Studies of the tonal-rhythmic structure of disyllables in Yoruba (as the basis of syllables) make it possible to suggest a general pattern of the linguistic arrangement of tones and also to formulate the basic rules governing tones in this unit of speech.

The method of synthesis used in linguistic studies makes it possible to approach many linguistic problems at a qualitatively new level. In coping with these problems researchers nevertheless need to know the so-called phonetic characteristics of speech which prototype. The method of synthesis, i.e., the formulation of the basic rules which concern disyllables, the minimal lexical unit in which the basic tonal-rhythmic structure is regulated by the rules of sandhi are manifest, has been chosen as the lingustic material in studying the tonal-rhythmic structure of Yoruba. In view of the fact that latest works on tones in Yoruba usually single out three tones, namely, medium, low and high (designated M for medium tone, L for low tone and H for high tone), nine tonal-rhythmic models of disyllables have been chosen for investigation: M+M, M+L, M+H, L+M, L+L, L+H, H+M, H+L, H+H.

In studying the tonal-rhythmic models of great interest are phonetic segmentation in which tones are joined together because it is precisely there that they are "adjusted" to each other, coordinating in a certain way the contour, register, and amplitude characteristics. The junctures of tones manifest most graphically the parameters that organise the tonal-rhythmic model as a certain semantic unit of the given linguistic system. It should be stressed that for the tonal-rhythmic structure to be modelled successfully it is necessary to take into consideration not only the contour and register parameters but also equal measurement amplitude, time, and interval parameters which, interacting with each other, alone can ensure that the given simulated tonal-rhythmic model is fully or at least partially associated with native speakers with its natural tonal-rhythmic model as a certain semantic unit of the given linguistic system. Therefore, it is necessary to know the so-called phonetic characteristics of speech which prototype.

The peculiarity of the M+M tonal-rhythmic model consists in the fact that its contour is formed by two even tones, without any frequency break at the beginning of the frequency of the end of the first syllable. The interval between the syllables in medium and high tones is equal in every tonal-rhythmic model, the auditors observed it with different frequency contrasts and without these at the juncture of syllables. The synthetic models identified only rhythmical characteristics of the medium tone in the first syllable in the correlation of the frequency of the end (medium tone) and of the beginning (low or rising high tone), with the indispensable prerequisite being the absence of any frequency break at the juncture of tones. Several variants of (M+M and M+H) types of models with different frequency contrasts and without these at the juncture of syllables have been synthesised to verify this hypothesis. The auditors identified only those of the synthesised (M+L and M+H) rhythmical models which had no frequency rupture between the syllables and also those with the minimal frequency rupture (not longer than a second). The rest of the synthesised models were identified incorrectly. The second-long interval of the frequency of the syllables between the syllables can, apparently, be considered admissible, whereas a longer one places these rhythmical models out of the range of rhythmical models.

The peculiarity of the M+M and M+L tonal-rhythmic models consists in the fact that for the combination of the medium tone and the low tone, the frequency relationship between the syllables, the auditors described the sound as "rhythmical", "exaggerated", or too "even". The medium tone was either formed of two even tones belonging to different registers or the medium tone was split into two even tones or the medium and low tones. For the low tone the register was determined by the frequency relationship between the syllables and was perceived as a combination of two syllables with the same frequency relationship between the syllables, the auditors identified them, for example, as a combination of two high tones. The determination of the frequency relationship between the syllables, the auditors described by the medium tone in disyllables suggests a certain strategy of synthesis, i.e., the creation of an exact time relationship between the medium tone, on the one hand, and the high and the low tones, on the other.

Our experimental material included cases of the synthesised medium tone being identified as a combination of three parameters -- the interval of the modification of F0 in V2, the medium value of F0 in V2 and the frequency breakages between the end (M+M) and beginning (M+L) of the set of functional features, treating amplitude and time characteristics non-functionally. It is apparently indisputable that the function of the tonal-rhythmic model is capable of distinguishing one tone from another in the final position by the features mentioned by Hombert; however, they are inadequate for the synthesis of rhythmical models from the point of view of rhythmical models which strictly reproduce all the rhythmically important contour interval and time parameters and deliberately distorted only the amplitude parameters. After listening to the sounding of these models, the auditors observed that they could hardly be considered as normative.

Analysis of tonal-rhythmic models with the medium tone (M+M, M+L, M+H) shows that it is most stable rhythmically in all the combinations with other tones and retains the even contour as its own duration and medium register (with respect to other tones within the three-level register scale). The Yoruba register scale for male voices close to baritone tenor can be conventionally divided into three ranges: low, medium, high.

90 - 115 Hz 120 - 160 Hz 165 - 200 Hz
The specificity of the M+M tonal-rhythmic model consists in the fact that its contour is formed by two even tones, without any frequency break at the beginning of the frequency of the end of the first syllable. The interval between the syllables in the medium tone and low tone is equal in every tonal-rhythmic model, the auditors observed that the medium tone is most stable rhythmically in all the combinations with other tones and retains the even contour as its own duration and medium register (with respect to other tones within the three-level register scale). The Yoruba register scale for male voices close to baritone tenor can be conventionally divided into three ranges: low, medium, high.
as a sort of a crucial point, beyond which these models disintegrate. An analysis of the rhythmic structures of the HiH tonic model is growing amplitude when the high tone is set against a medium tone with an even contour. Analysis of the medium tone showed a slight amplitude, and there was a slight increase in the second syllable (comparable to the first one) apparently complements the even contour and a similar correlation of these acoustic parameters will produce a significant frequency breakage in the high tone effect in the given tonic-rhythmic model for the native speakers of Yoruba. The natural question arises about the functional importance of each of these parameters for the high tone to be perceived unambiguously. With this aim in view several models were synthesized, with only one parameter changing in every one of them, so as to produce a growing intensity. For example, in one case the first and the second syllable had equal amplitudes, in another the amplitude of the second syllable was, on the contrary, increased but there was no register contrast between the medium and the high tone and in still another the first syllable had a bigger amplitude compared to the second syllable. The sounding was repeatedly recorded and offered for auditing at random. The results of the auditory analysis show that none of the acoustic parameters can be singled out as a factor determining the rhythm of a given model. It is rather the combination of these features that accounts for the certain stability of the rhythmic model in any contextual conditions.

Another type of tonal-rhythmic models (HiH and HiL) is formed by an even (in the first variant) or falling (HiL) contour in the second syllable. The factor important from the point of view of rhythm in this type of model is the rising or falling intervals, which begin at the frequency level of the end of the medium tone. In all the rhythmic structures of this type the interval between the medium, the high and the low tones is the range from a minor third to a fourth. It should be pointed out that the register frequency rupture in the first variant of the HiL and HiL tonic models is always set against the low tone with an even contour and that this interval decreases by a minor third and not more than a fourth because the sound of the high tone is above the low tone. The register frequency correspondence in the same models (/- and \)/) has one and the same meaning that with an interval exceeding a fourth in the high tone effect on the entire disyllable, the frequency correspondence in the set against the low tone in the final position becomes no longer possible to be perceived as a register contrast in Yoruba. This phenomenon principle underlying the rule of the frequency correspondence of high tones elucidates both the general mechanism of the interaction of tones in rhythmic models covered by the rule of register-contour oppositions and any particular manifestation of this general regularity. This ensures the necessary stability of tones and prevents their confusion in any contextual situation.

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Studies of the tonal-rhythmic structure of Yoruba words (analysis and synthesis on the basis of disyllables) make it possible to suggest a general pattern of the rhythmic arrangement of tones and to formulate the main rules of the fundamental governing tones in this unit of speech. The interaction of tones in disyllables is based on three major rules: one of them — the rule of register and register—contour oppositions — operates in all the rhythmic models and their possible variants, while the third rule — the register—contour oppositions of the second syllable that fall under the rule of register—contour oppositions. The specificity of the rhythmic organization of disyllabic Yoruba words consists in the fact that in one and the same model tones intersect differently, depending on the context, for which reason one of the variants of the model can fall under the rule of register—contour oppositions, while the other variant under the rule of register—register oppositions. For example, a variant of the model "H-L" with a medium tone in both syllables of a disyllable sounds high in disyllables, while its other variant "H-H" is governed by the rule of register—contour oppositions and falls under the rule of register—contour oppositions. The rule of register—contour oppositions is regulated in the interaction of tones in tocinal-rhythmic models by the close (in some cases) and distant (in different frequency levels in disyllables) register correlation in the set against the low tone in the final position. The rule of register—contour oppositions regulates the interaction of tones in tocinal-rhythmic models in the set against the low tone in the final position, whereas the register correlation in the set against the low tone in the final position is justified when this tone is contrasted with a different one, say, medium.