Scale Hierarchies and Culture-Historical Universality

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The application of information theory and statistical methods to the study of art phenomena may be quite successful if its purpose is to study information processes accompanying aesthetic perception, rather than reduce art to an abstract communication system. Quantitative models are to extend the range of expression means available to artists and indicate essentially new possibilities — but never replace artistic creativity by computer simulation. One of such models is presented in this paper. Being based on the idea of informational comparison of elementary conceptions (subjective representations) proposed by G. A. Golitsyn [1], this model is more than just a quantitative extension of the scheme, since it pays particular attention to the qualitative differences between the distinct levels of human activity.

Artistic creativity and aesthetic perception are hierarchically organized. However, in different situations and aspects, this hierarchy may unfold itself differently, manifesting various hierarchical structures [2]. A quantitative model built in the framework of hierarchical approach has uniformly described all the variety of scale phenomena in music, including the historical development of scales along a number of cultural lines [3,4]. The model shows the ways of the formation of coherent collections of pitch zones (scales) containing a number of subscales, some of which may, in a definite context, play the role of modes, while some other may be related to harmony. The theoretically calculated parameters of the structures can be used to predict the principal features of music based on a particular scale, allowing to particularize and extend the set of expressive techniques established in the musical practice. The important corollary of the theory is the relativity of consonance and dissonance, since the quality of a sound depends on the perceptive adaptation to a specific collection of pitch scales.

The development of the psychological side of the theory along the line of the well-known A. N. Leontiev's theory of activity has discovered analogous mechanisms in visual form perception, thus leading to the visual analogs of pitch scales [5,6]. Thus, the curves in the plane have are akin to the melodic movement, while plane figures resemble the chords. Both the discreteness of the set of distinguishable objects and the possibility of expressive variations within the respective zones have been preserved in this way. Of course, the difference in the "material" makes the perception of intrinsically similar aesthetic phenomena apparently different; moreover, the activities underlying the formation of graphic and pitch scales are analogous in a limited region only, albeit rather large.

The parallels in the development of pitch scales and graphic scales indicate that the processes of the same level usually coexist in every particular culture, so that the mode of pitch perception correlates with the mode of visual form perception in any historical period. One might expect such correlation for all the other forms of aesthetic perception, which would support the hypothesis that cultural development must generally proceed though an objective sequence of stages, which are called *culture-historical* (or simply *cultural*) *formations* [5]. Within a definite cultural formation, the ways of people's interaction with their material and social products are relatively uniform, while the change of cultural formation is associated with a significant shift in people's spirituality. The process of the development and alteration of cultural formations is relatively independent of economic and social development, being intrinsically related to it.

The preferable usage of particular scales may be an indicator of the stage of cultural development. If a zone structure has formed in a certain area of perception, it may be transferred to any other areas, thus becoming a universal categorization base. In this sense, one could speak of "pentatonic" or "diatonic" culture, and the quantitative analysis of a single aspect of the spirituality of some historical period (e.g. its art) may provide information on the culture as a whole.

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Graphic analogs of pitch scales originate from the similarity of the schemes of a certain activity, namely, one-dimensional categorization. The perception of such parameters as color, or timbre, is known to be essentially many-dimensional, so that a direct correspondence with pitch perception seems problematic. However, according to the principle of the universality of hierarchical scaling, one may suppose that color perception should pass the stages similar to the levels of pitch perception, with the formation of analogously organized scales (zone structures). Psychophysical and psycholinguistic experiments reveal relatively few basic categories in color perception, which do not directly correlate with the spectral characteristics of light and cannot, in general, be linearly ordered. The experience of conform transformations of abstract paintings acquired by the author together with French artist Guy Levrier [7] supports the discreteness of the set of qualitatively different variations and its zone nature.

One might conjecture that the informational mechanism of one-dimensional categorization is the key to the development of any other categorization schemes, the formation of relatively complex forms being mediated by the cultural crystallization of one-dimensional scales, establishing them as a kind of standard. This may be the cause of a delay in the development of zone structures in color perception as compared to the development of pitch or graphic scales.

Literature is one more branch of art where scale-like zone structures can be discovered. The artistic usage of language is different from that of everyday life, science or philosophy. The conceptual basis of speech would not dominate here, and the main function of language in the arts is to produce forms. Thus, for instance, poetry intensely exploits the phonemic side of speech, so that it is often more important how it sounds than what it means in a verse. The transition to the internal speech makes semantics rather than voicing the material of art, and the zone structures arising here are similar to those discussed above. This level often dominates in prose.

Semantic discreteness is apparent in epic genres: as a rule, the narration centers on a few main characters interacting through the typical positions in a number of standard situations. A literature type is a zone of possible variants of behavior, and the violation of zone boundaries (non-typical behavior) is much like the chromatic function of dissonance in music. Of course, the semantic scales of modern literature are much more diverse than those of the past, and what might look a strong dissonance then may be accepted as quite common today. Many-thread organization and sharp conflicts of the modern prose perfectly match the complex textures and chromatic tenseness of modern music. On the contrary, a folk tale is marked by strict "diatonicity" (or even "pentatonicity"), and non-typical behavior of the characters is practically impossible in it. Modal lability of the pentatonic and diatonic scales correlates with the typical construction of the traditional epic, with its arbitrary concatenation of events assuming no beginning or end and lacking global tensions.

Naturally, there may exist more abstract zone structures in speech, with the transition from the semantic to symbolic level. The examples of various symbol schemes are well known in the literature.

External (uttered) speech is also the unity of discreteness and continuity. Phonemics typically describes a kind of "articulation zones", when distinct states of articulation organs form a basic set of phonemes, of which more complex speech units are constructed. As in music, where the intonation may vary through an alteration of pitch within a zone, each phoneme is represented by a large variety of allophones in speech. However, linguistic tradition is to consider the set of phonemes as pre-defined and constant. The development of phonemic systems is usually treated as mere transition from one subset of the complete phonemic system to another, with a simplification and roughening of some "primary" set, which could be "reconstructed" using the well-developed methods.

Phonemic evolution looks quite differently within hierarchical approach. Thus, pitch perception developed from mere distinction of a few zones to pentatonic and diatonic, and then to more complex structures. In the same way, primitive languages could not have any regular phonemic systems, and all they had was very few phonemes with extremely wide zones; it is much later, with the formation of more refined perceptive scales, that the number of distinguishable phonemes has increased. The zones of vocals were formed first in this process, since vocals are closer to the musical sounds, though based on a different (timbre, format) mechanism of hearing. One might state with much certainty that the appearance of written language in Europe should be referred to the "pentatonic" stage of phonemic development, since five basic vocals have been fixed in the ancient alphabets, and further phonemic differentiation resulted in that new phonemes either were not reflected in writing al all, or were

denoted by the combinations of the already existing characters, just like the traditional musical notation bears the diatonic stamp and cannot always meet the demands of modern music.

An important implication of the finite number of allowed structures is that they may historically appear in non-communicating phonemic systems. Traditionally, phonemic parallels in different languages has been considered as a sign of kinship, while hierarchical approach allows phonemic correspondences due to the common laws of structure formation, just like various kinds of pentatonic and diatonic scales were independently discovered by quite different peoples.

The comparison of a phonemic system with a musical scale brings a new insight into the organization of poetical speech. It is commonly known that poets pay special attention to the selection of words and their placement within the verse. Still, it is rhythmic regularity that is generally recognized, while the sounds are treated as accessory, enhancing or masking the rhythm. Such techniques as assonance, alliteration, anaphor and epiphor, phone contraction or avoidance are often described as formal tricks irrelevant to the versification proper. The theory of hierarchical scaling helps to appreciate the role of poetic phone-writing, occupying the central place in poetry. Purposeful phone arrangement makes the speech a verse even in the absence of any elements of "poetical" rhythm, like strophes, rimes, metrics, regular caesurae, intonation repetitions etc.

I suggest that the alteration of vocals in the verse is analogous to the melodic movement in music, while the consonants *articulate* this alteration, like instrumental timbres demarcate musical sounds, or determine the way of performance of the poetic "melody" (dynamics, hues, strikes etc.). This hypothesis is supported by the practice of poetry, as well as by the observation of such phenomena as purely expressive "cartoons" language, projection of speech onto a different language, or transcriptions of poetic texts in various phonemic environments. Despite the essential one-dimensionality, the examples of harmonic thought can be found in poetry as well.

Thus, the hierarchical model of zone structure formation in aesthetic perception gives a novel look to a number of art phenomena already established and predicts new experiences in the arts. The simplest informational mechanism lying in its foundation is not sufficient for that on itself, and the consideration of various reflection levels is required. Still, informational methods and quantitative models are quite possible in this area too, if historical development of different cultures is accounted for.

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