syllables of *tuna* and *relative*, respectively.

In the American chart, pale orange **schw** represents the sound in words with an <r> in the spelling of a weak vowel, for example in *sugar*, *backward* and *feature*.

On the right, pale green **schwu** represents any weak [u]- or [ʊ]-type sound, for example in the second syllable of the words *influence* and *stimulus*, respectively.

Thus the vowels of English are displayed in two sections, strong and weak. This distinguishes the arrangement of sounds on this chart from other pronunciation charts we are aware of. The organisation of the strong vowels into ‘families’, as described next, is another unique feature of these charts.

⁴ The sound in the first syllable of *terrain* or *police* is an open transition between the first two consonants: the articulation of the first consonant is completed before the second one is started, and something is heard in between which allows listeners to hear two syllables. This contrasts with the ‘close transition’ between the same two consonants in *train* and *please*, where the articulations of the consonants overlap and a single syllable is heard.

⁵ Strictly speaking, “expiratory drive” would be better, but “respiratory drive” is the colloquial expression. (“Respiratory system drive” or “ventilatory drive” would be other possibilities.)

⁶ In one of our earlier articles, we used the name *schwi* for the so-called “happY vowel”. It seemed a better name for it. However, from a pedagogical point of view we have not found it helpful to distinguish between the happY vowel and weak /ɪ/. There are certainly differences in the qualities of these two sounds, but these are largely determined by where they appear in syllables (their phonotactics) and any learner who produces a low-energy sound of any kind with a front gesture of the tongue will make a sound that is acceptable. So we now use the name *schwi* for both the happY vowel and weak /ɪ/. We recently discovered that we haven’t been the first to use the name *schwi*. It was coined by Pitman in his description of his Initial Teaching Alphabet. According to Fatti (1967), he used it to refer to the weak neutral vowel in *orange*, *captain* and *respect*. Our usage, therefore, enlarges on this to encompass the happY vowel as well.

Strong vowels – British English

On the British chart, the full vowels at the top are arranged in four rows (which we'll describe from the top downwards) and four 'families' (from left to right).

The top row contains the tense vowels of British English: /i: ɜ: u: ɔ: ɑ:/. These are sometimes loosely called the 'long' vowels, although they are only relatively long in certain contexts. They are, however, correctly described as 'free' vowels because they can appear in syllables either with or without a consonant immediately afterwards, e.g. in both *seat* and *sea* (they are 'free' to appear in any position in a syllable). Phoneticians have understood different things by the label 'tense', but one production characteristic that these vowels share is that the relevant part of the tongue moves to a position that is quite close to the opposite wall of the vocal tract. One result is that there is a relatively small opening for air to pass through, particularly in a child's mouth⁷.

The second row contains the 'closing' diphthongs: /eɪ aʊ əʊ ɔɪ aɪ/. These are vertically aligned with the rectangles whose colours are used for their starting positions, shown in the top of each rectangle. The direction of the glide in each case is indicated by the lower colour, either the pale pink of schwi or the pale blue of schwu.

Note that the upper colours used are approximations to the starting positions of the diphthongs, which are not exactly the same as the positions of any of the pure vowels. For the same reason that a given phonetic symbol gets used for different sounds⁸, the need to be economical with the number of colours on the charts means that the starting positions are indicative rather than exact⁹.

⁷ In a model of the interaction of the respiratory system and the upper articulators during speech that one of us (PM) has developed, there is extra tension in the vocal folds of a young child as he produces the 'tense' vowels of English. This is needed to increase the air resistance at the glottis and thus to reduce airflow which would otherwise be turbulent and noisy as it passes through a small constriction. See Messum (2007) for details.

⁸ It is not always appreciated by teachers that the symbols used by phoneticians for a diphthong do not mean, for example, that /eɪ/ is the same as /e/ followed by /ɪ/. The diphthong symbols are *gestalts*, with the combination of the two symbols representing the whole production. Similarly, although /aɪ/ and /aʊ/ both use an initial /a/ symbol, this does not mean that they start with the 'same' sound (for most speakers, they don't) or that the sound is the same as, say, a French /a/ in either case. The International Phonetic Alphabet is a set of symbols that phoneticians use to label sounds, but it leaves the phonetician latitude in how to use them for any one language or across languages. The IPA certainly doesn't define and label sounds in a language-independent, precise one-to-one mapping as people sometimes imagine that it would.

⁹ If you are familiar with phonemic transcription within the British tradition, you will know that a consensus had more or less emerged by the end of the 1990's about which symbols to use for which sounds for British English. So there was then some consternation among phoneticians about a decision in the Oxford Dictionary of Pronunciation and in some other OUP dictionaries to use the symbol /ʌɪ/ for the diphthong in *price*, that was being transcribed with /aɪ/ elsewhere. The justification given for this change was the editorial view that the starting position of the diphthong is somewhere in the area of the IPA quadrilateral that is covered by /ʌ/, rather than in the area covered by /a/. Other phoneticians vehemently disagree.

But there is no pure vowel sound in British English which phoneticians represent with /a/, so for this chart we had a decision to make about how to colour the diphthongs in which it is used. Had we misunderstood the symbols /aʊ/ and /aɪ/ to indicate that these two diphthongs have the same starting position - which they don't - then we would have been tempted to introduce another colour and we would have misled users in the way that many are misled by the symbols. Instead, we have found that the buff and yellow colours used for /æ/ and /ʌ/ respectively work well enough for these diphthongs for pedagogical purposes. Students can use them for their first attempts at the sounds, but then quickly

The third row contains the ‘centring’ diphthongs: /ɪə eə ʊə/.

It is noteworthy that the glides of all the diphthongs in English move towards the same set of low energy vowels used in isolation. By putting the low energy family of sounds at the bottom of the chart, we give students a clear idea of the balance of energy to be used in diphthongs when they see that these colours are used in their representations. The first element of the diphthong is the most important, giving the essential quality of the sound, while the target of the glide is of lower energy, fading away and even sometimes being omitted in fast speech.

The final row contains the lax vowels: /ɪ e ə ʊ ɒ ʌ/. Again, while these are sometimes relatively ‘short’ this is not a completely reliable way to describe them. (/æ/, for example, can be quite long for some people in some words.) However, they are ‘checked’ because they cannot end a syllable. Expressed equivalently, they are always followed by a consonant. So /sɪt/ is a possible word form in English, but /sɪ/ is not. The articulations of the lax vowels share the characteristic that the gap between the tongue and the opposite wall of the vocal tract is relatively large: air can pass through with no significant impediment, even in a child’s mouth.

Changing our orientation, the leftmost family of **front** vowels is anchored by red /i:/. These are the vowels and diphthongs which are produced by a frontward movement of the tongue and, when hyperarticulating, by adjustment of the jaw height. As the lax vowels within this family, /ɪ e ə/, move from left to right so the jaw opens progressively, something that can be felt very clearly if you put your forefinger on your nose and your thumb beneath your jaw. In the consonantal section of the chart, there is another member of this family, the semi-vowel /j/. In the bottom section, there is another member: pale pink schwi. Both are centred below red /i:/.

The **central** family is anchored by blush-coloured /ɜ:/, produced with the tongue, jaw and lips in a more-or-less neutral position. Both /r/ in the semi-vowel part of the consonants and pale yellow schwa in the bottom section are part of this family. Note that blush is the colour used for the starting position of the /əʊ/ diphthong. Like all the English diphthongs, this one moves from high to low energy production, so it would make no sense to follow the convention of phonetic symbolization and to start it with the pale yellow, low energy, schwa colour¹⁰.

The **raised** family is anchored by green /u:/, produced by raising the back of the tongue towards the soft palate. Its members have different degrees of lip rounding (little in the case of /u:/ itself, but a little more in the case of /ʊ/). /w/ in the semi-vowel part of the consonants and pale blue schwu in the bottom section are part of this family.

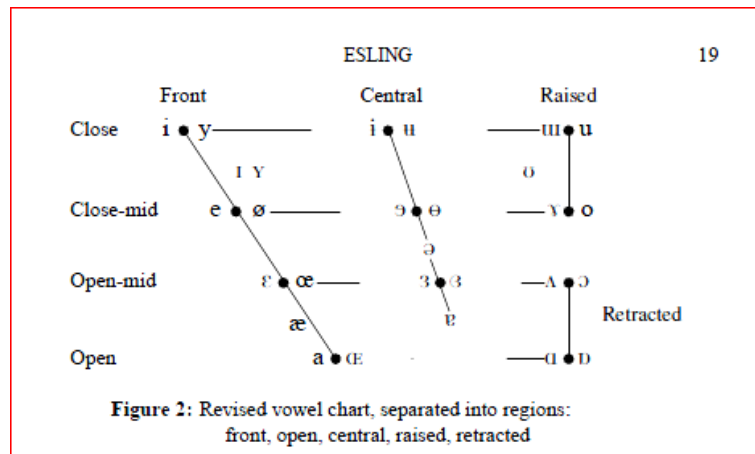
The **retracted** family, on the right hand side of the chart, is anchored by two sounds, /ɔ:/ and /ɑ:/, both produced by retracting the tongue: moving its root towards the back of the throat. This happens at a higher position for /ɔ:/ than for /ɑ:/, which also has a wider jaw opening. /ɔ:/ and /ɒ/ have some lip rounding, /ɑ:/ and /ʌ/ do not.

develop a sense of what the colour combination represents as a *gestalt* rather than as one sound followed by another.

For similar reasons, we use the ochre colour used for /ɔ/ in the American English chart for the start of the diphthong in *goat* /oʊ/.

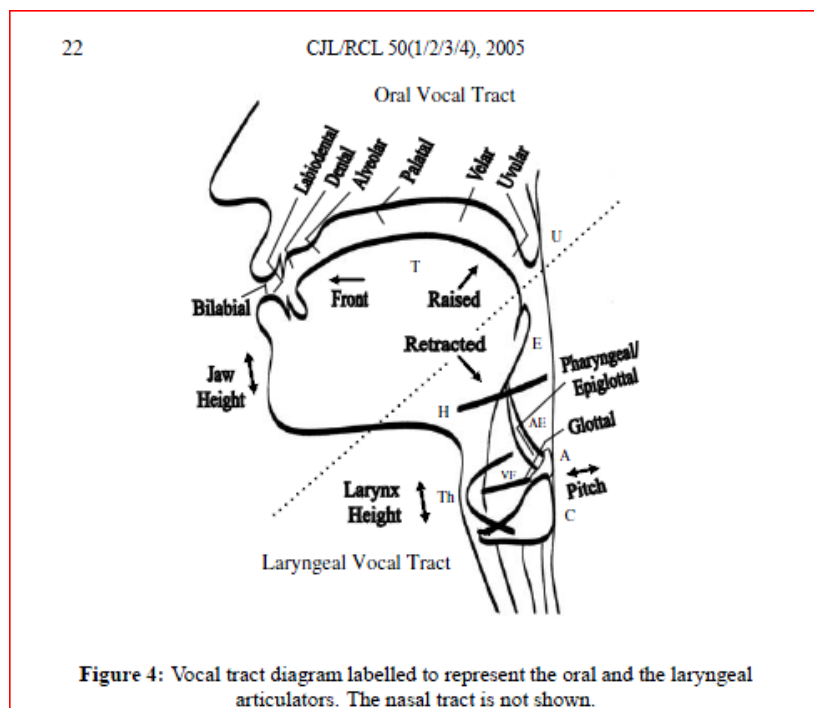
¹⁰ Wells (1990:xix) said that he, “might have been tempted to write ɜʊ for Gimson’s əʊ,” but, “rejected such innovations from the standard [Gimson] established.” This makes perfect sense from the perspective of a need to communicate within phonetic science, but is a constraint that makes no sense in English language teaching materials which use colour coding rather than IPA symbols.

The following diagrams, from Esling (2005), illustrate the articulatory approach we have taken to the organisation of the vowels¹¹:



In Esling’s Figure 2, following phonetic convention, the symbols on the left of each line represent vowel sounds made with unrounded lips, and those on the right, sounds made with rounded lips. Many of the sounds shown are not used in English, but it can be seen how the ones that English does use are grouped when an articulatory perspective is taken.

In Esling’s Fig 4, below, notice that the dotted line divides the vocal tract into two parts, which he calls ‘Oral’ and ‘Laryngeal’:



The capital letters refer to the following parts of the anatomy: T – tongue; U – uvula; E – epiglottis; H – hyoid bone; AE – aryepiglottic folds; VF – vocal folds; Th – thyroid cartilage; C – cricoid cartilage. Bold text next to arrows refers to the movements of various articulators which affect sound production. Bold text with indicator lines names parts of the vocal tract used in the phonetic description of articulation.

¹¹ We would also like to acknowledge how helpful a not-dissimilar scheme proposed by Wood (1993) has been for us. It was described in Messum (2002).

Strong vowels – American English

For American English, the strong vowels in the upper section of the chart are arranged in five rows (the bottom two rows overlap) and four ‘families’ (from left to right). The principles behind this are the same as for British English and the comments on the organisation of the chart above apply.

The three main differences between the British and American charts reflect differences in the ‘retracted’ vowels on the right of the chart (coloured white and ochre), the starting point of the diphthongs, and the ‘diphthongs’ created by American pronunciation of words such as *near*, *fair*, *arm* and *more*, where the vowel is rhotacised.

With respect to the retracted vowels - in *lot* and *law* (white /ɑ/ and ochre /ɔ/) - the sound qualities are clearly very different from their British ‘counterparts’, so we have used different colours. Many Americans do not distinguish the two vowels (the so-called *cot-caught* merger), and teachers can choose to do so or not.

The starting points for the six American ‘diphthongs’ on the right of the chart are well represented using white and brown/ochre, but there is not enough room for a dedicated row for the sounds in *now* and *goat*. So this row overlaps with the row of lax vowels to the left.

We have treated the vowel sounds in words such as *near*, *fair*, *arm* and *more* as a vowel + schwa (which comes down to treating these sounds as diphthongs) rather than using any of the other conceptual possibilities. In particular, we rejected equating the rhotacisation with the consonant /r/. From a pedagogical perspective, this would give it undue prominence.

Consonants

The arrangement of the consonants is the same in the British and American charts.

There are four rows of consonants, with the lowest two rectangles, bright blue /l/ and pale blue /h/, set apart from them.

The top row of consonants contains the semi-vowels /j r w/, which function as consonants but are produced like vowels. These are aligned with their appropriate families of vowels above the dividing line.

The second row contains eight voiceless consonants /p f .../. The third row shows their voiced cognates, /b v .../ etc. The last row contains the nasals /m n ŋ/.

Rows two, three and four are also arranged into 3 families running from left to right, based on their primary place of articulation. The sounds in the left-hand group use the lips, the central group is made up of sounds heavily influenced by the articulatory setting¹² that characterises English (in particular, the way that the tongue is held in the mouth) and the sounds in the right-hand group are formed by raising the back of the tongue to the soft palate.

¹² Articulatory settings (AS) are an important part of the pronunciation of languages. The expression refers to the characteristic way that the tongue, lips etc are held when speaking. The AS for English is very different from that of many other languages. For more information, see Messum and Young (2017) and Messum (2010, 2012).

Pedagogical phonetics

The arrangement of the sounds of English on these charts reflects a ‘pedagogical phonetics’ of the language. Phoneticians usually place vowels on the IPA quadrilateral, which is an auditory analysis even if its labels (front-back, open-close) appear to be articulatory¹³. This is not useful for language teaching purposes, so we have arranged our strong vowels on an articulatory basis, which gives teachers and students useful information about how the sounds are produced.

Similarly, phoneticians often do not distinguish schwa and other weak ‘vowels’ from the strong vowels of English, preferring an acoustic analysis which places all these ‘sounds’ within the same conceptual framework. However, making the distinction clear as we do has shown itself to be more helpful for learners of the language.

There is more than one way of analysing English vowels, and the analysis that phoneticians use most of the time turns out not to be the best one for language teaching purposes.

Photocopiable resources

For a comprehensive approach to teaching English pronunciation, we recommend the use of the colour versions of the three types of PronSci charts: Rectangle, Spelling and Word charts. However, if you are only presently able to use a black and white phonemic chart, we recommend our layout for the reasons described above.

The black and white phonemic charts can be freely downloaded from the PronSci website. They may be reproduced, at any size, provided (1) that they are not altered and (2) that all the copyright and other information on the title line is retained.

On the American English chart, the alternative IPA symbols used for some sounds are given.

¹³ See Messum (2002) for references from the phonetics literature that discuss this unfortunate, misleading practice. A recent confirmation can be found in Ladefoged and Disner (2012).

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¹⁴ Our articles, and others dealing with the teaching of pronunciation, are available at www.pronsci.com/downloads