

Visualizing speech rhythm: A survey of alternatives

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What is rhythm and why visualize it?

Rhythm is one of the prosodic features of speech and its importance for fluent speech cannot be overstressed. But how can the rhythm of speech be conveyed to a linguist or a naive learner?

For decades since Pike (1945), speech rhythm was nearly synonymous with “isochrony” –either of stresses (ISIs or interstress intervals) or of syllable durations. Strict regularities were, however, never evidenced in real speech.

Following Dauer (1983; 1987), the focus has changed. Research is now centered in language form-specific metrics used to describe the durational ratios between specific levels of units in speech (stressed vs. unstressed syllables, stressed vs. unstressed vowels, vowels vs. syllables, etc.).

Pike’s apparent rhythmic dichotomy, however, had another aim. It was used to describe the rhythm of the target language for language learners in a way that would make sense to them and maybe even help them acquire a foreign phonetic feature.

This aim is lost in the numeric metrics that dominate current research of speech rhythm. Many visualizations now in use summarize the type of language rather than describing speech utterances

How to graphically present rhythm for applied purposes?

What attributes does rhythm have for a naive listener or a non-phonetician linguist?

Typographical visualization

Typographically one can often easily denote some prosodic features.

This works mainly when it is already known how emphasis is achieved in the language in question. IPA currently still mostly omits prosodic notation, and those systems that do not, such as the one used in conversational analysis, mainly denote “phonological” information.

Intonational and durational patterns cannot be conveniently denoted, since variations in spacing, font size etc. are easily read as marking different levels of emphasis.

Example: Leinonen *et al.* (1990) use orthographic conventions for emphasis– boldface, underline, font size– and additionally separate the syllables.

hop-pa in-te på **tå**-get när det har **satt** i **gång**.

Orthography could be replaced or augmented with transliteration, if necessary.

How to map writing to actual speech?

How do FO and duration relate to the rhythmic “pattern”?

"Emphasis and intonation"

Largo.

To be! or not to be? that is the question,
whether 'tis nobler in the mind to suffer the
stings and arrows of outrageous fortune, or to
take arms against affail of troubles, and by op-

The image shows four staves of music with lyrics underneath. Above the notes are various symbols: circles, triangles, and lines, representing emphasis and intonation. The lyrics are from Shakespeare's Hamlet. The notation is a form of musical shorthand used in the 18th century to indicate stress and pitch contour.

Steele's (1775) music-derived notation showing levels of emphasis (stress) and stylized intonation pattern.

|there is "↑BÀsically| . be|tween . thē . ↑right wing of
'low' _the ↑LÀbour PÁrty| ' |which is the of ↑ficial ↑WÍNG| and
the con|SÈrvative ↑PÁrty|....

The image shows three staves of text with musical notation above it. The notation includes vertical lines, circles, and dots, representing stresses and intonation. The text is a sentence about the Labour Party and the Conservative Party. The notation is a form of musical shorthand used in the 1960s to indicate stress and pitch contour.

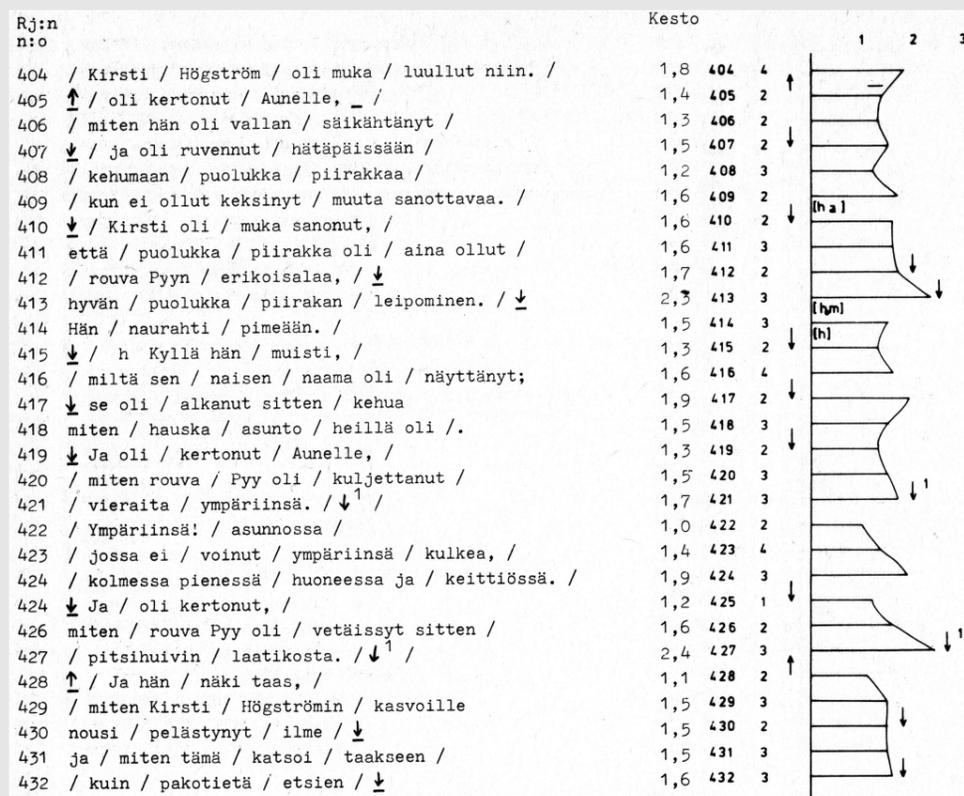
Crystal's (1969) version denotes the stresses, intonation and rhythmic grouping. It can easily be supplemented to show durational information as well (as spacing).

Fairly comprehensive visualization but may be difficult to read.

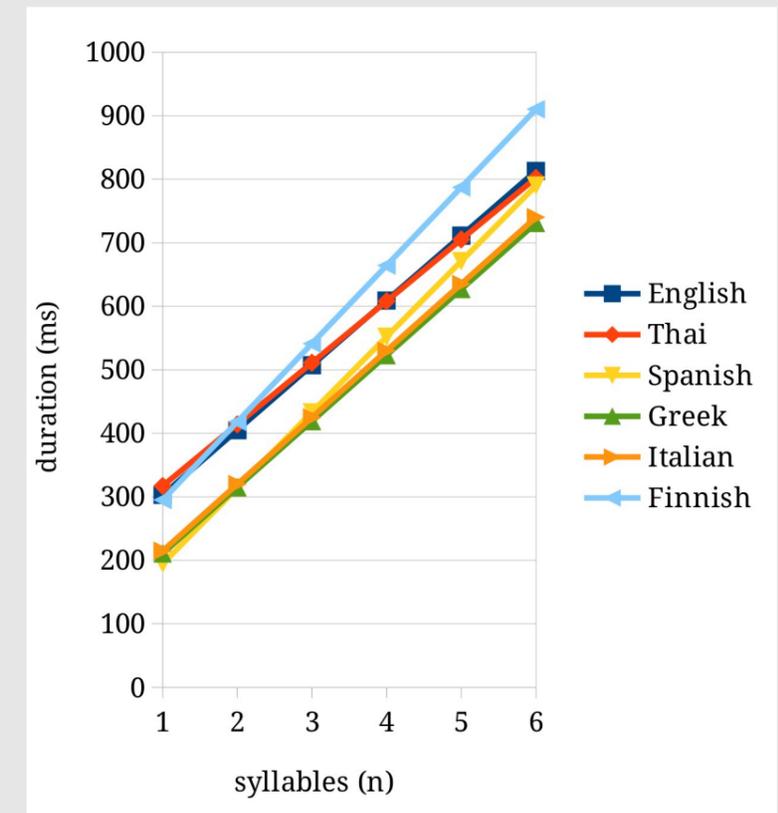
Durational graphs

Since the beginning of the 20th century duration, or timing patterns, have held the main focus in the study of the linguistic rhythm (Crystal 1969, 26). Durational graphs may be combined with any other visualization technique.

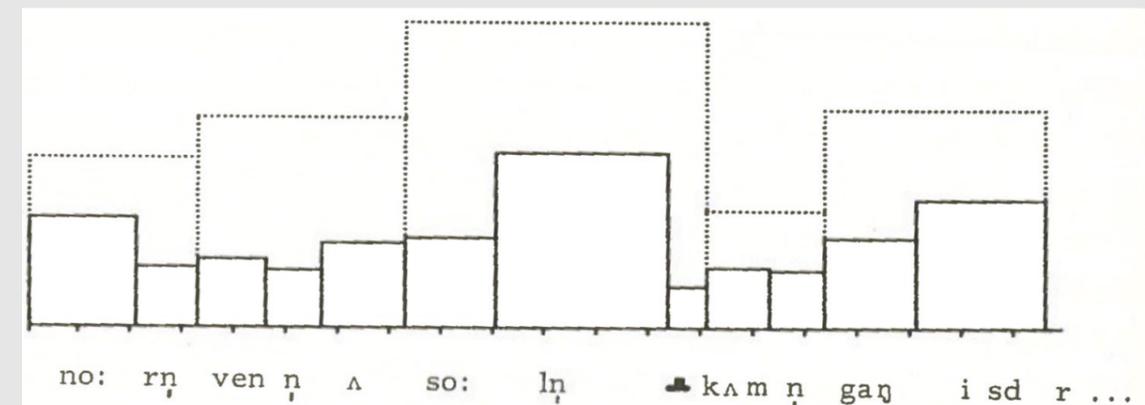
Monola's (1976) graph based on Sovijärvi's (1946) theoretically somewhat vague concepts. The patterning of different durations is intended to signify speech rhythm.



Eriksson (1991) used Dauer's data to demonstrate that stress- and syllable-timed languages really differ in duration of ISI as a function of syllables. (Finnish is added here as in Nieminen 1995.)



Gustafson's (1987) TEDAS marks duration as squares which was intended to give a better impression of speech prominences.



Metrical notation

Metrical visualization techniques mix typographical and music-derived notations. They are particularly suited for displaying poetic rhythm patternings, and according to Abercrombie, “the rhythm of everyday speech [is] the foundation of verse, in most languages” (1967, 98).

In actual practice, even musical rhythm can be and is described in many ways.

Abercrombie (1967, 98), among others, thought that adding vertical lines to mark the feet makes the regularity of the stresses more evident. (^ is a “stressed pause” or silent ictus.)

The lines are only an alternative way to mark stresses, but visually they also seem to separate the utterance into rhythmic groups.

| My | sire | ^ is of a | noble | line

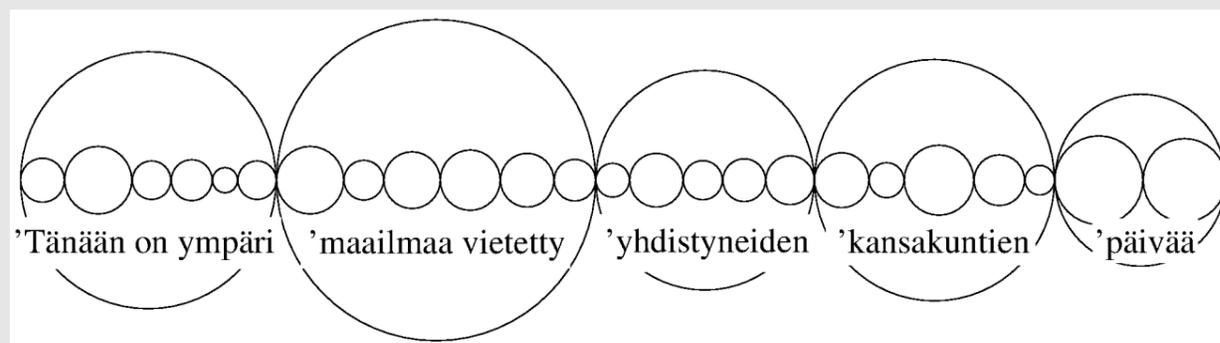
Sovijärvi (1946) combined this with italics and up arrows to point out the alternation of “strong and weak rhythm groups”:

| Onkohan kello ↑ *jo seitsemän?* |
Menen nimittäin ↑ *Kansallisteatteriin.*

Bubble charts

“Bubbles” is basically a simple modification of Gustafson’s TEDAS that uses circles (or ellipses) instead of squares.

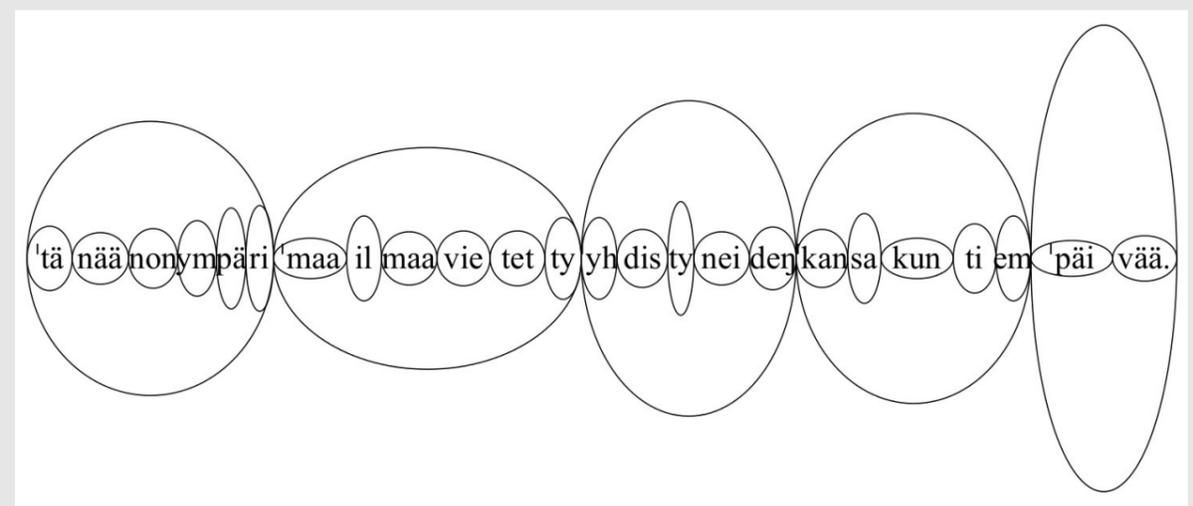
It should be fairly easy to supplement the graph with further information, say intonation patterns. The transliteration could also be more narrow, if needed.



One version: syllable and ISI durations are shown as circles with identical shape but varying area.

Another possibility is to keep area constant (for units on the same level) while allowing shape to vary.

These elastic bubbles show more clearly how units are stretched or compressed to achieve synchrony between levels (cf. Coupled Oscillator Model, eg. O'Dell & Nieminen 2009).



Conclusions & bibliography

What **needs** to be shown in an ideal rhythmic visualization? – stresses; regularities; durational information; other prosodic factors that may affect the perception of regularity? The closer you get to the ideal, the harder is it to read.

Here we have experimented with Gustafson's TEDAS and given it new life in a somewhat altered form, the "bubble model". It is hardly ideal but shows some promise.

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