

# PHONETIC AND PHONOLOGICAL COMPONENTS OF LANGUAGE RHYTHM

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## ABSTRACT

Rhythm, or the grouping of elements into larger units, is a property of all languages. The particular rhythm of a language is the result of the interaction of a number of components, including phonetic components, such as the relative length, pitch, and segmental quality of accented and unaccented syllables, and phonological components, such as syllable structure and the function of accent. A system of rating whereby these components are broken down into features which can be assigned a plus or minus value allows us to compare the rhythm of languages or language varieties. Languages which have "strong stress" or which have been labeled "stress-timed" are seen to share certain features. Rhythm is a total effect involving phonetic and phonological as well as segmental and prosodic phenomena.

## INTRODUCTION

Is it possible to develop a phonetic concept of rhythm that can be applied to all languages, in the same way that we use the system of cardinal vowels or the IPA chart of consonants? The distinction between stress-timed languages and syllable-timed languages [1, 2] is just such an effort at a general phonetic definition. In this theory, stress-timed languages show a tendency for stresses to recur at regular time intervals, and in syllable-timed languages, syllables are said to recur at regular intervals; all languages are believed to have one or the other rhythmic basis. Although many linguists have adopted the distinction, some have criticized the theory for being too simplistic (after all, it only divides all the languages in the world in half) and for grouping together languages which are felt to have noticeably different rhythms, such as English and Arabic [3] or Spanish and French. In addition, many native speakers of "syllable-timed" languages have objected to the designation, as if it somehow meant that their language had no rhythm. Indeed, Crystal and Quirk [4] refer to the lack of regular stress-timed pulses as "arhythmic." Linguists have had difficulty applying the concept to languages. Attempts to do so by instrumental analysis have been futile. Numerous experiments have shown that a language can not be assigned to one or the other category on the basis of instrumental measurements of interstress intervals or syllable durations [5,

6]. Moreover, Scott, Isard, and Boysson-Bardies [7] have shown that the perceptual tendency towards isochrony of stress beats is not specific to stress-timed languages, nor to language. Miller [8] had English and French phoneticians and nonphoneticians listen to selections of seven different languages and evaluate them as stress-timed or syllable-timed. Only Arabic was unequivocally categorized as stress-timed by all groups. Phoneticians generally agreed in finding Spanish stress-timed and Yoruba syllable-timed, but found no strong tendency for Finnish, Japanese, or Indonesian, and disagreed about Polish. This experiment seems to suggest that a language may be categorized on the basis of how strong and easily perceivable stress is.

Should we then give up the only phonetic theory of rhythm that we have, or perhaps turn to a purely phonological approach? Phonologists in the tradition of Trubetzkoy have treated rhythm in terms of the function and location of accent in the word. Metrical phonologists (following Martin [9]) have assumed that all languages have an underlying strong-weak distinction and show a tendency towards alternation which can be shown in a grid or tree structure of the word. Although this approach brings out the importance of grouping of elements into larger units, which is considered essential in all psychological definitions of rhythm, it tends to make all languages look alike, at least on paper, and makes no attempt to specify further how these patterns are realized in spoken language in continuous speech. But as Ladefoged and Wu [10] have noted, phonetic details are part of linguistics and do matter to any linguist who wants to make a complete, accurate description of a language.

It seems that an adequate description of rhythm in a language or across languages requires both phonetic and phonological information (a conclusion also reached by Hyman [11]). We can define rhythm as the grouping of elements into larger units; the units need to have some similarity and be marked off from each other in some way in order to be perceived as groups [12, 13]. In language, most would agree that the elements that are grouped are syllables, and that in some languages at least, stresses (or accents) serve to set off groups. Neither "syllable" nor "stress" have general phonetic definitions, which

from the start makes a purely phonetic definition of language rhythm impossible. All instrumental studies as well as all phonological studies have had to decide in advance where the stresses (if any) fall and what a syllable is in the language under investigation in order to proceed. Although rules for syllable division and inventories of syllable types have been worked out for many languages on the basis of phonological criteria, stress is more problematic, and definitions of it have varied widely. In this paper, I shall use the term "accent" as it has been defined by Trubetzkoy [14] as the phonological feature which when realized promotes the perception of one particular syllable (or mora) in relation to others. Accent can then serve as a basis of rhythmic grouping. The term "stress" will be reserved for the phonetic realization of certain kinds of linguistic accent. I hypothesize that all languages have rhythmic grouping, but that not all necessarily have accent. Rhythm is a total effect (also probably a grouped series of motor commands in production) that involves the interaction of a number of components, of which the following appear to be the most important for the purposes of comparing languages. It is most evident in continuous speech through the repetition of rhythmic groups at a natural speed for the speaker. Obviously, some speakers and some styles exhibit better rhythm than others and seem to be more representative of a particular speech community. The following analysis is based on the "consultative" style [15] of informal lectures, monologues, or prose reading by people who are used to reading aloud. In each category, a plus, zero, or minus is assigned to a language depending on the extent to which it exhibits the feature in question.

#### COMPONENTS OF LANGUAGE RHYTHM

##### 1. Length

###### Duration

+ Accented syllables, and especially accented vowels, are regularly longer than unaccented syllables (by 1.5 or more). (e.g. English, Serbo-Croatian)

0 Accented syllables are slightly longer than unaccented syllables. (e.g. Spanish, Greek)

- Accent does not affect the length of syllables, or the language has no accent. (e.g. Japanese, Yoruba)

###### Syllable Structure

+ The language has a variety of syllable types (both heavy and light syllables with many different possible syllable structures), and heavy syllables tend to be accented, whereas light syllables tend to be unaccented. (English, Arabic)

- There are a very limited number of syllable types (predominantly CV or CVC), and accent and syllable weight are independent. There may be active processes such as final cluster simplification, epenthesis, or liaison to break up or prevent the formation of unusually heavy syllables. (Spanish, French)

###### Quantity

+ Quantity distinctions, if present in the language, are only permitted in accented syllables; in unaccented syllables they are neutralized (only short). (some Arabic dialects)

0 All quantity distinctions occur in accented syllables, but only a small subset can occur in unaccented syllables. (Estonian)

- Quantity distinctions are permitted in both accented and unaccented syllables. Restrictions on quantity are not conditioned by accent. (Hungarian, Finnish)

##### 2. Pitch

###### Intonation

+ Accented syllables are turning points in the intonation contour. Pitch (usually high or changing) correlates with accent, but the actual pitch contour depends on the position in the utterance and the intonational meaning. Emphasis or contrast affects primarily the accented syllable. (English, Greek)

- Intonation and accent are independent; there may be a negative correlation of pitch and accent. Relative pitch patterns may be consistent with respect to the word regardless of its position in the utterance or intonational meaning. Emphasis may affect unaccented syllables or be achieved by other means. (French, Japanese)

###### Tone

+ Tones, if present in the language, only exist on accented syllables; unaccented syllables are atonal. (Swedish)

0 Tones are fully developed on accented syllables, but they are neutralized or subject to numerous changes (sandhi rules) in unaccented syllables. (Thai)

- Tones are present on all syllables or all syllables with a particular structure, regardless of accent. If there are sandhi rules, they are not related to accent. (Yoruba)

##### 3. Quality

###### Vowels

+ The maximal vowel system exists in accented syllables; vowels in unaccented syllables tend to be reduced or centralized (especially open vowels). (English, Swedish)

0 The unaccented vowel system is smaller than that of accented vowels, but unaccented vowels are not necessarily centralized. There may be processes of devoicing or raising which occur only to unaccented vowels. (Russian, Portuguese)

- There is the same vowel system and similar articulation in all syllables. If elision or devoicing processes exist, they affect accented and unaccented vowels equally and are determined by phonetic environment rather than accent. (Spanish, Japanese)

###### Consonants

+ Consonants are more precisely articulated in accented syllables, and some may have special reduced allophones (e.g. syllabic consonants, loss of aspiration) or be subject to neutralizations in unaccented syllables. (English, Thai)

- All consonants have the same articulation regardless of accent. Consonantal allophones are not conditioned by accent. (French)

##### 4. Function of accent

+ Accent can occur in different positions in a word (accent is "free" or free over a range) and is an integral part of the word shape for recognition. Moving the accent could result in a new word with a different meaning. (English, Spanish, Swedish, Russian)

0 Accent can occur only in one position in a word (accent is "fixed," typically on the first syllable). Moving the accent or adding an accent could result in the formation of a new word boundary. (Hungarian)

- There is no word-level phonological accent; no one syllable consistently stands out over others in a word. Accent can be moved for stylistic or emotional reasons (in a language with a phrasal accent), but moving the accent does not result in a change in referential meaning or the establishment of new word boundaries. (Yoruba, French)

##### CONCLUSION

By applying these categories to various languages, one should be able to come up with a comparative rhythm "score." The more pluses a language has, the more likely we are to say that the language has "strong stress" ("dynamic" or "expiratory" accent) and is "stress-timed." The differences between accented and unaccented syllables are maximized, and accent would clearly be the principle for grouping. We would expect that naive native speakers—as well as trained non-native speakers—could fairly consistently identify accented syllables in continuous speech. In a language with many minuses in these categories, we would have to look elsewhere for the principle of grouping: what is it that permeates the entire linguistic system, binds units together and helps listeners segment the flow of speech into meaningful chunks? It could be patterns of tone, of syllable or vowel length, or even the repetition of certain segmental or grammatical features. Although the language may have some kind of accent, naive native speakers would have difficulty identifying the place of accent consistently in continuous speech, and linguists would have difficulty finding its acoustic correlates, even in words said in isolation. This does not necessarily mean that this kind of language is somehow defective or arhythmic because it is lacking a feature that certain prestige languages have. All languages have rhythm, but more independent research needs to be done to discover exactly what the rhythmic principles are in languages which do not show a tendency towards "stress-timing."

The above chart would also be useful in comparing different styles, dialects, or historical stages of a language. Rhythm can be significantly changed, for example, by pronouncing every syllable distinctly in a language which has vowel reduction rules (Jamaican English). Non-native speakers of English can improve their rhythm enormously by reducing unstressed syllables, and this is usually more successful than trying to get them to equalize stress beats. In comparing the naturalness of synthetic speech samples, Carlson, Granström, and Klatt [16] concluded that "the amount of isochrony implemented in the rules via, e.g., cluster shortening and unstressed segment shortening is probably sufficient, and no 'isochrony rule' per se need to be added." We must not forget that the division into segmental and prosodic phenomena is an abstraction created by linguistic science for the purposes of analysis. In early stages of language acquisition, Crystal [17] aptly notes that primitive words are used as units "with the segmental and non-segmental characteristics 'fused'." Even in adult language, segmental and non-segmental phenomena are interdependent and can influence one another. This fact is quite evident in the analysis of tone languages. It is also important in helping us to better understand language rhythm.

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