# Understanding and teaching the English articulatory setting

*Piers Messum*

**An articulatory setting (AS) is the basic or underlying configuration of a speaker's vocal apparatus that facilitates pronouncing a given language. It is believed that pronouncing a second language well requires developing a second AS. However, we do not know how the first language AS is learnt by a child. At the Harrogate conference, I presented an account of that development. It suggests new ways of building on existing techniques to teach the English AS, as part of how we teach pronunciation to older learners.**

One of the first things we learn when we take up a sport is how to hold ourselves to best meet its particular demands. A squash player keeps his head up and his shoulders square to the front of the court. A fencer stands side-on to his opponent, with his free arm held behind and to the side of his head. The difference between the two postures is very evident and affects all the movements made.

Since at least the 19th century and especially in continental Europe (Laver 1978; Jenner 2001), phoneticians and language teachers have asked if speakers of different languages adopt distinctive underlying postures for their tongues and other articulatory organs in order to produce particular inventories of speech sounds or to meet other language specific demands. If speakers do develop an 'articulatory setting' (AS) that is characteristic for a given language, then this might explain some of the difficulties experienced by our students if their AS is poorly adapted for speaking English. Perhaps, as Honikman (1964:74) put it, 'where two languages are disparate in articulatory setting, it is not possible completely to master the pronunciation of one whilst maintaining the articulatory setting of the other.' On the other hand, if we could successfully teach an English AS to our students, then perhaps they might sort out a swathe of segmental problems for themselves, quite naturally, and possibly sort out some suprasegmental ones, too.

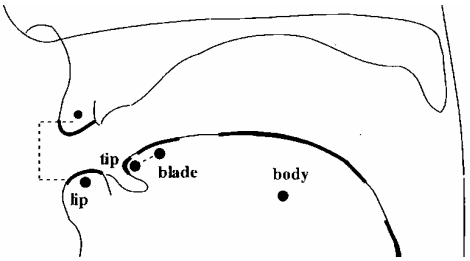
Unfortunately, we have not yet found a way of turning this potential into anything suitable for widespread adoption by language teachers. I don't have the space here for a review what has been proposed and achieved to date, but anyone interested in teaching the English AS should certainly read Honikman (1964), Jenner and Bradford (1982), Jenner (1987a) and Mompeán-González (2003).

For some years I have been investigating the mechanisms by which children learn to pronounce. Until we understand this, I don't think we can be confident that we are doing the right things with our older learners. Surprisingly, perhaps, no one knows how children learn the systemic aspects of pronunciation. They certainly learn how to pronounce individual words by copying them, but how they learn (1) the qualities of the speech sounds that make up the words and (2) the timing patterns of speech (including 'rhythm') remains unknown. Much of our teaching is based on the assumption that these, too, are learnt by some form of imitation. However, not only is there no evidence for this but when one begins to examine the issue there turns out to be evidence and good arguments against it. It is certainly possible that these aspects of pronunciation are not learnt by imitation but by other mechanisms.

I have described my ideas about how children learn to pronounce and the implications for teaching in Speak Out and elsewhere (in articles that are all available on my website). One of my themes has been the consequences of a distinctive style of speech breathing that children who learn West Germanic, stress-accent languages must develop. Here I use this idea to explain how the English AS might be developed by each generation of new learners, and how we might turn this understanding into something teachable to older ones.

## The English AS

I will mainly be discussing the posture of the tongue during speech. Ladefoged and Maddieson (1996) describe two of its divisions as follows: 'The **tip** of the tongue … [is] the part that has a mainly vertical aspect … plus a small area about 2mm wide on the upper surface.'



'Behind the tip is the **blade**, ... It is difficult to say how far back the blade extends [but … it] is the part of the tongue below the centre of the alveolar ridge when the tongue is at rest.'

Given this anatomical arrangement, it is unsurprising that Laver's (1980:23) description of a neutral configuration of the supralaryngeal tract proposed that, 'Front oral articulations [e.g. /t d n/] are performed by the **blade**.' It appears that the easiest way to close the vocal tract at the front of the mouth is just to raise the tongue. The blade then makes contact with the alveolar ridge. (The tip would then most naturally come into contact with the back of the upper front teeth.) It also seems plausible that there would be some biomechanical advantage to using the blade rather than the tip to create an airtight seal; a small child can probably better mobilise the muscles of the tongue to exert pressure this way than further forward.

Thus, amongst many others, French speakers are reported to form their alveolar consonants using the blade of the tongue in this way.

However, English seems to depart from Laver's neutral configuration. Honikman, for example, describes the characteristic English tongue position as drawn back and 'tethered laterally to the roof of the mouth, by allowing the sides to rest along the inner surface of the upper lateral gums and teeth.' She goes on,

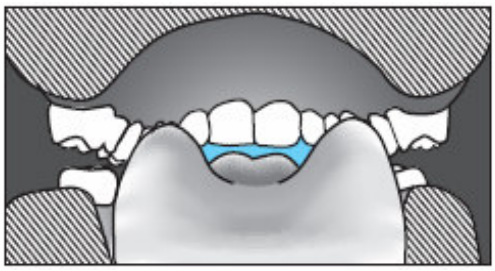
> [T]he lateral rims of the tongue very seldom entirely leave this part of the roof of the mouth, whereas the tip constantly … moves up and down. Thus, one might regard the tethered part — in this case, the lateral contact — as the *anchorage*, and the untethered part as the *free* or *operative part* of the tongue-setting.

Earlier, she observed that,

> One becomes aware in speaking English of the constant rapping of the tongue-tip against the alveolar ridge and intermittent closing and opening and other slight motions of the lips; whereas this is not the case in French, where the tongue-tip is hardly palpable and certainly less active than the blade and front and the constantly moving (rounding and spreading) lips.

Gilbert (2001) has helpful pictures of the tongue imagined from a vantage point at the top of the throat looking forward.

Her illustration for English /r/ (below) shows a position for the sides of the tongue similar to that described by Honikman.



The position of the tip is not clearly defined, but can be imagined as lying just below the alveolar ridge.

Why does English have a tongue position for its AS that departs from Laver's neutral configuration and appears to be so awkward? I am not aware of this question having been asked by phoneticians, but for an answer it will surely be helpful for us to understand out how an AS is developed by a child.

For this, Gick et al (2004:222) described various possible developmental mechanisms, which had two basic starting points. Either an AS is a 'specified part of a language's inventory' and hence learned from other speakers, presumably by imitation of audible cues. (Cues which can best be reproduced by adopting an AS similar to that of the speakers a child hears.) Or an AS is 'a functionally derived property of speech motor production', honed for reasons of motor efficiency as a young speaker performs all the manoeuvres needed for the speech sounds in the particular inventory of a given language.

I don't find either of these proposals particularly plausible to explain the development of an apparently awkward English AS by every speaker in every new generation. With respect to the first, I can't see this AS being reliably developed by auditory imitation alone. With respect to the second, it seems that the English AS is determined in some way by its consonants rather than its vowels, but there doesn't seem to be a compelling reason why the alveolar consonants should be produced by the tip of the tongue rather than the blade. In other words, I can't see why the language would not have innovated away from its odd AS if there was nothing apart from its consonantal contrasts to anchor it there.

My proposal is completely different from these, starting from the fact that speech is learnt by young people whose bodies are both smaller and different in various other ways

from those of older speakers. To set the scene, I now need to summarise some information about speech breathing (SB) and speech aerodynamics in children. This is more fully described in Messum (2007, 2008a, 2008b & 2009). It will provide a platform for a description of how a key class of consonants, the plosives, may develop and how this would lead to the development of a particular AS by English speakers.

## The style of a child's speech breathing (SB)

The physical act of speaking can be conveniently broken down into the actions of three sub-systems: speech breathing (SB), the vocal folds and the upper articulators. The last two receive more or less all the attention in phonetics and in the teaching of pronunciation. If we restrict our interest to adults then this is understandable. SB hasn't been demonstrated to be different across languages, and it seems rather straightforward: inhalation inflates a 'balloon' inside us (whose elastic skin is made up of the elastic tissue of the lungs and chest wall), and the recoil pressure created drives airflow outwards, with supplementary pressure generated as and when needed by expiratory muscles.

However, SB in a young child is very different. First of all, the recoil pressure he creates as a result of inhalation is negligible, because his chest wall is quite 'floppy' compared to that of an adult. When a child inhales he does not create a balloon of air inside himself, but something more like a paper bag: a volume of air that is not under significant pressure.

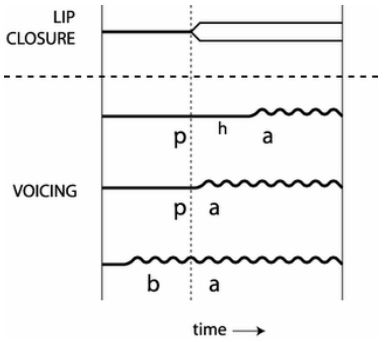
Secondly, with respect to speech aerodynamics, the child cannot be considered to be a scaled down version of an adult. While his lungs and airways are smaller, of course, the rate of his airflow in speech is comparable to that of an adult female, and his subglottal pressures are actually considerably higher.

Elsewhere, I have explained in detail how these differences mean that a child's style of SB for West Germanic languages like English and German must be pulsatile during a considerable part of the time during which he is learning to speak. For each stressed syllable, he must actively contract his expiratory musculature. Changes in his body size and physiology may not make the adult style of speech breathing possible until after about 7 years of age. I have argued that this provides a base for more plausible accounts of various timing phenomena (including so-called 'stress-timed' rhythm) than the currently accepted ones.

## The development of aspirated, long-lag plosives in English

One of those timing phenomena is the variability of voice onset time (VOT) across different languages. VOT is the time period between the release of a consonantal closure (e.g. the closed lips of [p]) and the vocal fold vibration associated with the following vowel. In English, /p t k/ have 'long lag' VOT's because there is a noticeable delay between these two events, at least when the syllable involved is in a prominent (stressed) position. During this period there is also aspiration: a puff of air and whatever sound there is associated with this.

An English /b/ is often unvoiced in normal speech, but with a short-lag VOT that means that perceptually it still clearly contrasts with English /p/. In French, /b/ is typically pre-voiced and /p/ has a short-lag VOT; meaning that an unvoiced English /b/ and a French /p/ can actually sound very similar (the English /b/ in this case being situated in the middle section of the diagram below, with the unaspirated [p]).




The VOT differences in English plosives are easily perceptible and VOT is easily measurable. For these reasons, perhaps, VOT is a more prominent concept in contemporary speech science than aspiration, and it is the subject of many experimental investigations. The assumption is made that children develop the long-lag/short-lag dichotomy for English plosives by imitating VOT, despite the fact that the data on VOT development is inconsistent with this in various ways (see Messum 2007).

If, though, we consider the development of plosives in the light of English having a pulsatile style of SB (in contrast to the more even style of SB a young French speaker soon develops), then an alternative explanation for long-lag VOT readily appears. A stressed syllable beginning with a /p/ will have a strong pulse of SB activity associated with it, and this may both delay voicing after release because subglottal pressure is initially too high for vocal fold activity,

and lead to aspiration. The English style of SB will have led the child to 'discover' a long-lag, aspirated /p/ and his interlocutors will respond positively to it. Their reinforcement leads to him adopting this way of producing the speech sound.

However, one problem with this argument is that there are languages, such as Hindi, where all stops, unvoiced and voiced, appear with unaspirated and aspirated variants, i.e. /p $p^h$ b $b^h$/, /t $t^h$ d $d^h$/ etc. Something further is needed to account for how these might appear by discovery and reinforcement, rather than by imitation.

A plausible answer, I think, is to consider how plosives can be released. To produce a /p/, the lips can be actively opened; but they can also just be relaxed, so that the pressure that has built up behind them 'blows' them apart – a passive opening. It is easy to make this contrast for oneself, and it would be easy for a child to discover. In fact, during an infant's period of babbling I would be amazed if every child did not discover this for himself. The contrasting results are too interesting to be missed.

One significant effect is that the pressure in the mouth after release drops more slowly in the case of passive opening. This slows the restoration of a pressure differential across the vocal folds and delays voicing. At the same time, air is escaping through a slowly opening aperture which will create a turbulent sound source – an aspiration sound.

These two types of release could also be found in front articulations made with the tongue against the alveolar ridge, as for /t/. The tongue can be removed with an active gesture on the part of the speaker, or it can be relaxed and passively removed by the pressure behind it. In children, passive releases would be facilitated by the greater pressure a child generates behind a closure (double that of an adult) and perhaps by his tongue and lips being weaker than those of an adult.

The sequence of events I am proposing for English /t/, then, runs like this:

- Children babble with Laver's neutral configuration of the vocal tract, using the blade of the tongue for front oral articulations.
- They experiment with different ways of releasing closures, using active opening gestures and passive relaxation of the articulators.
- Young English speakers adopt stress-accent to make stressed syllables prominent, and they maintain and further develop a pulsatile style of speech breathing for this.
- Stress pulses and passive releases lead to the appearance of aspirated, long-lag /t/ ([$t^h$]).
- Listeners recognise and reinforce this production, since the child now pronounces words like 'toy' or 'two' in a way that is so much closer to what they expect. The child himself may also notice this.

(This is not an exhaustive account of the process. Some details, including the production of voiced plosives, an explanation of how the Dutch system emerges, etc, are discussed in a supplementary document on my website.)

I should note that I am not suggesting that a long-lag plosive is produced this way by mature speakers. They are likely to have redescribed the production process into a relative timing phenomenon, as it is conventionally described.

## Development of the English AS

We seem to have come some way from articulatory settings! But there are two reasons why an English speaking child's passive release of the closure of /t/ would favour him developing a new AS. Firstly, use of the tip rather than the blade would probably make the relaxation manoeuvre much easier. I certainly find this true for myself as an adult speaker and I would invite you to compare 'blowing' your tongue off the alveolar ridge when contact has been made with tip with when it has been made with the blade. Secondly, use of the blade might lead to the creation of an unwanted sound source, as a jet of air passes over the tip during the release of the closure and becomes turbulent. A change to the use of the tip for the closure would eliminate this.

To make comfortable and regular contact between the tip of the tongue and the alveolar ridge for /t/, the body of the tongue must be retracted and the 'tethering' or 'anchorage' that Honikman described (as quoted earlier) would facilitate this. Other aspects of the tongue posture she describes for English – tapering, concavity to the roof of the mouth – would also emerge from the mechanical demands of these manoeuvres.

A parallel set of arguments apply to the development of long-lag /p/. Here, though, the requirement to be able to passively release a lip closure would favour the 'loose inactive lips' which Jenner (1987a) described as characteristic of the English AS. These contrast, for

example, with the 'pursed lips' of Dutch (Collins and Mees 1996) and the vigorously active lips of French (Honikman 1964); in both these languages /p/ is short-lag and unaspirated.

So I am arguing that the English AS arises out of the need to make its high frequency plosive consonants using the particular speech production system that a child commands. This is a non-imitative account of how one aspect of pronunciation develops. It is consistent with the more general account I have developed, in which children do not have to pay considerable attention to the phonetic niceties of the ambient language in order to acquire it. The alternative seems developmentally implausible. My account provides answers not only to how children acquire the English AS, but also to why they do so and why the AS itself is so apparently awkward. The association between aspiration, long-lag VOT's and stress-accent becomes understandable (as does the further association with the existence of a breathy onset to syllables, the consonant /h/, in the same languages where this occurs).

## Teaching implications

The action of the tongue tip has been noted by everyone who has described teaching the English AS. Here, for example, is Honikman's distillation of the results of her experiments:

> Of course it needed further perseverance to establish the setting; instructions for obtaining the articulatory setting required were finally reduced to the following formula: taper and concave the tongue[1], draw it as a whole back into the mouth so that the pointed tip presses against the edge of the alveolar ridge; close the jaws, don't clench them; still the lips; swallow to relax; now to limber up, repeat [t, d, n, l].

Based on how I have described a child's development, there are two new elements we should add to this. First, we should ask learners to relax their tongue and lips to produce aspirated plosives. This is fun! My students are delighted with how 'English' they sound when they say 'Tea for two' or 'Ping-pong in Paris' in this way. Aspiration emerges without having to be consciously created.

This is greatly helped if, secondly, we ask learners to use their abdominal musculature to produce stress pulses, in the way that I have described English speaking children doing. There is a justification and more detailed advice about this in Messum (2009). I would argue that pulsatile SB is as fundamental a part of the English AS as the activities of the vocal folds and upper articulators. As I also argue elsewhere, changes to SB are probably also the key to getting the 'rhythm' of English and acquiring some of the segmental timing phenomena (as in tense and lax vowels) that characterise the language.

I don't teach in an environment where sustained work on AS can be justified. I would imagine that university courses and 'accent reduction' classes would be the best testing ground for these ideas. I can report, though, that I pronounce French much better when I make an attempt at Honikman's description of the French AS, and it would be very interesting to hear what learners of English who are motivated to master its pronunciation do with the ideas above.


### Acknowledgements

My thanks to Marie-Laure Lagrange for our conversation about French and English during which some of these ideas finally crystallised between us. Also to Roslyn Young, who has been an insightful sounding board and support for these and many other ideas.


### References

For reasons of space, the references for this article are listed on my website, address below, together with some supplementary notes.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[1] I can't imagine specifying this to ordinary EFL learners, but Honikman's students may have been studying phonetics. Also, Honikman doesn't mention the lateral 'tethering' against the rear upper molars which does seem to be perceptible reasonably readily. If the tongue is drawn back then presumably some bunching and lateral contact is inevitable, and it might do no harm to at least warn students that they are likely to feel this and that it is authentic and not a problem.

**References and Supplementary Notes for**

Messum (2010) 'Understanding and teaching the English articulatory setting' Speak Out, Issue 43, pp. 20-24

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Here is some additional material on AS's, including other points from the Harrogate presentation.

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Jenner (1987b:137) insisted even more strongly than Honikman on the need for an understanding and teaching of AS's:

> The contentions of this study have been:
> 1. that a non-native variety [of English] cannot be described with reference only to differences in phonetic realisation from the target variety;
> 2. that it cannot be adequately characterised in terms of its segmental phonology alone;
> 3. that a representation of the generalised articulatory and phonatory settings must precede and inform any merely taxonomic study.
>
> Without this the essential nature of 'foreign accent' cannot be captured and phonetics will not be able to offer the language teacher any basis for an improvement in strategies for the teaching of pronunciation.

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Further articles that will be of interest on teaching the English AS include Thornbury (1993) and Sarn's article on the web. Esling & Wong (1983) and van Buuren (1995) take other perspectives on the issue.

Kelz (1971), Laver (1978) and Jenner (2001) are about the history of AS's in phonetics. Recently, phoneticians have started to apply modern instruments to investigate this subject: Gick et al. (2004) and Wilson (2006).

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Most authors describe English and German alveolar consonants being produced with the tip (or 'apex') of the tongue rather than with the blade (or 'lamina'). In addition to the sources referenced, there is Enstrom (1981; 1982) who describes Swiss German [alveolar] stops as 'apical', and Mooshammer et al (2003) who do the same for German 'coronal' stops, and explicitly say that /l/ has an apical articulation (for which, they say, the jaw must be lowered).

But Hall (2003) 'Modern German Pronunciation' has /t d/ as either apical or laminal, and an anonymous web presentation says they are laminal:

> http://www.scribd.com/doc/2592693/Introduction-to-Phonetics-Phonology

So the use of the tip in German is not universally accepted.

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Jenner (1987a) made a connection between the English AS and aspiration before me. He pointed out that,

> despite the activity of the English tongue tip, articulatory gestures in English are very relaxed compared to many other languages. Muscular effort is minimal and tension is almost nonexistent. This in part accounts for the regular aspiration of voiceless stop consonants, since a vigorous or

> firm closure inhibits aspiration. This we see exemplified in the accents of French or Dutch learners.

Young French speakers develop away from pulsatile SB at an early stage, as French does not use stress-accent as a prominence mechanism. Interestingly, both young French and young Spanish speakers are reported as not mastering the adult system of pre-voiced lenis plosives (/b/, /d/, etc) until around 4 years of age.

Dutch is an interesting language for my theories. Like French, its fortis plosives are short lag and its lenis ones are pre-voiced. It is also reported as being spoken with a high degree of laryngeal tension. However, I assume it has pulsatile SB like the other West Germanic, stress-accent languages.

So there must be the possibility of at least two stable systems within the pulsatile SB family of languages. In both, children experiment with different types of release, but they get differentially reinforced (active rather than passive release being encouraged in Dutch children) and develop their plosive system in line with the ambient language as a result.

Consistent with my proposals, Jenner (1987b:133) reports that while English speakers use the, 'tip (and blade)' for alveolar plosives, the Dutch use the, 'blade (and front); with tip lowered (and almost completely inactive).' Use of the blade, as in Laver's neutral configuration, is what we would expect for the Dutch AS since there is no requirement that the child's tongue contact be opened passively, by the pressure behind the closure.

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In the article, I quote Honikman's distilled instructions for the English AS, which partly ran as follows, 'taper and concave the tongue, draw it as a whole back into the mouth so that the pointed tip presses against the edge of the alveolar ridge.' I also reproduced Judy Gilbert's illustration showing how the tongue would look from the top of the throat as a result.

It seems to me that this aspect of the English AS is important in the production of a number of consonants (and perhaps vowels), and not just for /t d/.

There are consonants, of course, which require a forward part of the tongue to touch the alveolar ridge, and the English versions of /n l tʃ dʒ/ presumably sound slightly different from cognates in other languages which use the blade rather than the tip for this.

More interestingly, Roach (1991:60) says the only articulation of (simple) /r/ he can recommend to learners of RP is as a post-alveolar approximant:

> The important thing about the articulation of /r/ is that the tip of the tongue approaches the alveolar area in approximately the way it would for a /t/ or /d/, but never actually makes contact with any part of the roof of the mouth … (This is, of course, very different from the "r-sounds" of many other languages where some kind of tongue-palate contact is made.) The tongue is in fact usually slightly curled backwards with the tip raised; consonants with this tongue shape are usually called retroflex … The

> "curling-back" process usually carries the tip of the tongue to a position slightly further back in the mouth than that for alveolar consonants such as /t/ and /d/, which is why this approximant is called "post-alveolar".

This articulation would seem to be facilitated by the English AS.

To produce /θ/ and /ð/, my usual instruction is for the student to hold the tip of the tongue lightly against the back of the upper front teeth and then to allow air to flow out around the sides.

(Roach (1991:49) says that, 'the air escapes through the gaps between the tongue and the teeth,' while Gimson (1989:184) says, 'the tip and rims of the tongue make a light contact with the edge and inner surface of the upper incisors and a firmer contact with the upper side teeth, so that the air escaping between the forward surface of the tongue and the incisors causes friction.')

One common problem is that the student can't get any air to escape at all if the tip is in contact with the back of the upper teeth. Instead, he tries unsuccessfully and then produces a dental plosive.

Here, it seems to me that the air can't escape because the bulk of the tongue is too far forward. To produce these consonants satisfactorily it may be essential to draw the tongue back as a whole and taper it, as, of course, in the English AS.

It's dangerous to generalize from knowing the sound systems of only a few languages, so, as speculation, let me just float the idea that the reason for the rarity of /θ/ and /ð/ in the world's languages is because to produce them comfortably requires an odd AS. Perhaps the English /r/ is distinctive for the same reason, and I've argued elsewhere (Messum 2007) that the availability of /h/ in the consonant inventories of West Germanic languages is based on the speech breathing aspect of their AS's.

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When considering my suggestions, remember that a child's mouth and tongue are different in shape and relative dimensions to those of an adult, with aerodynamic consequences that have not been greatly investigated or well understood.

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It seems that we should be able to observe differences in the lip activity of, say, young English and French speaking children when they produce word-initial /p/. Of course, English speakers are supposed to have relaxed lips as part of their AS, so observing this might just be dismissed as the result of imitation of the AS. But would we see greater relaxation than in adults, and an impression of the lips being blown apart on occasions where a long-lag /p/ is produced? If so, then this would support my arguments.

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