Stress-timing: observations, beliefs, and evidence

Richard Cauldwell
English for International Students Unit
Department of English
The University of Birmingham
United Kingdom
r.t.cauldwell@bham.ac.uk

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Abstract

Researchers are in two minds about stress-timing because their studies show that stress-timing does not exist, yet there remain observations which seem explainable only if one continues to believe that stress-timing exists. The belief that stress-timing exists is thus necessary, but goes counter to results of research. Scholars argue that there is a 'strong tendency' for English to be stress-timed despite the fact, which they concede, that 'other factors' militate against stress-timing being observed. The belief continues (I surmise) because (a) the data focused on consists of short stretches of speech (usually nursery rhymes) which can be made to display rhythmical alignment of stresses (b) perceptions of differences between L1s and L2s in second and foreign language learning (c) teachers and students find rhythm-based exercises useful. There exists no account of rhythm in speech for these observations other than the stress-timing hypothesis. I present an alternative interpretation of findings from the work of three scholars (Roach, 1982; Couper Kuhlen, 1993; Halliday, 1994). I argue that their findings can be reinterpreted to take account of these observations, without having to continue believing in stress-timing. I argue that their research shows that stress-timing is not an underlying feature of spoken English. I suggest why the avoidance of stress-timing might be functional.

1 Schizophrenia: belief versus evidence

Linguists and language teachers are schizophrenic about the issue of stress-timing. On the one hand they acknowledge that experimental evidence is against the stress-timing hypothesis; on the other hand they adhere to the belief that English is 'underlyingly' stress-timed. They are thus in a situation where they hold incompatible beliefs. In this paper I want to suggest reasons for the existence of this schizophrenia, and I want also to suggest a cure.

2 Stress-timing and syllable timing

Stress-timing (or isochrony) is said to be a characteristic of languages such as English, Russian, and Arabic. It is said that the stresses occur at equal intervals of time, and that as a consequence, syllables vary in length in order to allow stresses to occur at roughly equal intervals of time. In the following example (from Halliday, 1994, p. 293) the syllables after the slash symbols '/' (a foot boundary) are the salient syllables which occur at regular intervals of time:

/James / James / said to his / mother / 'Mother,' he / said, said / he

The idea is that the first syllables of each foot occur at equal intervals of time. This would result in the syllables in the multi-word feet, the third foot (*said to his*), fifth foot (*Mother he*), and sixth foot (*said said)*, being shorter than if the words were to occur on their own. Thus the two syllables of *mother* in the fifth foot are shorter than their counterparts in the fourth foot to allow space for the word *he* to be spoken 'in time' before the salient syllable *said*. Thus, it is argued, syllable length varies to allow stresses to occur at 'roughly' equal intervals. The issue of how 'roughly equal' the intervals can be will be explored below (cf. 5.3).

Syllable-timing is said to be characteristic of languages such as French, and Japanese. It is argued first that syllables do not vary in length; and second that the intervals between stresses vary in order to preserve the constant length of syllables. Take for example the fourteen underlined syllables of the portion from a feminist speech:

Le feminisme est une doctrine philosophique basée sur l'égalité de tous les êtres humains et qui a pour but d'établir l'égalité des sexes dans tous les domaines: civile, politique, intellectuel, économique et social. (Verone, 1992)

The argument goes that each of the syllables occupies an equal time-frame, as represented in Table 1.

1	2	3	4	5	6	7	8	9	10	11	12	13	14
et	qui	a	pour	but	d'e	ta	blir	l'e	ga	li	te	des	sexes

Table 1 Syllable-timing

Imagine that there are stresses in the syllables 5, 8, 12 and 14:

et qui a pour BUT d'étaBLIR l'égaliTÉ des SEXES

The argument goes that the stresses are anisochronous (i.e. are not rhythmic) because the intervening numbers of syllables varies - there are respectively, two, three, and one intervening syllables between these stresses. Because the syllables take an equal amount of time to say, the stresses occur at non-regular intervals. Now, I have the recording of this extract and I have listened to it repeatedly, but as I am not a native speaker of French I cannot tell where the stresses do in fact occur.[1] What I can do however is to measure the lengths of the syllables in units of seventy-fifths of a second. These measurements are given in the third row of Table 2.

1	2	3	4	5	6	7	8	9	10	11	12	13	14
et	qui	a	pour	but	d'e	ta	blir	l'e	ga	li	té	des	sexes
10	10	15	18	11	12	15	14	10	10	12	10	08	30

Table 2 Syllable-timing measured

Table 2 shows that syllables vary in length between 8 and 30 units: that is from approximately one tenth to four tenths of a second. So the syllables are certainly not 'of the same length. When presented like this, it is easy to see why nobody takes syllable-timing very seriously - not even by those who take its twin, stress-timing, seriously. A further indication of its improbability can be obtained if you try to read this so that the syllables have the same length, it will sound extremely unnatural.

It is interesting to note with Roach (1982, p. 75 & p. 78) that most research has been conducted by speakers of stress-timed languages. So although (cf. 4 below) stress-timing and syllable-timing were viewed as a binary distinction, there has been relatively little interest from scholars who speak the syllable-timed languages.

3 Three everyday observations

The stress-timing hypothesis arose and is perpetuated because of the common observation that languages sound rhythmically different: for example, language learners who have English as a mother tongue report that the units of French speech (segments, syllables, tone units) have a different relationship to time. Another observation is that it is normal to speak nursery-rhymes in English in such a way that stresses do occur at equal time intervals. The third observation is one often made by teachers who have found that practice of short stretches of language with stress-timing (cf. Underhill, 1994) can improve students' fluency in speaking.

These observations have led to the transformation of the stress-timing hypothesis into a belief: English is, underlyingly, stress-timed. Meanwhile, the fact that stress-timing is part of a binary distinction – it is twinned with syllable-timing – has been conveniently ignored. The schizophrenia has arisen because these everyday observations conflict with the findings of research: research into stress-timing, whether it has focused on the speaker, the sound signal, or the hearer, has failed to provide the desired 'proof' or validation of the hypothesis. In fact it seems quite

[1] For an excellent discussion on why this might be so cf. Roach (1982).

reasonable to take the view that the research has falsified the stress-timing hypothesis, and that it should have been abandoned a long time ago. But the force of the three observations mentioned above (and the lack of an alternative explanation for them) has been so great that researchers have refused to acknowledge this falsification. This is despite the number of papers (e.g. Dauer, 1983) which have argued strongly against stress-timing.

It might be argued that this is a low level schizophrenia with which we have been comfortable for some time, and that it is not really a problem. I would argue that on the contrary it is a problem for two reasons. First, it is intellectually irresponsible to allow a contradiction to exist between experimental evidence and hypothesis. Second, there are practical consequences: if we do not seek to resolve the conflict between hypothesis and experimental evidence we run the serious risk of confusing students. If we tell them that English is stress-timed and the speech they hear is manifestly not so, then they are going to worry that their ability to learn is deficient because they cannot hear what their teachers tell them they ought to hear. They will thus be disabled from learning to be good listeners.

4 The tradition of belief

The first person in the twentieth century to put forward the stress-timing hypothesis was Daniel Jones who wrote in 1918 that for English there 'is a strong tendency in connected speech to make stressed syllables follow each other as nearly as possible at equal distances' (1972, p. 237). One of the first to test this hypothesis was Classe (1939). Couper-Kuhlen (1993) reports that 'the results he[Classe] obtained showed strict isochrony only under very special conditions: the rhythmic groups had to have a similar number of syllables with similar phonetic structure and similar grammatical structure in order to be isochronous in any strict sense (1993, p. 11). Couper-Kuhlen quotes Classe's conclusion:

> a series of nearly isochronous groups must be rare in English prose, as it may only occur through a complicated system of coincidences. If the necessary conditions have been consciously fulfilled by the writer, we are very near to verse. From the very nature of speech, it is obvious that, in the normal course of events, all the necessary conditions will generally not be present at the same time (1939, p. 85-86)

The last sentence amounts to a refutation of the stress-timing hypothesis. Despite this Classe equivocates sufficiently to hold out a lifeline for those who wished still to cling to the belief that English is stress-timed. Isochrony is still

> …a characteristic which always seems to be present and to make its influence felt; although frequently, it only remains as an underlying tendency of which some other factor at times almost completely obliterates the effects (1939, p. 90)

The choice of those following Classe has been to grasp at the pro-stress-timing side of the equivocation rather than the natural consequence of the results. The equivocation allowed others to continue the tradition of believing in stress-timing. Pike for example (1945, p. 35) distinguishes between stress and syllable timed languages and Abercrombie (1967) asserted that all languages can be categorised as being either stress or syllable-timed:

> As far as is known, every language in the world is spoken with one kind of rhythm or with the other. In…*syllable-timed* rhythm …the chest-pulses, and hence the syllables recur at equal intervals of time-they are *isochronous*. In…stress-timed rhythm…the stress pulses, and hence the stressed syllables, are isochronous.(Abercrombie, 1967, p. 97). [Italics are Abercrombie's]

Abercrombie's implies that the rhythm of speech has physical origins - he mentions 'chest-pulses' and 'stress pulses'. We should note with Dauer (1983) that the hypothesis concerning a link between speech rhythm and physical movements such as chest pulses has been refuted by Ladefoged (1967).

Depressingly, much scholarly writing on the rhythm of English continues to associate speech rhythm with observable physical movements. Brown (1990) states

> If you watch an English speaker talking you will be able to see, without hearing what he is saying, where the stressed syllables are….there is a tendency for a rhythm to be established in speech…These beats will coincide with other muscular beats of the body. (pp. 43-44)

She then goes on to assert that stressed syllables 'will tend to occur at roughly equal intervals of time', but only under ideal conditions:

> 'Thus, in general, prose read aloud by a fluent reader has a much more obvious rhythm than conversational speech which may be full of pauses and false starts. Very fluent speakers, who can organize their thoughts well in advance of actually uttering them, also establish a far more obvious rhythm than those who have to search for the right word and keep trying to refine a thought while in the middle of expressing it' (p. 44).

Notice here that she is prioritising a formal speech style (prose read aloud), and (implicitly) denigrating the most common speech style spontaneous, real-time, purpose-driven speech in which speakers have to 'search for the right word' and 'refine a thought while in the middle of expressing it'.

Thus we have a situation in which there is considerable evidence that stress-timing does not exist, yet the belief is adhered to and the evidence is ignored because of the lack of an alternative explanation for observations about speech rhythm.

5 Measurements and tendencies

In sections 5.2, 6, and 7, I re-interpret the findings of scholars (Halliday, 1994; Roach, 1982; Couper-Kuhlen, 1993). I hope to show that this reinterpretation can resolve the conflict between the three observations and experimental results and thus cure our schizophrenia. Prior to doing so, it is necessary to discuss the nature of rhythm.

5.1 Rhythm

Rhythm can be defined as a series (or pattern) of 'events' which occur at (roughly) equal intervals of time. There is a also a definition of rhythm, 'a regular pattern of changes' (COBUILD, 1995, p. 1428) which has a more approximate relationship to time: this is the sense in which we speak of the rhythm of the seasons of the year. Research into rhythm thus varies from investigation of short equal intervals of time (in which there are questions such as 'Are intervals of 2.0 and 2.1 seconds perceived as equal in length?') to investigation of 'regular patterns of changes' in which the relationship to time is more approximate. Perceptions of rhythm thus depend first on one's purpose in measuring, and second the criteria for rhythmicality. If one is investigating changes in the rhythm of the seasons of the year as part of research into global warming, one will have very different criteria from those used if one is measuring rhythmicality of ten seconds of speech. What happens with research into stress-timing is that the criteria for what is, and what is not rhythmical are not tightly drawn.

The danger is that anything which occurs frequently in time can be described as rhythmic (such as the visits of birds to a birdtable) if one allows oneself the luxury of redefining the criteria for rhythmicality whenever irrythmicality threatens.

5.2 Measuring rhythm

Some indication of the problems of measuring rhythm are illustrated by Halliday. He states:

> …the provisional finding is that , on the average, in spontaneous conversation carried on at a constant speed, a two-syllable foot will be about one fifth as long again as a one-syllable foot (i.e. slightly longer, but nothing like twice as long…(1994, p. 293)

He then presents the following series of relationships between numbers of syllables and duration:

no. of syllables in foot	1	2	3	4
relative duration of feet	1	1.2	1.4	1.5

Table 3 Relative duration of feet with increasing numbers of syllables

The first row in Table 3 shows increasing numbers of syllables in the foot; the second row gives the proportions of time that each foot would be likely to take. Thus a foot with four syllables will last half as long again (1.5) as a foot with one syllable (1). The implication is that in the following utterance (imagine it is spoken by a considerate boss to an employee who is ill and has been told to go home) *Sleep well and don't come to work tomorrow* the timing would be likely to be

words	*Sleep*	*well and*	*don't come to*	*work tomorrow*
syllables	1	2	3	4
timing	0.5	0.6	0.7	0.75

Table 4 relative duration of feet in a fabricated utterance

Table 4 indicates that *sleep* would last half a second, *well and* would last one tenth of a second longer, and so on.[2] Note that the last foot, with four syllables, is predicted to last half as long again as the first syllable. The very fact that proponents of stress-timing accept that the duration of feet, and therefore the distance (in time) between stresses is variable calls into question the notion of stress-timing. In particular the issue arises of whether the difference of 50% duration between the first and fourth feet in the above example is noticeable to hearers. If hearers perceive these feet to have the same duration then this would be some indication that the stress-timing hypothesis has some validity; and the corollary of this would be that if they perceive them to be different in length, then this would be evidence against the stress-timing hypothesis. We will return to the issue of perception in Section 7.

5.3 'Strong Tendency'

The quotation from Jones (1918) cited above mentioned the 'strong tendency' for stress-timing to occur. The theme of the 'strong tendency' has been continued by succeeding generations of scholars, of whom Halliday is one:

> In natural speech, the tempo is not as regular as in counting or in children's rhymes. Nevertheless there is a strong tendency in English for the salient syllables to occur at regular intervals; speakers of English like their feet to be all roughly the same length. (1994, p. 293)

The problem with the term 'strong tendency' is that makes it possible for scholars to dismiss any counter-evidence by stating 'I only said it was a tendency'. Because 'strong tendency' is unquantifiable, it is impossible to prove or refute this statement. This is therefore a hypothesis which for Halliday and others has become a matter of belief masquerading as a scientific statement.

6 Measuring duration of syllables

[2] Remember this is a fabricated utterance, with imagined timings given in tenths of a second.

Roach (1982) sets out to test (amongst other things) the statement by Abercrombie that:

> (i) 'there is considerable variation in syllable length in a language spoken with stress-timed rhythm whereas in a language spoken with a syllable-timed rhythm the syllables tend to be equal in length'
> (Abercrombie, 1967, p. 98)

Roach measured duration of syllables in three syllable-timed languages (French, Telugu, and Yoruba) and three stress-timed languages (English, Russian and Arabic). Samples of spontaneous unscripted speech from six speakers, one for each language, were recorded and analysed.

After presenting his results Peter Roach comments that his figures do 'not appear to support' Abercrombie's claim. At the close of his paper Roach concludes with the statement that 'there is no language which is totally syllable-timed or totally stress-timed–all languages display both sorts of timing'. This is a very important finding, because Abercrombie viewed stress-timing as part of an opposition – a language is either one or the other – if the opposition is shown to be misguided, or false, as it has been, then one should abandon the contrast, and with it the notion of stress-timing for English. There is a second conclusion which also points towards the necessity of abandoning the hypothesis: 'different types of timing will be exhibited by the same speaker on different occasions and in different contexts' (p. 78). An important consequence of this point is that no language can be regarded as possessing an inherent syllable/stress timing mechanism: Roach's conclusion suggests that it would be better to view languages as 'speaker-timed' rather than syllable or stress-timed:

But Roach equivocates sufficiently to allow the believers a lifeline: after stating that 'all languages display both types of timing' he goes on to assert that 'languages will, however, differ in which type of timing predominates'. This 'predomination' view seems to go against his other findings and conclusions, it allows people to believe that English is more stress-timed than French.

7 Perceptions of stress-timing

Perhaps the most extensive recent study of rhythm in English is that by Elizabeth Couper-Kuhlen (Couper-Kuhlen, 1993). She used a two-minute extract from a phone-in programme broadcast on Radio Manchester, which consist of twenty-three turns of varying length between the host and a caller. Two informants analysed the recording for 'isochronous chains' – stretches of speech sufficiently rhythmic for them to be able to tap a pencil, or nod their head to. They identified 48 such isochronous chains in the recording. This figure of 48 is important: first because of the simple fact that it is greater than one - not all of the text is contained in one isochronous chain – a fact that any adequate theory of timing would have to explain away; second because it is greater than 23 (the number of turns at speech) this means that (as Roach noted) speakers changed their rhythm within a turn.

The analysts were allowed to redefine the criteria for rhythmicality as often as they liked: this, as I have mentioned above allows one to find a rhythm for almost anything. Even with this flexibility however, some of the text occurs outside the 48 isochronous chains – 36% of the total number of syllables in fact. This might not matter if these syllables were unstressed (because it is occurrences of stresses which is perceived as rhythmic). However, this is not the case: 17% of stressed syllables occur outside isochronous chains.

It is useful to consider the case of the longest isochronous chain in the recording, the following stretch of twenty-seven (twenty-eight if you count *family* as three syllables):

*priv*ately I agree en*tirel*y with you, but *when* you've been Dick
as long as *I* have because your *fa*mily (Chain 9).

Couper-Kuhlen's informants perceived there to be a high order rhythm at the level of the 'intonation phrase' there are 'stresses' in the words *privately*, *entirely*, *where*, *I,* and *family*. But Couper Kuhlen's analysis also identifies other isochronous chains in this same stretch of speech:

*priv*ately I a*gree* entirely *with* you	[Chain 10 Intonation group level]
I a*gree* en*tire*ly *with* you	[Chain 11 Phrase group level]
when you've *been Dick*	[Chain 12 Group level]
Dick as long as *I* have be*cause*	[Chain 13 Group level]

There are a number of points to be made about this type of analysis. First the analysis is derived from attending to the recording, and the orthographic transcription of it, as if it were a product. This is a luxury available only to the analyst listening to a recording, it is not one available to the participants. It has been subjected to repeated listenings in order to identify these isochronous chains, and it is probable that it is only through such repeated listenings that such chains are perceptible. In other words, it is possible they are not relevant to the speaker and the hearer. It is also unlikely that speakers and hearers can perceive isochronous chains at more than one level at the same time: notice that the four chains 10-13 all overlap with chain 09, and that chains 12 and 13 (both at the phrase level) share a 'stress' on *Dick*.

A Discourse Intonation (Brazil, 1985, 1994) transcription of the recording that Couper-Kuhlen used is given below:

01	④➲ PRIvately
02	④ i aGREE enTIREly WITH you
03	**?** but WHEN you've been DICK
04	④➲as LONG as I have
05	➲ because your FAmily STARTed it
06	…there's…
07	④ NO point in ARguing really

Note: Upper case letters indicate prominent syllables; the tone choice is indicated at the beginning of the tone unit, but the tone begins on the underlined syllable. Key and Termination are not indicated in this transcription.

The question mark at the beginning of tone unit 3 signifies that the tone is not clear.

This is a transcription that attends to meaning, rather than to rhythm. Note that Couper-Kuhlen's isochronous chain stops half way through tone unit 5: after the onset prominence *family* and before the word *started*. This is a curious place to end a chain because the tonic prominence on *started* represents an important selection of meaning, and is likely to figure strongly in any hearer's perceptions.

It is now clear that a major failing of this type of analysis is that it attends to the form of an utterance and ignores those features of speech (selections of meaning) on which the attention of speakers and hearers is most likely to be focused, and which are most likely to colour any perceptions they might have of rhythm.

Couper-Kuhlen's conclusion begins by acknowledging that her findings are largely against the stress-timing hypothesis:

…the passage is not uniformly isochronous throughout. In this sense, those who have been skeptical of finding isochrony in performance are right: English speech is *not uniformly isochronous* over extended periods of time. (p. 48 her italics)

but then comes the lifeline:

> But just as significantly, the passage is *not wholly anisochronous* either. In fact, allowing for discontinuities, a large portion of it is isochronous in one way or another (p. 48 her italics)

The last clause allows continued belief in stress timing. What is not made clear is that isochrony is only observable if one allows oneself the twin luxuries of redrawing the criteria for rhythmicality and repeated listenings. There are 48 different isochronous chains in her data, each of which is judged to be isochronous by different rhythmic criteria, and some chains are judged to be isochronous only if one ignores meaning. It would be safer to conclude that English speech is characterised by brief stretches of rhythmic groups, but that it is not isochronous. As preceding scholars have done, Couper-Kuhlen leaves it open for people to continue to believe in stress-timing.

8 What if English were stress-timed?

One question, rarely addressed but productive to consider, concerns what English would be like if it were stress-timed in long stretches. It seems to me that utterances in English would be very difficult to attend to as units of meaning. The stress-timed rhythm would draw attention to itself and distract the listener's attention away from meaningful choices: it would, in other words, be English in oblique orientation (cf. Brazil, 1985).

Bolinger commented on this type of speech:

> It seems only natural that when you're speaking routinely and mechanically, the mechanical phenomenon of even rhythm would assert itself…(1986, p. 47)

Bolinger goes on to suggest two reasons why purpose-driven spontaneous speech is not 'routine and mechanical': first he states that 'one thing the adjustment is never allowed to interfere [with] is our meaning' (1986, p. 47) and 'the words we want to emphasize are often irregularly spaced, which means that the number of syllables may be radically different from measure to measure' (1986, p. 47).

He concedes that 'stylized intonation' (his example of this is // it's NEver too LATE to MEND //) does have this routine and mechanical feel to it. But 'stylized intonation' is a special case, and is therefore not an appropriate style of spoken discourse on which to base generalisations about everyday purpose-driven speech. He expresses the worry that 'this sort of sing song is just the kind of intonational frame that a classroom drill is apt to fall into' (p. 48), and suggests that the use of such drills 'has helped to make us see English accentual rhythm as more regular than it really is' (p. 48).

9 Why anisochrony is essential

It is possible that a lack of a single regular rhythm is in fact essential, in other words there might be a reason why purpose-driven spontaneous speech is not stress-timed. Rhythm in speech is fleeting and ever-changing: short stretches of up to four tone units appear rhythmical, they are followed by moments of irrhythmicality, and then another rhythm may establish itself briefly again before irrhythmicality or a rhythm change occurs once again. If this did not happen, a speaker might find it difficult to hold the attention of the hearer: the hearer instead of attending to selections of meaning would be distracted – by the pattern of an established rhythm – from attending to the communication of meanings which is the purpose of most speech. The non-occurrence of a continued rhythm of any sort could therefore be viewed as a necessary feature of any co-operative purpose-driven speech: what matters are the

selections of meaning which a speaker makes through the placement of prominences.

10 Conclusion

I mentioned earlier that if we abandon the notion that English is stress-timed in favour of one that recognises that English is speaker-timed one has to account for three common observations: (a) differences in rhythm between languages reported by language learners; (b) short natural-sounding samples have stress-timing; (c) the value teachers' place on stress-timing exercises.

As far differences between languages are concerned one need do no more than quote Dauer (1983), who argues that a theory of 'stress-timing/syllable-timing' is not required to explain such perceptions. She proposes that 'rhythmic differences we feel to exist between languages…are more a result of phonological, phonetic, lexical and syntactic facts about that language than any attempt on the part of the speaker to equalize interstress or intersyllabic intervals' (1983, p. 55). Dauer suggests that it is phenomena such as syllable structure, word-accent, and vowel reduction which are the cause of perceptions of rhythmic differences: not speaker behaviour, nor any underlying feature of language.

The other two points can be taken together, because they both essentially involve the same kind of activity, the reading aloud of short written utterances. Couper-Kuhlen's work has indicated that stretches of speech as long as 27 syllables may possess isochronicity. The value that language learners get from practising stress-timing exercises is that they are practising the mechanics of producing non prominent syllables between prominences occurring at roughly equal intervals. The material they practice with is (generally) short enough for it to remain natural-sounding.

It is only possible to believe in stress-timing if you are happy assuming that it is acceptable to: (a) redraw the criteria for rhythmicality whenever you wish (b) treat speech as a product, and subject it to repeated analyses that ignore meaning (c) regard nursery-rhymes as proto-typical speech. None of these assumptions is acceptable. If patches of stress-timing do occur this is an incidental, patchy effect brought about by fleeting coincidences between time and the occurrence of prominences and word-accents. Speakers time language: language does not time speakers.

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