Segmentation and juxtaposition:
A brief critical survey

MARCOS MESQUITA*

Abstract

On the one hand, segmentation has been an important topic of several books and articles on musical analysis and cognition. On the other hand, juxtaposition has been the most important form articulation strategy of music since the Classicism. The article discusses some approaches to, and experiments in both these study fields, without forgetting the historical context of musical theory.

Keywords: cognitive psychology, musical phraseology, generative theory of music, segmentation, juxtaposition

Segmentação e justaposição: Um breve exame crítico

Resumo

Por um lado, segmentação tem sido um importante tópico em diversos livros e artigos de análise e cognição musical. Por outro lado, justaposição tem sido a mais importante estratégia de articulação formal em música desde o Classicismo. O artigo discute algumas abordagens a, e experimentos nestes dois campos de estudo, sem esquecer o contexto histórico da teoria musical.

*Palavras-chave***:** psicologia cognitiva, fraseologia musical, teoria gerativa da música, segmentação, justaposição

* Institute of Arts, State University of São Paulo - UNESP
  E-mail: marcosmesquita@yahoo.com.br

1. What music theory says

In the essay *Über die Möglichkeiten der Oper* (*On the Possibilities of Opera*), Ferruccio Busoni relates that "the spirited theorist [Jérôme-Joseph de] Momigny has undertaken the attempt to put lyrics in the style of the 'opera seria' to the first movement of Mozart's [*String*] *Quartet* in D minor [KV 421]" (1967, p. 7)[1]. Indeed, in the first volume of his book on harmony and composition, Momigny presents an analysis of the mentioned movement, explaining that "the seventh staff [on plate 30] presents the first violin provided [*revêtu*] with words which make know the real leading melody's expression of this composition" (1806, 1st vol., p. 307). The referred plate 30 can be found on pages 109–156 in the third volume of Momigny's book, and its first page is reproduced in *figure 1*. Although Busoni was discussing in his text the interrelation between instrumental and vocal music, the reference to Momigny's attempt is also interesting in order to take a brief glance at the way this theorist and composer sectioned the movement of Mozart's string quartet. He explains his sectioning method, beginning from the shortest musical unity—a harmonic one—, extending it to a whole movement:

> The harmonic *Proposition* is composed of two chords; a *Hemistich* is composed of two, three, or four musical Propositions (this number is not compulsory); two *Hemistichs* compose a Verse; two Verses, or three, and sometimes a bigger number, compose a Period. Several Periods compose a Piece (1806, 1st vol., pp. 145–146, italics by Momigny).

Figure 1. Beginning of the plate 30 from Momigny's book
(1806, 3rd vol., p. 109) .

---

[1] Translations from German and French by the author.

It is not the aim of this text to present a survey on historical sectioning methods, but it is worthy to mention that Adolph Bernhard Marx, already in the second half of the 19th century, presents a similar classification, starting, differently of Momigny's "harmonic Proposition", with a thematic unity. He lists: motive, pace forming (*Gangbildung*), phrase[2] forming (*Satzbildung*) and period forming (1868, pp. 31–45). In order to show students that it is possible to expand the mentioned concepts, this author adds an interesting section entitled "Opening new ways" (*Anbahnung neuer Wege*) (1868, pp. 46–50).

As last remark, the stages of melody structuring according to Johann Christian Lobe can be remembered: motive member, motive—normally one measure long—, section (*Abschnitt*)—two measures—, phrase (*Satz*)—four measures—, period—varying from six up to thirteen measures—, and period group—which can form either a short piece or part of a longer composition (1882).

One can see that the analytical strategy of traditional books on musical analysis was a morphological or structural one. Books on analysis of the 20th century still followed this tendency: the perceiving subject was the theorist/author himself. Among many others, following authors can be cited: Schenker, 1906, pp. 4–19; Macpherson, 1915, pp. 25–48; Leichtentritt, 1951, pp. 3–26; Salzer, 1952, pp. 41–44, and pp. 191–194; Tovey, 1956, pp. 91–95; Zamacois, 1960, pp. 6–10; Stein, 1962, pp. 3–8, and pp. 22–45; Green, 1965, pp. 29–37; Schoenberg, 1967, pp. 8–81; Ratz, 1973, pp. 17–39; Berry, 1976, pp. 301–305, and 3pp. 10–313; Stoïanova, 1996, pp. 21–30; Caplin, 1998, pp. 9–15).

2. Ruwet on musical analysis

If one is not aware of the mentioned historical precedents of musical analysis, one can naively declare something like this:

> The importance of the process of segmentation and the identification of the criteria applied during this activity is an issue that has in fact been recognized in analytical studies ever since the famous study by Ruwet (1966) (Adessi & Caterina, 2005, p. 97).

The three examples of sectioning methods mentioned above give evidence that the matter was approached seriously by the musical theorists of past centuries. Admittedly the text by Ruwet was considered a landmark for researchers of musical semiology and, up to a certain point, musical cognition. In spite of giving evidence of a serious lack of studies in the fields of musical theory and history of musical the-

---

[2] Phrase (*Satz*) refers here either to a single musical phrase or to the half of a period.

ory, Ruwet apply a segmentation method to vocal monodies (1966, pp. 76–88) which clearly descends from the analytical strategy which Vincent D'Indy applied to monodic cantilenas and popular songs 54 years before (1912, pp. 79–80 and pp. 86–89, respectively). *Figures* 2 and 3 reproduce analyses by D'Indy and Ruwet:

Figure 2. Analysis of *La belle Yolans* by D'Indy (1912, p. 89).

Figure 3. Analysis of *Geisslerlied* by Ruvet (1966, p. 77).

Even the choice of traditional vocal melodies is questionable, for they have an intrinsic relationship to the text, therefore, melodic structure in traditional vocal music confirms or reinforces the poetical one, and rarely establishes a segmentation ambiguity. In addition, and unfortunetely, Ruwet does not inform the respective lyrics of the analyzed melodies.

A book, which Ruwet ought to have known in order to deepen his approach, was Reti's *The Thematic Process in Music* (1978) that, although some methodological excesses, established broader boundaries for this subject. It is also interesting that Ruwet passes over the discussions about the decomposition of sound parameters and the resultant

multilayered time articulation in music—a so dear subject for integral serialists in the 1950's. Schoenberg has verified the decomposition of sound parameters in the traditional tonal music, asseverating: "I define variation as changing a number of a unit's features, while preserving others" (1948/1984, p. 287). Some years later, Stockhausen (1955) explained how a single melodic line by Anton Webern—meant is the first section in the second movement of his *String Quartet*, Op. 28—could be differently sectioned, depending on the parameter which is considered.

3. Lerdahl, Jackendoff, and Deliège

Lerdahl and Jackendoff reissued concepts of the traditional musical analysis, linking them with elements of Gestalt theory and generative grammar in order to conceive the generative theory of tonal music (GTTM) which they first presented in two articles (1977 and 1981) and afterwards in a book (1983). The scheme in *figure 4* resembles that one of any kind of motivic analysis, showing how briefer unities are brought together to form longer ones:

Figure 4. Segmentation scheme after Lehdahl and Jackendoff (1983, p. 117).

73

The "grouping analysis" by Lerdahl and Jackendoff, however, is much more comprehensive than Ruwet's attempts, including other kinds of parametric articulation:

> Group boundaries are articulated by such factors as distance between attack points, rests, slurs written into the music, change in register, change in texture, change in dynamics, and change in timbre. A further articulatory device is the harmonic cadence, which from the phrase level upward normally signifies the ending of groups (...). (1977, p. 118).

In addition, the authors give space to segmentation ambiguity, when they consider: "Thus musical grouping is not strictly hierarchical in the sense described. However, the conditions under which overlaps and elisions are perceived are highly constrained; these cases require special treatment" (1981, p. 482).

While the scheme in *figure 4* emphasizes that the musical apprehension occurs somehow synchronically to the sound events, the next one in Figure 5 remembers us that there is also a set of diachronic reference points during which the short-term memory (active memory) plays an important part:
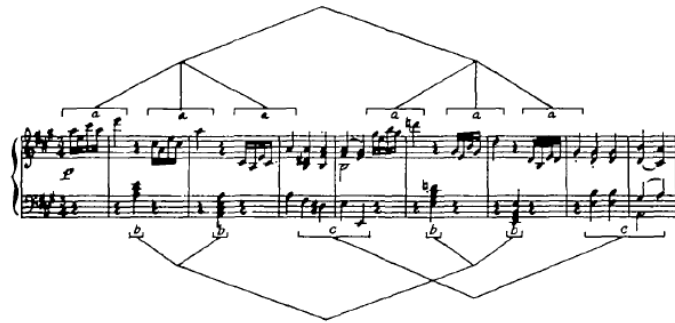
Figure 5. Motivic cells in the first eight measures of the Scherzo
from Beethoven's. *Piano Sonata*, Op. 2, No. 2,
after Lehdahl and Jackendoff (1981, p. 484).

In spite of their contribution in the field, the authors themselves admitted the limitation of their theory on what concerns polyphonic music:

> At the present stage of development of the theory, we are treating all music as essentially homophonic; that is, we assume that a single grouping analysis suffices for all voices of a piece. For the more contrapuntal varieties of tonal music, where this condition does not obtain, our theory is inadequate (1983, p. 37).

In addition, GTTM was conceived structurally, i.e., it was not validated by tests involving human subjects. This was Deliège's aim with two experiments she elaborated and explained in an article (1987) whose first part presents a review of GTTM and questions some of its principles. She informs that, for the first experiment, "only monorhythmic sequences (one rhythm for all instruments) were selected in order to guarantee a nonequivocal [sic] studying of the responses" (1987, p. 334), but unfortunately she does not list the 32 "instrumental or orchestral sequences from the Baroque, Classical, Romantic, or early twentieth century repertoires" (1987, p. 334) she chose for her experiment number 1. With this experiment she verified that "nonmusicians [sic] as a whole averaged 50.8% of responses in accordance with the rules [of GTTM]" and "musicians averaged 77.2 % of responses in accordance with the rules" (1987, p. 337). She remarks that "musical training does not appear to induce the emergence of a grouping behavior radically different from the one used by the naive listener. Yet it seems to make memory more efficient" (1987, p. 344).

4. Some discussions since the 1980s

The majority of studies and experiments in this field in the last decades still works, in general, with Gestalt grouping principles—proximity, similarity, symmetry, good continuation, and common fate (Shepard,

1999, p. 32–33)—, and attributes derived from GTTM, "however, the conditions that determine which attribute is followed are complex ones" (Deutsch, 2013a, p. 183). This means that the experimental designs can reach from physical-acoustic ones—apparently unmusical!—until musical and performative correct ones—designs which have the so-called ecological validity. But the great diversity of experiments that Deutsch reviews (2013a and 2013b) is understandable, because researchers have to test each attribute separately in order to detect what kind of role it and the corresponding subsystem in brain play in sound/music cognition:

> the evidence shows that grouping decisions are not made by a single, internally coherent, system, but rather by a number of different subsystems, which at some stage act independently of each other, and can arrive at inconsistent conclusions. (Deutsch, 2013a, p. 184).

Among several attributes Deutsch reviews (2013b), the following are worthy of mention:

1) Melodic contour: it is related to global and specific cues which include "overall pitch range, the distribution of interval sizes, and the relative proportions of ascending and descending intervals" (2013b, p. 256);

2) Pitch organization in melody: humans have the tendency

> to group together tones that are close in pitch, and to separate out those that are further apart. When tones are presented at a rapid tempo, and these are drawn from two different pitch ranges, the listener perceives two melodic streams in parallel, one corresponding to the lower tones and the other to the higher ones (...). (2013b, p. 258).

3) Abstraction of higher-order shapes: this kind of research inquires "into how higher-order abstractions are derived so as to lead to perceptual equivalences and similarities" (2013b, p. 268);

4) The organization of short-term memory for tones:

> Neurophysiological findings support the hypothesis of multiple auditory memory stores that subserve different stimulus attributes. When a listener is presented with a series of identical tones followed by a new tone, the new tone elicits an event-related brain potential called the "mismatch negativity" or MMN, which is assumed to reflect the detection of a difference between the incoming stimulus and the stimuli that have been stored in memory (2013b, p. 284).

The mentioned MMN occurs in the frontal lobe "about 150 msec. after any stimulus change", and "tend to be observed following any 'oddball' in an otherwise predictable stimulus" (Thompson, 2015, pp. 152–153). Therefore, all segmentation tests, which include obviously some degree of contrast, with human subjects cause this kind of time delay, and not only this: there are evidences that the brain needs dif-

ferent time spans to interpret different parametrical structures present in a given melody, remembering that a melody is the result of the sum of parametrical structures like rhythmical, intervallic, and timbristic. Since the 1980's, experiments suggest that pitch pattern and temporal pattern, for instance, make independent contributions to judgments of melodic similarity. Two articles of that time are reported below.

After reviewing several articles on the subject, Monahan and Carterette

> hypothesized, first, that pitch factors would probably overshadow temporal factors in listeners' musical space and, second, that consonance of the periodicities of pitch and duration patterns would generate a factor in the ensuing multidimensional scaling of the similarity of patterns (1985, p. 9).

The term "consonance" here means a parallelism between an intervallic structure, which can induce a melodic accent—for instance an ascending leap—, and the actual accent of the metrical structure in a given passage.

The experiments conducted by Palmer and Krumhansl focused on pitch and temporal structures, and investigated if the "musical phrase structure can be described in terms of tonal and rhythmic hierarchies arising from the pitch and temporal information" (1987, p. 116). This question is related to a broader subject, i.e., the "capacity for encoding and processing more than one source of stimulus information simultaneously" (1987, p. 117). The authors choosed for their experiments the theme of the Fugue XX in A minor from J. S. Bach's *Well-Tempered Clavier* (Book I). Although developing two psychometrical experiments, whose results could be easily impaired by subjective – and even mood – variants of participants, the results of both experiments suggested "independent contributions of pitch and temporal factors to melodic phrase judgments in the excerpt" (1987, p. 124), leading the authors to cautiously conclude that "temporal and pitch information may engage independent mental processes due to internal constraints on the way we produce and perceive information across temporal frames" (1987, p. 125).

5. Juxtaposition

Among the five strategies of sound projection in time I discussed in my book (Mesquita, 2010, pp. 41–78), there is the juxtaposition. It is the most characteristic one of tonal Western music, especially since the classical period and, analogously to a space articulation, can be named vertical cut. Antecedent and consequent in Beethoven's period, and even the succession of the "a" motives, shown in *figure 5* above, illustrate this procedure paradigmatically in a phraseological context. But

of course, composers were never satisfied with such a simple, although efficacious, strategy. There are several ways to veil this vertical cut even in homophonic music.

Figure 6 shows the end of the first subject group and the beginning of the transition in the first movement of Beethoven's *Piano Sonata*, Op. 14, No. 2. We see/hear that at the very end of the first subject group in measure 8, Beethoven begins a new accompaniment in the left hand. In other words, he anticipates the accompaniment of the transition, which starts in measure nine, and confounds momentaneously the listener:

Figure 6. Ludwig van Beethoven. *Piano Sonata*, Op. 14, No. 2, 1st mov., ms. 5–9.

In this case, it can be speculated that, if participants in an psychometrical experiment were requested to indicate the beginning of the second phraseological unity, they would have divergent opinions: some would indicate measure 8, but others would indicate measure 9.

Figure 7 shows, in the same movement, the end of the first idea—a regular period—and beginning of the second one in the second subject group. Who is encultured in this kind of regular phraseological construction expects an antecedent and a consequent, four measures long each. In this case, the last measure of the consequent (33) is simultaneously the first measure of the next idea. This procedure is called elision by traditional music theory. Here again, the composer confounds the listener during a short while:

Figure 7. Ludwig van Beethoven. *Piano Sonata*, Op. 14, No. 2, 1st mov., ms. 29–33.

Such kinds of juxtaposition ambiguity are the most interesting in the traditional homophonic music, but unfortunately very difficult—rather impossible—to measure in psychometrical and imaging tests used nowadays. For this reason many researchers have to content themselves with melodic fragments the likes of:

Figure 8. Structured ascending sequence and unstructured control sequence after Hamaoui and Deutsch (2010, p. 85).

Admitedly, Hamaoui and Deutsch were trying to elucidate how multiple grouping cues, present in a given sequence, influence on perceptual grouping, but every trained musician feels a little disappointed (perhaps more than a little...), noticing how many experiments and researches are so far away from the musical fact—again the question of ecological validity.

6. Instead of a conclusion

The cases of ambiguity cited above are important constituents of music phraseology and, in spite of their simplicity, allow recipients to interpret the aesthetic message of music in different ways, and perhaps confer to this kind of message a fascination, which once was classified as transcendental.

Because thematic and sound structures have several parameters— meant here are not only the four traditional ones, but all variable components which can be measured and play a distinctive role in a given thematic/sound structure—, composers and sound artists can establish articulations in different parameters in different points of time, and blur the perception of sections and subsections, and consequently of the form as a whole. As seen, this procedure is possible even in simple textures like the homophonic ones.

Cognitive researchers in general have to deepen their knowledge on musical analysis, in order to give their studies a more profound historical perspective and musical foundation. But perhaps the most challenging problem in the near future for researchers, especially for those who deal with segmentation, is to develop experimental designs which take ambiguous musical/sound characteristics into consideration.

78

References

Addessi, Anna Rita & Caterina, Roberto. (2005). Analysis and perception in post-tonal music: An example from Kurtág's String Quartet Op. 1. *Psychology of Music*, vol. 33 (I), 94–116.

Berry, Wallace. (1976/1987). *Structural functions in music*. Corrected ed. Mineola: Dover Publications.

Busoni, Ferruccio. (1921/1967). Über die Möglichkeiten der Oper und über die Partitur des *"Doktor Faust"*. 2nd ed. Wiesbaden: Breitkopf & Härtel.

Caplin, William E. (1998). *Classical Form. A Theory of Formal Functions for the Instrumental Music of Haydn, Mozart, and Beethoven*. New York: Oxford University Press.

Deliège, Irene. (1987). Grouping conditions in listening to music: An approach to Lerdahl & Jackendoff's grouping preference rules. *Music Perception*, Vol. 4, No. 4, 325–360.

Deutsch, Diana. (2013a). Grouping mechanisms in music. In Diana Deutsch (ed.), *The Psychology of Music*. 3rd ed. Amsterdam: Academic Press, 183–248.

Deutsch, Diana. (2013b). The processing of pitch combinations. In Diana Deutsch (ed.), *The Psychology of Music*. 3rd ed. Amsterdam: Academic Press, 249–325.

D'Indy, Vincent. (1912). *Cours de composition musicale*. Vol. 1. Written with the collaboration of Auguste Sérieyx. Paris: A. Durand et Fils, Éditeurs.

Green, Douglass M. (1965). *Form in tonal music. An introduction to analysis*. New York: Holt, Rinehart and Winston, Inc.

Hamaoui, Kamil & Deutsch, Diana. (2010). The perceptual grouping of musical sequences: Pitch and timing as competing cues. In S. M. Demorest et al. (eds.), *Proceedings of the 11th International Conference on Music Perception and Cognition*. Seattle: ICMPC, 81–87.

Leichtentritt, Hugo. (1951). *Musical Form*. Cambridge, MA: Harvard University Press.

Lerdahl, Fred & Jackendoff, Ray. (1977). Toward a formal theory of tonal music. *Journal of Music Theory*, Vol. 21, No. 1, 111–171.

Lerdahl, Fred & Jackendoff, Ray. (1981). On the theory of grouping and meter. *The Musical Quarterly*, LXVII/4, 479–506.

Lerdahl, Fred & Jackendoff, Ray. (1983). *A generative theory of tonal music*. Cambridge, MA: MIT Press.

Lobe, Johann Christian. (1882). *Katechismus der Compositionslehre*. 4th revised ed. Leipzig: Verlagsbuchhandlung von J. J. Weber.

Macpherson, Stewart. (1915). *Form in music. With special reference to the designs of instrumental music*. London: Joseph Williams, Limited.

Marx, Adolph Bernhard. (1868). *Die Lehre von der musikalischen Komposition, praktisch theoretisch*. 7th ed. Leipzig: Druck und Verlag von Breitkopf und Härtel.

Mesquita, Marcos (2010). *Klangprojektion in die Zeit: Ein Weg zum Orchesterwerk* Staub *von Helmut Lachenmann*. Hoffheim: Wolke Verlag.

Momigny, Jérôme-Joseph de. (1806). *Cours complet d'harmonie et de composition d'après une théorie neuve et générale de la musique*. 3 vols. Paris: Chez I' Auteur, en son magasin de Musique.

Monahan, Caroline B. & Carterette, Edward C. (1985). Pitch and duration as determinants of musical space. *Music Perception*, 3, 1–32.

Palmer, Caroline & Krumhansl, Carol L. (1987). Independent temporal and pitch structures in determination of musical phrases. *Journal of Experimental Psychology: Human Perception & Performance*, Vol. 13, No. 1, 116–126.

Ratz, Erwin. (1951/1973). *Einführung in die musikalische Formenlehre*. 3rd expanded ed. Viena: Universal Edition.

Reti, Rudolph. (1951/1978). *The thematic process in music*. Revised ed. Westport: Greenwood Press.

Ruwet, Nicholas. (1966). Méthodes d'analyse en musicologie. *Revue Belge de Musicologie*, vol. 20, No. 1/4, 65–90.

Salzer, Felix. (1952). *Structural hearing. Tonal coherence in music*. Vol. 1. New York: Charles Boni.

Shepard, Roger. (1999). Cognitive psychology and music. In Perry R. Cook (ed.), *Music, Cognition, and Computerized Music*. Cambridge, MA: MIT Press, 21–35.

Schenker, Heinrich. (1906). *Neue musikalische Theorien und Phantasien. Erster Band: Harmonielehre*. Stuttgart: J. G. Cotta'sche Buchhandlung Nachfolger.

Schoenberg, Arnold. (1948/1984). Connection of musical ideas. In *Style and Idea*. Ed. by Leonard Stein. Revised ed. as paperback. With translations by Leo Black. Berkeley: University of California Press, 287–288.

Schoenberg, Arnold. (1967). *Fundamentals of musical composition*. Edited by Gerald Strang, with the collaboration of Leonard Stein. London: Faber and Faber.

Stein, Leon. (1962). *Structure and style. The study and analysis of musical forms*. Evanston: Summy-Birchard Company.

Stockhausen, Karlheinz. (1955). Struktur und Erlebniszeit. *Die Reihe II. Anton Webern*, 69–79.

Stoïanova, Ivanka. (1996). *Manuel d'analyse musicale. Les formes classiques simples et complexes*. Paris: Minerve.

Thompson, William Forde. (2015). *Music, thought, and feeling. Understanding the psychology of music*. 2nd ed. New York: Oxford University Press.

Tovey, Donald Francis. (1956). *The forms of music* (1944). Cleveland: Meridian Books.

Zamacois, Joaquín. (1960). *Curso de formas musicales*. Barcelona: Editorial Labor, S. A.

80