Gestalt Phenomena in Musical Texture

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Abstract. We attempt to examine textural phenomena and their significance in music, by comparing and contrasting texture with timbre and *learned schemes*. The latter are the main subject of musical theories and relate to organizations of parameters (particularly intervals) in a quantitative, measurable form not suitable for describing texture. We extend the definition of texture to cover principles of organization that need qualitative or statistical tools in order to be described. The following points will be addressed in this study: (i) Principles for classification of texture. We suggest textural schemes pertaining to registers of all the parameters, to contours, and to operations. (ii) Combinations of textural schemes with learned schemes. (iii) The relationship to the stylistic ideal. Our assumption is that all of the schemes are selected so as to fit the stylistic ideal, and most of them (even the *learned* ones) are not arbitrary and are subject to psychoacoustic and cognitive constraints.

1 Introduction

In the present paper we attempt to understand the manifestations and significance of texture in music in contrast to other parameters, bearing in mind Gestalt principles and the stylistic ideal [1], which varies from culture to culture and from era to era. Most of Western tonal music theory relates to learned schemes that coalesce on the cognitive level (scales, chords, certain forms, and so on), whereas texture is considered subsidiary – a factor that "cannot exist independently" (Levy, 1982, p.403). Very little direct attention has been paid to the meaning of texture in Western tonal music, and the available studies on the subject (Levy, 1982; Lorince Jr, 1966; Ratner, 1980; Rothgeb, 1977) address mainly the parameter of pitch.

In the music theory of non-Western cultures, texture (in the sense used here) is often an integral part of the learned schemes. Moreover, Lomax (1968, 1977), in his extensive study that compared 400 musical cultures in order to

[1] The stylistic ideal, which can be thought of as a message that shapes the style, has been called by various names such as *ideal*, *ideology*, and *poiesis*. In our opinion, the stylistic ideal can be characterized by four main variables: (1) connection/lack of connection with the outside world; (2) expression of calmness vs. excitement; (3) focusing on the moment vs. the overall structure; (4) clear or blurred units and directionality.

expose possible links between sociocultural and musical characteristics, relates in fact to the manifestations of timbre and texture (without mentioning them explicitly) rather than to interval systems. In twentieth-century music, especially when it lacks learned schemes and is based on timbres and textures only, texture is addressed not only by researchers (Lansky, 1974; Goldstein, 1974; Czink, 1987; Scolnic, 1993), but by the composers themselves (Varèse, 1967; Stockhausen, 1957; Boulez, 1971; Ligeti, 1993).

There are even studies dealing with the formulation of textural phenomena on the acoustic level in electronic and computer music (Smalley, 1986; Czink, 1987). Nevertheless, no conceptual framework has been laid out for understanding texture in all its manifestations, and certain questions arise:

- Is it at all possible to develop a suitable definition for texture that would encompass all its manifestations?
- Can one speak of Gestalt phenomena, that is, the existence of units or schemes, in texture?
- What is the role of texture in relation to the other parameters in various styles?
- Is texture of significance for the stylistic ideal? In what way?

2 Proposal for Characterizing Textural Phenomena by Comparison

2.1 Comparison of Texture with Timbre and Learned Schemes

Texture, as we define it, can be viewed as a superparameter that is related to various combinations of other parameters. In the most general sense, textural phenomena are familiar to us from nature as psychoacoustic factors that evoke various emotional associations.

Music in a given style contains two kinds of information: one having to do with learned schemes and the other with textural information. The relationship between the two is one of the characteristics of the style.

Just as the most general definition of timbre is based on negation of the other parameters, here, too, we define texture as a principle of organization that is not derived from learned schemes that have coalesced on the cognitive level and that differ from culture to culture. Positively speaking, in the most general sense we can define texture as the way of distributing the sound (of defined or undefined pitches) in the dimensions of frequency, time, and intensity. This definition also holds true for timbre, but texture is divisible and refers to longer durations than does timbre. Timbre can be defined even for a duration of approximately 20 milliseconds and is indivisible when we hear it, despite its extreme complexity. Texture, on the other hand, requires some separability along the frequency or time axis; a single-note event has no texture.

Another property of texture is that it is not well defined quantitatively. By contrast, in most pre-twentieth-century styles the parameters (intervals, rhythms, and meters) are not only defined quantitatively but also belong to systems of learned schemes that serve as building blocks for the musical organization of the particular style.

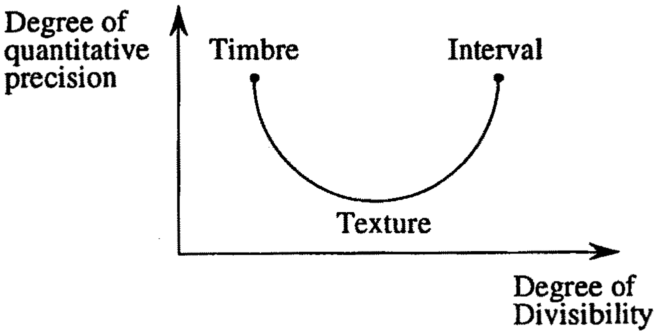

Fig. 1. Texture is contrasted both with intervals and with timbre with respect to the degree of quantitative precision. It is situated between them as far as degree of divisibility is concerned

Difference in learned schemes refers to quantitative difference. For example, the major scale differs from the minor scale in the sizes of three intervals, whereas in texture the important factor is the relative relationship of greater than, less than, or equal to. It refers to the direction of change and not its exact magnitude. We have termed such a relationship a *type*. Type relationships can appear in many forms. For example, a *metric type* is poetic meter, which, unlike musical meter, is not well-defined quantitatively; *type of intonation* characterizes the scale skeleton of Arab singing in practice (Cohen, 1969). Each musical realization of texture is a manifestation of a certain *type*, and conversely, each *type* has many realizations, with the typical ones having high probability of occurrence. Thus, one might speak about texture either as a probability distribution P that underlies a certain type, or look at a typical musical example as a representative of that type. We can measure the difference/similarity by using probability separability measures $D(P_1, P_2)$, which measure the *distance* between distribution functions P_1 and P_2. Such measures are widely used in the pattern recognition literature, and we will not discuss them here.

2.2 Analogy to Speech and Bird Calls

Comparisons and analogies between music and speech have been offered from various perspectives. Here we wish to propose an additional analogy between

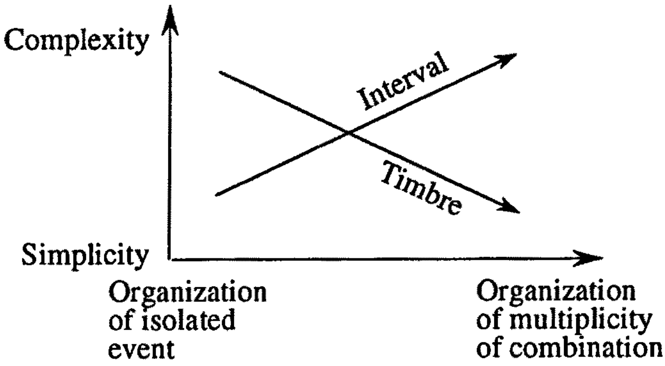

Fig. 2. Intermediate states between texture and interval are arranged along the definability axis of difference/similarity. One pole represents a system of coherent, well defined intervals, whereas the other represents textures defined by *type* relationships

two complementary pairs: learned schemes/texture in music, and lexical stratum/prosody in speech.

The stratum of prosody, or the *musical factors* in speech – called *intonation* in linguistics (Bolinger, 1972) – has two functions: (1) to represent the laws of syntax; and (2) to convey the speaker's attitude to the listener and to what he or she is saying – that is, to convey emotion. Texture in music has the same two functions: (1) *syntactic* – to clarify or blur the musical structure based on learned schemes; (2) to convey emotion, that is, to characterize the musical expression in terms of extra-musical factors. From the standpoint of the psychoacoustic parameters, the musical factors in speech are represented by the texture, that is, the distribution of loudness, duration, and pitch (without reference to precise quantitative magnitudes). Like the texture in music that may or may not concur with the learned schemes, the musical factors in speech may or may not be correlated with the message contained in the lexical stratum[2]. They can also appear as an independent message, as in various nonverbal exclamations. Many experiments have been done in this field (Fónagy & Magdis, 1972), and the findings of these experiments indicate an interesting regularity in the expression of emotion by means of the prosodic level of speech. This regularity has served as a basis for formulating the laws of Palestrina counterpoint, in which the stylistic ideal calls for calm (Cohen, 1971). Moreover, in comprehensive studies of bird calls, we have compared their calls to the musical features of speech, although they have no lexical

[2] Try saying "I'd like to see you" twice – the first time emphasizing the semantic content, the second time emphasizing the opposite meaning, in other words, "go to hell!"

stratum. Interestingly enough, the universal principles of tension and relaxation that determine the laws of Palestrina counterpoint (and not only them, of course) also apply to bird calls in different situations (Cohen, 1983) (for more details, see Fig.9).

2.3 The Contribution of Musical Timbre, Interval, and Texture to the Static and Dynamic Poles

One of the characteristics of a piece of music is its relationship to the time axis, which extends between two poles: one representing the sense of *flow* and directionality that accompanies a series of musical events (typical of Western tonal music), the other representing the sense of focusing on the present moment. Aspects of music that are related to these poles have been given various names: vertical/horizontal; inside time/outside of time and space/time (Czink, 1987); material/structure (Cage, 1966); local/global; momentariness/overall directionality and complexity (Cohen, 1994). Here we shall call this pair *static/dynamic*. Although these features of music with respect to time cannot appear independently, relations between them vary enormously, reflecting one of the important characteristics of a given stylistic ideal. Indeed, the importance of focusing on the moment has been stated explicitly both in non-Western cultures (Chou, 1970) and by twentieth-century composers. We should also note that many twentieth-century compositions are based, consciously or otherwise, on the compositional principles of non-Western music (Chou, 1974). With regard to the possibilities for simple or complex organization in the short or long term, the most prominent representative of the static pole is timbre, which is also significant as an isolated event. In contrast, the most prominent representative of the dynamic pole is the interval (under certain conditions), whose significance stems mainly from its context and which serves as a foundation for many learned schemes that contribute to directional flow.

Particularly noteworthy is the contribution to the static pole of the *borderline states* (as we shall see below) between texture and the other parameters. Texture can be placed between timbre and intervals in terms of the static/dynamic and other aspects, as we shall see below (Fig.4).

3 Borderline States

Due to psychoacoustic constraints (which determine thresholds for our ability to make distinctions), there are borderline states for various musical parameters and texture. In these states, either the parameters cannot be distinguished quantitatively, so that they approach texture; or there is textural change but its direction cannot be identified (producing a sensation of random change). Alternatively, there may be no differentiation between simultaneous textural events. In all these states, the degree to which events can

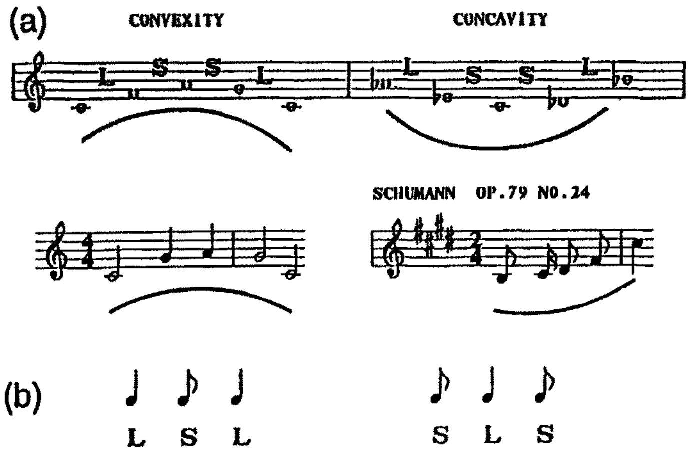

Fig. 3. Inverse relationship between interval and timbre: interval (simple as an isolated event) allows for the most complex organization, while timbre (highly complex as an isolated event) does not allow for a clear and complex organization

be defined is small. There are many levels of borderline states. In the most general terms we will distinguish between relatively stable situations and the various borderline states.

3.1 Borderline States between Texture and Timbre

In borderline states between texture and timbre, on the one hand we cannot detect the texture due to psychoacoustic constraints, and on the other hand we are able to sense the changes that occur within the timbre. The latter occurs in continuous sounds or notes: either when the attack phase is relatively long and the changes in it are meaningful to the listener, as in artistic singing (Rapoport, 1997, this book), or when significant continuous changes in timbre take place throughout the the envelope, as with a bell, or other idiophonic instruments. Note that in ancient China when one spoke of the meaning of a single note, one was referring to the constantly changing idiophonic sound. Texture can thus be regarded as an expansion of timbre, and conversely, timbre can be viewed as a borderline case of texture, with a gray area between them (Fig.4). There are even situations in which an event is perceived both as texture and as timbre – for example, a chord whose components we can identify, is defined by the texture (chords that are open or closed or in different inversions) as well as by the timbre (major or minor, or even the timbre of a particular inversion, in addition to the timbre of the instrument on which the chord is played).

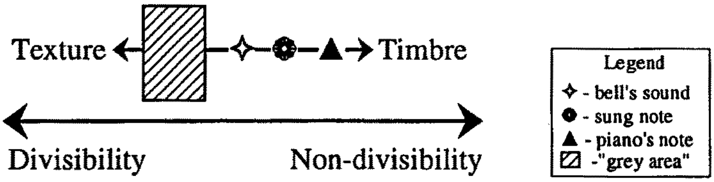

Fig. 4. Examples of borderline states between timbre and texture, when we sense changes in timbre

3.2 Borderline States between Texture and other Parameters

As between timbre and texture, there are also borderline states between texture and intervals and between texture and rhythm. These are the situations in which small or rapid changes occur in pitch or duration, and psychoacoustic constraints prevent clear identification of the pitches, the intervals, or the rhythm. Situations in which intervals turn into texture are intentional in many non-Western musical cultures, as well as in contemporary music.

4 Classification and Schemes of Texture

Three main factors may produce cognitive units: (1) a scheme or Gestalt principle that fuses a collection of events into a unit; (2) a repetition of the collection (A, A, A); (3) a substantial difference of the collection from the surroundings. Learned schemes serve as a unit-forming factor on various levels. With respect to the texture, too, as we shall see, there are some *natural* schemes that combine to form a single unit. Here we shall try to *classify texture by the nature of the events and the manner in which they are distributed*. The distribution will be classified as follows: (1) static distribution – by the range of occurrence of each parameter, based on segregation into separate horizontal layers and the range of scatter in each layer; (2) dynamic distribution – by the curves of change of the different parameters in each layer and between layers, with or without concurrence between the curves. Thus, texture may appear in a single layer with regard to all parameters or in many; without change along the time axis or with a great deal of change, producing numerous musical units of varying degrees of definability.

The nature of the events will be classified as follows: (1) by their stability or definability, from events made up of separate, well-defined elements to events in various borderline states (described above), distinguishing between different degrees of randomness; (2) by connection or lack of connection between the texture and learned schemes. Below we describe the various classifications and their meanings.

4.1 Classification of Textural Events by their Stability

This classification is by the degree of separability or inseparability (borderline states) and the degree of definability of pitch. One can characterize these types using computer sound synthesis and algorithmic composition methods. Below is a selection of types of sound at various levels of indefinability:

- White noise: This is a perceptually indivisible sound undefined in all ways. It can be produced by random number generators.
- Continuous sounds composed of continuous-spectrum segments in which the sensation of pitch is not well-defined, like the *fricative* phonemes in speech, still belong more to the timbre side of the border. With a computer they are produced by filtering the white input noise.
- Sounds composed of a set of discrete frequencies, such as idiophonic instruments with continuous sound whose timbre gradually changes. These *complex* sounds are an example of the borderline case between texture and timbre. Such sounds, characterized by inharmonic spectra, are easily simulated by FM synthesis. The separability is sensed due to the lack of harmonic relations between the partials (Dubnov, Tishby, & Cohen, 1997).
- Timbres with well-defined pitch. We classify these according to the degree of their divisibility. Before, we distinguished between sound events with indivisible timbre and sound events in which we perceive changes, such that they are in a borderline area with respect to texture. Moreover, it is interesting that even timbres, which are considered indivisible, can be classified with respect to divisibility. This classification relates to the *concurrence/nonconcurrence* of its overtones (Dubnov et al., 1997). The non concurrent case approaches the state of texture within timbre. There are various methods of synthesizing pitched sounds, and the sense of texture is achieved by applying a random fluctuation to the harmonics. Applying a random modulation to the frequencies of the sinusoidal components in an additive synthesis method or randomizing the input pulses in *granular* synthesis creates smooth transitions along the continuum of pitch-texture-noise as randomness increases.
- In the case of very unclear interval construction, as in some of the music pieces by Ligeti, we arrive at a border between interval and texture typical of much modern music. In some limiting cases these textures can turn either into noise or into a well-defined pitch. In computer music, many algorithmic composition methods are actually concerned with producing textures. Thus, although many of Ligeti's works are written in conventional notation, one should regard it as sound-texture for purposes of analysis.

4.2 Categories of Schemes According to Manner of Distribution

1. Register Schemes (Ranges of Occurrence).
   These may be related to various parameters that can be arranged on a

scale: tempo, pitch, and intensity. The parameters are classified in accordance with their absolute range and the degree of scatter, described in terms of the three main quantities: low, medium, and high. In many cases the medium size is a *normative optimum*. A focus on the optimum (the medium) as opposed to the two extremes reflects the stylistic ideal. Such a classification system is commonly used in various cultures for tempo, tessitura, degree of melismatism, and so on. For example, the chants of Tibetan monks have a one-part layer (monophony) with extremely low scatter in the low range of pitch. In Palestrina's polyphonic music, whose ideal is calmness, all the indices – the scatter and absolute range of each part and between the parts – are *medium*.

2. Curves of Change (Contour) Along the Time Axis.
   The changes in the various parameters can be represented by six basic types of curves: level, zigzag (including sudden change), ascending, descending, convex, and concave, with concurrence or nonconcurrence between parameters (Fig.5).

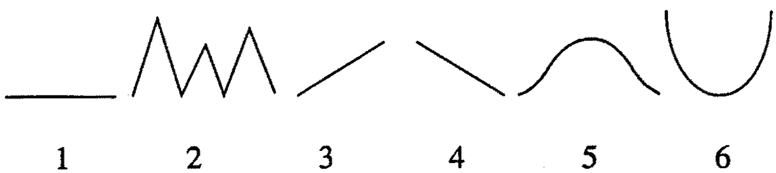

Fig. 5. The six basic curves (contours) of the various parameters, which define a certain part of the texture scheme

These curves may appear in various combinations and on various levels. For example, a curve of intensification may be described as being composed of a chain of convex curves. As we shall see, these types of curves are significant for musical expression in an interesting way. Some scholars refer to melodic curves on the immediate level as *gestures*, which are sometimes considered to be rhetorical means (Ratner, 1980). In the previous paragraph we defined stable texture primitives and used probability functions to describe them. Gradual changes in texture could be described as slow *modulation* acting on the parameters of the probability function.

(a) The flat curve (successive repetitions):
   Its meaning varies in accordance with the number of repetitions, the size of the repeated unit, and the precision of the repetition. Multiple repetitions of small units may serve as background for emphasizing events at another level or for creating tension due to uncertainty regarding the rest of the progression. This tension is limited by the

boredom threshold (Cohen, 1971). In contrast, a single repetition (two occurrences) of a directional unit based on any scheme intensifies the clear directionality. Hence, it is not surprising that the rules of Palestrina counterpoint prohibit various kinds of repetition, whereas multiple repetitions of small units are extremely common in Baroque music, and the symmetrical periodic phrases (one repetition) are so typical of the Classical period.

The 2^n scheme is an expansion of the simple symmetry obtained by a single repetition of a directional unit (two occurrences). In the Classical period, symmetry, which is considered to express maximum clarity, generally includes a series of repetitions, each of which contains its predecessor within it, so that a 2^n series is obtained:

$$1+1+2+4+8+16$$

This series can also be obtained from a repeated division of the whole into two parts. The 2^n scheme was common already in Far Eastern (especially ancient Chinese) music, and currently appears mainly in Gamelan (orchestral) music in Indonesia (Fig.6). Note that the repetitions are not exact; they may include various transformations.

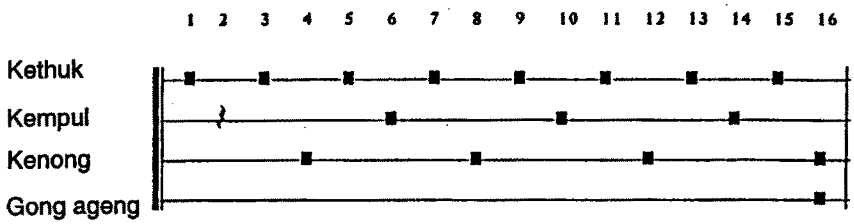

Fig. 6. *Gongan*, a rhythmic pattern in Gamelan music (in Indonesia), has 2^n beats (up to 256) performed by four idiophonic instruments

(b) Sudden change or zigzag curve:
Sudden changes lead to a sense of drama or to other emotions. Indeed, Palestrina counterpoint restricts the magnitude of changes – permitted intervals, ambitus, and range of rhythmic values, and combinations thereof. In Beethoven, on the other hand, there are sudden marked silences, changes of register, volume, and rhythmic values, even within a single theme. Sudden changes are rare in non-Western music, which is characterized by graduality.

(c) The ascending curve (gradual intensification):
This curve, which is common in large units in many non-Western cultures, is expressed through various parameters: ambitus, density, loudness, pitch register, and the degree of definability. The principle of the ascending curve has also been given special names, emphasizing

the fact that it is a natural process (*alap-jor-jahala* in Indian music; *jo-ha-kiu* in Japanese music, levels of *irama* [density] in Gamelan). It also exists, to a large extent, in twentieth-century Western music. A good example of applying the principle to all parameters, with a sudden interruption at the zenith of intensification followed by a short coda, is Charles Ives' The Housatonic at Stockbridge, from *Three Places in New England* (1903-1914); and the fourth of Webern's *Sechs Stücke für Orchester* (Op. 6) (1928).

(d) The descending curve:
This curve, of course, always appears as the second part of a convex curve. The unique aspect of this progression is that it appears at the beginning of a piece, i.e., when it begins at the maximum point. It appears often in twentieth-century music; however, it can also be found in tonal music. A striking example of its appearance in tonal music is the opening of the *Mass in B minor* by J. S. Bach. With respect to loudness only, we find Chopin's *Prelude in C minor* (Op. 28, No. 20) to be a good example (Fig.7). It is almost never found outside the West.

(e) The convex and concave curves:
In the extreme case, convexity refers to a gradual rise to a single peak, followed by a gradual decline. It allows for maximum predictability as to the next step in the process, and it helps consolidate the units. This curve prevails in folk tunes all over the world (Nettl, 1977; Huron, 1996), except for melodies meant to arouse specific emotions such as dirges. In art music, it is prominent in the vocal works of Palestrina, whose ideal, as stated above, was tranquility (Fig.8d). Here the convexity is expressed on various levels. At the level of the phrase, it appears in the parameters of pitch and duration. It also makes an appearance in other parameters, such as loudness, density, or ambitus, thereby helping to establish a sense of unit on various levels (Fig.8e). The convex curve makes a covert appearance in most works of Western tonal music, in the soprano line (according to Schenkerian analysis). Unlike the convex curve, the concave curve does not allow prediction of the duration of the process, because the curve has no upper limit. Concave curves appear in styles that seek to arouse emotions; for example, at the immediate level of performance of Rig Veda chants (Fig.8c), which are full of an explicit tension, and at various levels in Romantic music. On the other hand, the rules of Palestrina counterpoint forbid it.

Both the convex curve and the 2^n scheme are common schemes that represent types of Gestalt rules that contribute to the formation of a single directional unit. A comparison of the two is quite interesting. Both are extremely efficient methods of achieving predictability, but one (convexity) emphasizes the cohesion of the unit, whereas the other (2^n) emphasizes the divisibility and formation of levels in musical organization. Without

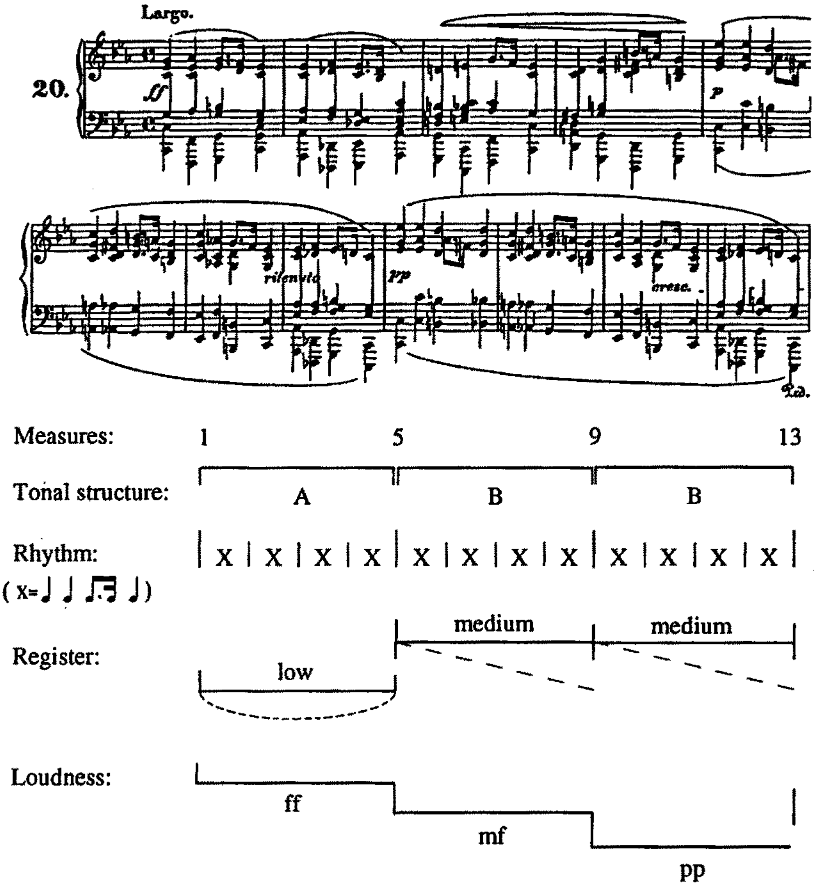

Fig. 7. Contours in Chopin's prelude: horizontal for rhythm (and in simultaneous density of chords, each one containing 5-7 notes); ascending for register; descending for loudness

going into detail, one can see that the convex/2^n curves correspond to stable/self-similar *modulation functions.*

3. Hierarchical Units of Texture – from the Static to the Dynamic Distribution.
   The curves of change over time can be seen as an organization of the static distribution on a higher hierarchical level. Accordingly, a particular static texture can be constructed by repetitive or random placement of basic elements or figures. Once this process has been held constant for a certain amount of time, we have a stationary phenomenon whose distribution can be defined. In practice, the stationariness is rarely observed for long time periods, and the parameters of the distribution vary slowly. Above we defined several types of such curves of change, which are basic

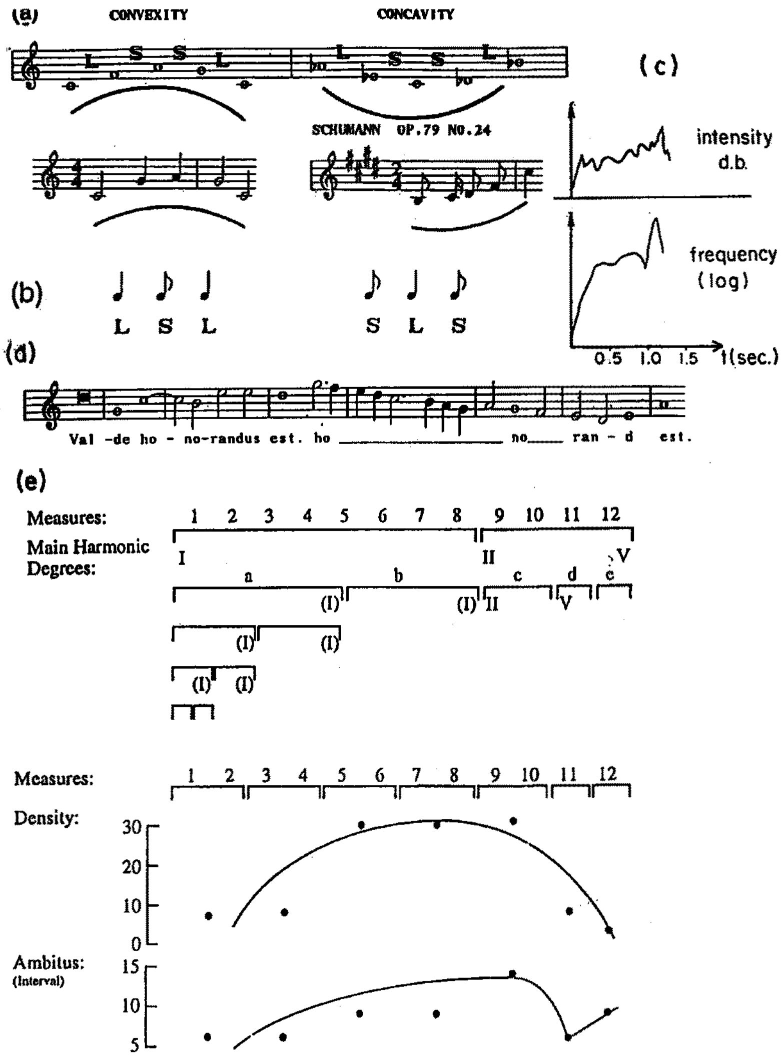

Fig. 8. Convex and concave curves: I. On the immediate level: (a) for the interval (s=relatively small; L=Large); (b) for the duration; (c) concavity for pitch and intensity in micro-motives in the Rig Veda chants. II. On the phrase level: (d) convexity for the interval and duration in the soprano line, taken from a motet by Palestrina; (e) convexity for density and ambitus (for each couple of bars) in a 2^n phrase opening Mozart's *Sonata in C* (K. 545)

ways of controlling and operating on the static texture properties. In the literature, the curves of change are also known as control functions, break point functions, gestures, and so on. Once the basic hierarchy of stationary distribution, characterized by a vector of parameters and curves of change acting and modifying these parameters, has been established, one obtains a basic unit of dynamic texture. This process can be repeated several times: the basic dynamic units can be juxtaposed in some stationary manner, or, on a higher level, the process of combining the units into texture can be varied in time, too.

4. Transformation and Symmetry

   (a) Transformation:
   An expansion of the single repetition is obtained from the phenomenon of transformation, which is a repetition of a unit with an operation on different parameters in different schemes at various levels of organization. Interestingly, the operations can be grouped into five categories whose principles govern general cognitive operations: *contrast*, which has a wide range of manifestations (Cohen, 1994); *expansion and contraction* of various parameters; *shifts* in cyclical systems along the time or pitch axis; *fusion and segregation*; and *equivalence*. We can thus see transformations as principles of textural organization that link units.

   (b) Symmetry:
   One frequently hears today of principles of symmetry that are common to inanimate objects in nature, living organisms, and even works of art [3]. Without going into detail, we shall merely state that in music symmetry is expressed both in schemes and in operations (Cohen, in press). In the present paper we have stressed the two symmetrical textural schemes – the convex curve and 2^n – as representing Gestalt principles that fuse a collection of events into a unit. Similarly, we mentioned *natural* operations that represent symmetrical organization in the texture. Finally, there is the common symmetrical organization expressed as ABA. Grouping together all the different phenomena mentioned here, some of them extremely hidden, within the category of *symmetry* is a relatively new idea that reinforces the significance of forms of textural organization in music from another point of view.

Thus, texture appears in a wide range of forms, even without taking into account the possible transformations: all six kinds of curves may appear either in one stratum or in several strata, in a large or small range of change within each stratum and between the strata, in different locations within the absolute ranges of the various parameters, and with concurrence or nonconcurrence between them.

[3] Note the existence of an international association for symmetry in nature and in man-made products.

5 States of Concurrence/Nonconcurrence

5.1 The General Significance of the Phenomena

These states refer to various kinds of combinations of simultaneous events. For example, two simultaneous parameters may change either in the same direction (concurrence) or in opposite directions (*nonconcurrence*, such as an increase in pitch with a decrease in intensity). Complete concurrence is obtained when an event that is emphasized in terms of all parameters (peak in pitch, intensity, and duration) appears on the stressed beat in the measure. In the case of simultaneous schemes, their borders may be identical (concurrence) or not (nonconcurrence); in the latter case the result is uncertainty about the musical unit (which is determined by the combination of schemes). The distinction between states of concurrence and nonconcurrence appears to be extremely fundamental; further confirmation of this distinction can be learned from its significance in bird calls in expressing tension and relaxation, as we mentioned above (Fig.9).

Nonconcurrence can occur in an enormous variety of ways, and even within the timbre of a single note such as concurrence or nonconcurrence between the phases of the overtones (Dubnov et al., 1997), and it adds to complexity and uncertainty of various kinds that emerge in most musical analyses. Thus, concurrence/nonconcurrence can be viewed as another characteristic of the texture.

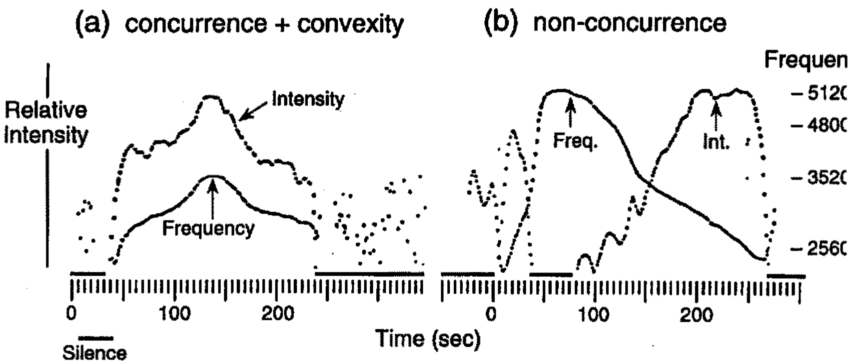

Fig. 9. Concurrence/nonconcurrence between pitch and intensity curves in *syllables* of bird calls (babblers): (a) in calm situations; (b) in tense situations

5.2 Texture and Learned Schemes, with Concurrence or Nonconcurrence

In Western tonal music, every learned scheme may be realized in a variety of textures, and the texture may be concurrent or nonconcurrent with the learned schemes. In a situation of concurrence, textural changes follow changes in the learned schemes, thereby highlighting the structure based on the schemes. In a situation of nonconcurrence the texture may blur the structure. In twentieth-century music, the texture is often not only unconnected to learned schemes but may also be realized in a variety of intervals or durations while retaining the *type* as expressed in its specific notation. The relationship between texture and learned schemes with respect to their role and importance differs from style to style.

In Palestrina counterpoint there were severe restrictions on states of nonconcurrence (Cohen, 1971). In the Classical sonata harmonic exchanges generally occur at the beginning of a measure and the various themes appear in various textures (concurrence) such that the texture supports the tonal organization (Lorince Jr, 1966). Of course, there are exceptions, and states of nonconcurrence are particularly conspicuous by their rarity. In Bach's works, in contrast, long sections are marked conspicuously by uniform texture, with an abundance of states of nonconcurrence of various sorts, some of which are quite latent (Fig.10).

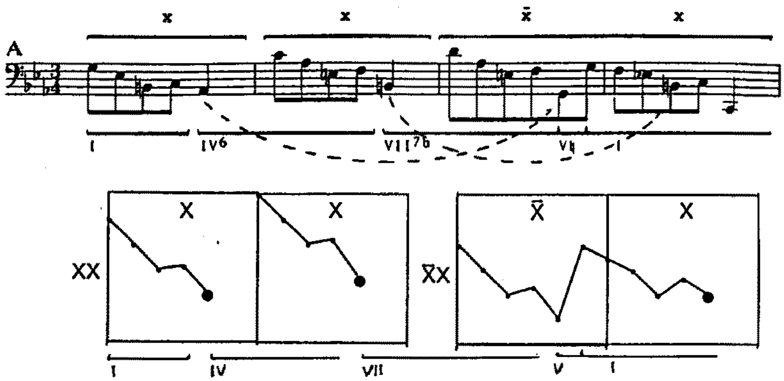

Fig. 10. Nonconcurrence between boundaries of contour units (textural schemes – x) and chordal units (learned schemes) at the beginning of the Saraband from Bach's *Fifth Suite for Cello Solo*

6 Conclusion

In conclusion, we have attempted to clarify textural phenomena, taking into account Gestalt principles and the stylistic ideal. We have shown here that texture, which is also familiar to us from the world outside of music, is a complementary contrast to both timbre and the learned schemes (which are not necessarily arbitrary and reach their peak in the organization of intervals; this issue is not discussed here). Schemes, which represent the rules of Gestalt, may also relate to texture and are expressed not only in categories defining the manner of distribution of the parameters and their combinations with concurrence or nonconcurrence, but also in categories of operations that, though unfamiliar from nature, represent (*natural*) principles of our cognitive activity. Textural schemes also contribute, though sometimes latently, to the organization of Western tonal music. Below is a brief summary of our answers to the questions raised:

- In the broadest sense, our definition of texture is suitable for describing many musical phenomena that we presented in the paper. In special cases, such as in borderline states and due to psychoacoustic constraints, some of the definitions are irrelevant.
- There are indeed texture-based Gestalt phenomena. First of all, we should note that what are known as Gestalt phenomena, which have been formulated (Huron, 1996) and corroborated empirically (Deutsch & Feroe, 1981), are textural ones (according to our definition here). Furthermore, one should bear in mind the conspicuous symmetrical schemes, including the convex curve and 2^n, and the basic operation of the various transformations and the contours and registers of the various parameters.
- Texture may be regarded as a *superparameter* that suggests three types of relationships with the parameters measured and their learned schemes: it can support the organization based on a scheme, it can blur it, or it can have gray areas. Moreover, it can serve as a major factor in organization and can be realized in various ways, so as to assume the function of the learned schemes.
- By definition, texture, unlike learned schemes, has direct, inherent extramusical meanings and can therefore contribute directly to states of calmness/excitement; certainty/uncertainty; and types of momentary/overall and clear/suspensive directionality. All of these are characteristics of the stylistic ideal. The learned schemes, unlike texture, allow for an extremely complex hierarchical overall organization, and their contribution (not explained here) to characteristics of the stylistic ideal is more indirect. In any given style one *chooses*, whether consciously or unconsciously, to emphasize learned schemes or textural organization, types of learned schemes, and types of textural schemes (including kinds of uncertainty), all of which are vital to the definition of the style.

It is interesting to note also that texture, as an intermediate property between timbre and interval organization, provides an important link between electroacoustic music, and *stylistic* music based on learned schemes. In many contemporary compositions that involve technology, a computer is used to provide timbres/sounds that extend the instrumental gestures; and vice versa, the pitch organization is built so as to reflect or augment textural properties of a sound.

The research naturally calls for more investigation, but we strongly believe that texture should already be regarded as an indispensable factor in musical analysis of all styles.

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