An Interactive Media Oriented Analysis of Tonal and Post-Tonal Music

Now, I would like to focus on a rising concept in the field which is "association." Around the same time of Edward Lowinsky – Joseph Kerman debate in musicology, Edward T. Cone was writing about the current state of the music theory and some compelling questions the field faces:

> "…we have arrived at a crucial point in the history of Western music. Up until now there has been no ambiguity between up and down- at least not since the fourth was distinguished in effect from the fifth; There has been no question of choice between forward and backward since the appearance of melodic cadence-and, later and a fortiori, the harmonic cadence; there has been no transpositional relationship that could not be explained by reference to some sort of tonic. But these aspects of composition, hitherto accepted as basic, are unaccounted for by twelve-tone theory. (T. Cone 1967, 46)

Edward T. Cone's somewhat provocative work criticizes internal consistencies (or inconsistencies) of twelve-tone music and claims Schoenberg's himself take that principal music should not have directions like upward/downward, forward/backward, when the more like a mechanical procedure applied to the composition, mirror inversion is as valid as the original row. Some tools are implemented from tonal music to provide consistency, but T. Cone asks what rights to apply this method without a tension-relation pattern; and, how it is expected to produce a positive outcome. What is beyond the analysis is to say "I like a work of art" or not, but this end is made with absolute decisions that take its source from concrete values.

In his reply to T. Cone, David Lewin claims that theory and analysis are two different entities and Edward T. Cone was not able to distinguish them in his critic. Composers should critically think about what composition is engaging, boring, good, or bad but then ask themselves why they think in that way. Good pedagogy would provide an efficient mindset about the relation between theory/analysis and criticism/composition. Even if they did not mention it, it was good to realize they agree with each other about absolute decisions made by concrete values. And then, Lewin accepted that there are some problems at the theoretical level which can be get a handle on analysis.

> There is no doubt in my mind that the classical twelve-tone composers heard up/down, bass/principal line, and before/after as highly functional. To recapitulate: analysis certainly can deal with these categories; problems that arise are theoretical, in that we decide what

> the meanings of the categories are in the context of the relevant sound-universe, or else run the risk of simply pointing out everything, quite unselectively, in an analysis. (Lewin 1967, 69)

Debate between T. Cone and Lewin brought about an awareness towards analytical approaches to twelve-tone music. In later decades, the concept "association" started to be highly distinct in this search for an efficient analysis for atonal music.

In 1988, Joseph Strauss proposed that since prolongation is not applicable to atonal music, it needs to find out some different ways and associative analytical techniques would be promising for this goal. Then, Strauss demonstrated his thoughts about prolongation denoting for conditions of prolongation and how they cannot be functional in atonal music. Finally, he introduced his own associative analysis in the case of Anton Webern's "Concerto for Nine Instruments."

In his work Strauss points out some voice-leading procedures of tonal music and how they prevent the idea of prolongation in post-tonal music. First *consonance dissonance* and second register and duration can be considered different in tonal and post tonal music. There is no chance of providing a middle ground prolongation unless there is a consensus about difference between pitch base structural vs nonstructural tones. In terms of tonal music, *scale degrees* have some hierarchies which is not the case for post tonal music. *Embellishment condition*s are about voice leading procedures like passing, neighboring, double neighboring, suspension which are not applicable to twelve-tone music. *The harmony/voice leading condition* as horizontal and vertical voice leading principles are clearly determined in tonal music closely related with functional harmony and scale steps. This is not the case for atonal music.

Although all these difficulties, he thinks that it is still possible to find out some ways to do an efficient analysis for post-tonal music and this can be achievable with association rather than prolongation. He calls this method "associational model" and demonstrates the concept with an analysis on Webern's concerto for Nine Instruments.

> If we wish to discuss middle ground structure in post-tonal music, we will have to retreat to a less comprehensive but more defensible model voice leading, one based on association rather than prolongation. Associational claims differ significantly from prolongational claims. Given three musical events, X, Y, and Z, an associational model is content merely

> to assert some kind of connection between X and Z without commenting one way or another about Y. Assertions of this type are easy to justify and provide the only reliable basis for describing post-tonal middle grounds. Musical tones separated in time may be associated by a variety of contextual means, including register, timbre, metrical placement, dynamics, and articulation. Associations of this kind draw together elements separated in time and create coherence at the middle ground. (Strauss 1987, 13)

As we have seen in Strauss's article, prolongation conditions seem to be something given as rules in which atonal music cannot be analyzed with prolongation. It means consonance structures determine the prolongation. This point is challenged by Steve Larson in 1997 with outstanding ideas.

According to Larson, prolongation determines consonance-dissonance structure of a musical continuum. He shows evidence that 7^{th} chords' seventh degree can be embellished with an upper neighbor tone and return to seventh degree again. This rare situation is indeed a good example of how prolongation indicates consonance and dissonance structure. However, Strauss thinks that he himself is not the only wrong one in his 1997 paper taking consonances as precondition for prolongation but also Larson may be wrong because such instances of prolongated dissonances are exceptionally rare cases in music. Apart from this hard applicable case of point, I think there is another point in Larson's work that makes prolongation possible, but this point still takes precepts of tonal music. In other words, considering atonal music with the tonal music rules may present opportunities to provide a prolongation for atonal music. Now, I would like to expand the point of what Larson makes in his work.

Larson presents two sets of concepts. The first set consists of gravity, magnetism, and inertia that he calls "musical forces" which lead to spell-out of expressive meaning of music. Gravity is a descending unstable note a step down; magnetism is a tendency for an unstable tone to move towards a stable tone; and inertia is a tendency of music phrases to keep going on in the same manner. These expressive meanings cannot be articulated by natural languages though. In terms of the concept "association" he then says something important

> From those perceptions, listeners create meaning by (consciously or unconsciously) assigning musical sounds to categories. This process is captured in the phrase "to hear as,"

> that is, "to hear x as y" in which x is some sound and y is some meaning. (Larson 1997, 102)

What we understand with this first set of concepts is that gravity, magnitude, and inertia create an expressive meaning which can be associated with sound blocks e.g., x sound can be called y meaning. “Phrygian scale block” (x sound) is so “sentimental” (by meaning). While y is most of the time quite subjective, x and its continuum are intuitive in an enculturated sound environment.

The second set of concepts provides a dynamic to this static perception of sound blocks since sound blocks are highly dynamic in a musical continuum which changes expectation from the continuum in a “determined time span.” This second set can be called “stability” which has some different terms that are “auralize,” “trace” and “displace.” Auralize is much more related with expectation which is not present sound but a sound which is expected to happen in future depending on trace which is melodically active note or phrase. Displacement is to replace the current trace with the new one in an active listening. Even if there are further details of this structure, I will stick to this general understanding to apply it to my own technique of prolongation of atonal music. There appear to be two points to deal with here. First, this prolongation will not be applied to theory of the atonal music, but it may be functional in terms of analysis level as David Lewin encouraged to apply such analysis. Second, how to associate these sound blocks with the concept “metaphor.” Now, I will first focus on the analysis and then deal with association.

Kofi Agawu states that analysis has two primary functions; the first, it deepens our understanding of music, second compositional truth can be accessed here analysis. Agawu refers to the second point to Theodor Adorno. The point analysis deepens our understanding is widely accepted, he says, but truth content of the piece can be accessed is still debatable. Analysis starting point is the inner working mechanism of music and then external factors come into play. Another point of view, Kofi Agawu gives us a reference to Milton Babbitt. It does not matter what you hear but what you can learn to hear matters. As an important point, Kofi Agawu refers to Adorno about the truth content of a composition.

> Adorno insists that the truth content be mediated by a composition’s technical structure, and structure, and this suggests that an analysis that displays minimal engagement with a work's technical structure not as end but to an end cannot hope to reveal its “truth content”. In other words, we are not finished with formalism, despite the ritual and by now

> ineffectual denunciation of so called "formalism" by certain musicologists. Mediation allows passage from one state to another, facilitates translation, and encourages self-awareness in the performance of an analysis. (Agawu 2004, 273)

In short, analysis begins with internal structures of music and then extends to the external factors which includes analyst's mediation to find out the truth content of the work. This subjective truth content is problematic for my view, however, for the purposes of the present work, Kofi Agawu's statements are quite compatible with the concept "association" which is formulated in Steve Larson's work. While the first set of concepts brings us the internal structure of music, the second set of concepts furthers the understanding of the internal structure of music. In the later part of the present work, I will introduce Candace Bower's ideas about metaphors and association that might be the level of what Adorno's truth content can be externalized and Kofi Agawu's description is complete.

Candace Bower proposed a highly promising cognitive theory in music in the just beginning of the present century referring her ideas to two authors:

> Margolis's theory of pattern matching suggests that music takes on meaning with respect to itself because of our mapping the musical patterns that we hear onto those stored in memory. Johnson's theory of embodied meaning further suggests that these patterns take on metaphorical meaning because of our mapping them onto image schemas derived from bodily experience. (Bower 2000, 324)

Even if Johnson's embodied cognition is quite controversial here, in consideration of Margolis's approach mentioned by Bower, one can find many common points among Candace Bower, Steve Larson, and Kofi Agawu. The expressive meaning of music takes its source from the internal structure of music with these three authors. One important thing in Bower's work is that she refers metaphorical associations to bodily movement. I take this point as the suggestion of the author rather than associating these bodily movements with internal meanings of music. However, if we think that analysis is also a performance, an analyst has all rights to apply this point of view to his/her own work. Internal logic is the important one, how these arguments come together and how they are consistent with each other. I believe rather than bodily movements, structural tendencies of the musical continuum can be associated with images of the memories of people that can be related with bodily movement or not related. This point may also be communicated with

Zbikowski's Cross domain mappings. At this point, I would like to clarify something. When we expand the scope of the work, I believe we have seen a network of authors who work on analysis and more specifically on concept "association." Even if the point turns out to be uncontrollable as I expand boundaries, we may also think that in terms of music analysis, there is an implicit agreement for basics on the topic.

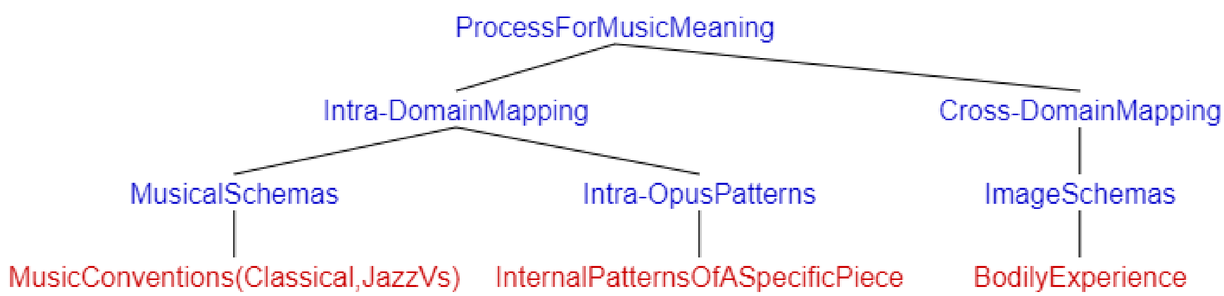

Figure 1 Candace Bower's Schema for Musical Meaning

Bower explains her theory,

> According to the present theory, musical meaning arises more specifically through the mapping of the heard patterns of a musical work onto three different types of stored patterns: (1) intra-opus patterns-patterns specific to the work itself; (2) musical schemas-patterns abstracted from musical convention; and (3) image schemas-patterns abstracted from bodily experience. … The first two types give rise to intra-domain mapping, while the third gives rise to metaphorical, or cross-domain mapping. (Bower 2000, 324)

At this point of the work, I draw a schema which is the synthesis of the ideas of different authors which will be the underlying mechanism of my analysis in this work.

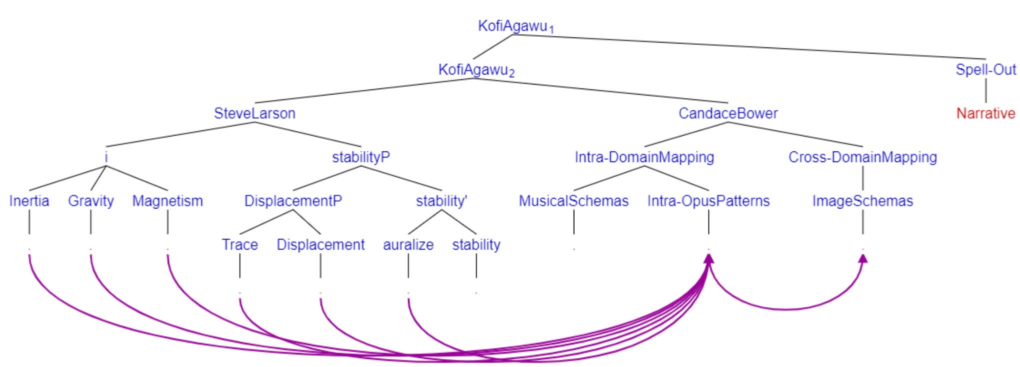

Figure 2 Agawu, Larson, Bower Synthesis

In figure 2, we have seen a network of analytical approaches. As before I mentioned, Kofi Agawu draws the main framework of an analytical framework. Analysis begins with the internal meaning of music, and then finds out truth content of the composition with external meanings. I take that external meanings would be associations and metaphors. Larson's static first set of concepts that consists of "Inertia," "Gravity" and "Magnetism" and dynamic set of concepts that includes "trace," "displacement" and "auralize" are the working mechanism of "Intra-Opus Patterns" in Candace Bower's schema. Then, these "Intra Opus Patterns" are associated with a metaphor but with a small difference. In my work, I will not strictly stick to the bodily movements when I associate expressive meanings of music with metaphors. The hermeneutics of these metaphors would take its resources from Topic Theory which I will focus on later. Now, I would like to delve into Intra-Opus Patterns a little further with another concept introduced in Bower's work which is "Paradigmatic Axis."

> Intra-opus pattern matching adds yet another layer of meaning. Patterns that recur within a musical work map not only onto schemas for tonal convention, but also onto versions of the same pattern heard earlier in the work. Each pattern, or paradigm, establishes its own *paradigmatic axis*, with each new statement of a pattern mapping onto those that precede it. (Bower 2000, 325)

Paradigmatic axis a concept borrowed from linguistics is simply a repetition of a similar pattern in the later parts of the composition. In the analytical part of the present work, we will see that I have constructed a network and relationship between model motives and pattern motives. From one model to its patterns, how musical perception changes in time and pitch will be accounted for in this paradigmatic axis. However, this can be surmountable if only applying a syntactical structure which is a topic of another work.

As I mentioned earlier, I will focus on topic theory to construct a visual narrative that associates intra opus patterns with well-known topics in music. In this work, I aim to develop another practice to visual representation of the music. It is good to remember the problem of music listening and spelling out again. When we listen to music, all conceptualized nested domains flow at an unfollowed speed. So, when we attempt to articulate what its meaning is, we can define it very general terms that make sense, however, when we focus on moments of the music and remember those moments in the later parts of the piece of music is not always so easy. Therefore, it has a great impact because we cannot make coherent explanation about a specific piece. What is a coherent spell-out may be that "the opening I chord gives me a "x" sense and then when I hear the IV two bars (or sometime) later, it makes a "y" sense as a conclusion of the context. But in the m.24 (or about the half of the piece) when I hear the same progression it overrides the first impression of what happened earlier, and I feel like "z."" This expert language is quite the hard one for everyday people and when we stop the music and try to match our feelings to what we have been hearing and call back those musical structures, even it is challenging for musicians too call the building blocks of music in a time span with their technical terms e.g. remembering I chord, C Major, dominant function 3 measures earlier. The main purpose of this tool of sound visual narrative is to give people enough lexicon to articulate their feelings in music and associate those feelings with a particular musical motive in the composition. These musical motives will represent consistent geometric shapes and colors and further techniques in digital arts to mark a retrievable trace of music to articulate later. And then, our articulation may turn out to be cross-sensory manner like "the opening red rectangle sound gives me a "x" sense and then when I hear the blue triangle two bars (or sometime) later, it makes a "y" sense as a conclusion of the context. But in m.24 (or about half of the piece) when I hear the same shape it overrides the first impression of what happened earlier, and I feel like "z."" I believe, this articulation of the expressive meaning of music may bring about easiness furthering our cognitive research in music and meaning. In the last section of the present work, I will deal with the application of this technique.

Zbikowski define the process I explained above

> Cross-domain mapping is a process through which we structure our understanding of one domain (which is typically unfamiliar or abstract) in terms of another (which is most often familiar and concrete). (Zbikowski 2002, 13)

Zbikowski's ideas are preceded by Candace Bower in 2000. This latter point will be much clearer in the following part of the present work. Now, I would like to focus on the topic theory.

The Oxford Handbook of Topic Theory introduces the concept.

> The concept of topics was introduced into the vocabulary of music scholars by Leonard Ratner to account for cross-references between eighteenth-century styles and genres. The emergence of this phenomenon followed the rapid proliferation and consolidation of

> stylistic and generic categories. While music theorists and critics classified styles and genres, defining their effects and proper contexts for their usage, composers crossed the boundaries between them, using stylistic conventions as means of communication with the audience. (Mirka 2014, 1 of 61)

And Leonard Ratner defines what topic theory is.

> From its contacts with worship, poetry, drama, entertainment, dance, ceremony, the military, the hunt, and the life of the lower classes, music in the early 18th century developed a thesaurus of characteristic figures, which formed a rich legacy for classic composers. Some of these figures were associated with various feelings and affections; others had a picturesque flavor. They are designated here as topics—subjects for musical discourse. (Ratner 1980, 9)

Topic theory in its current state seems to take its basis from 18th century music and extends to the later periods of the history of western music. It leaves two questions, first how topic theory might be extended to the non-Western Music that collaborate with a world music analysis and how individual topics which is independent from 18th century can be created with some abstracts thoughts that take its basis from math and geometry. At this point, it is important to mention Dmitri Tymoczko's "A Geometry of Music" the work explains music analysis with geometry. In the present work, I am curious how these shapes and colors can create an abstract narrative which is not only visualization of building blocks of music but also representation of its full context. I aim to make this point clearer at the end of this work with a multimedia presentation.

Neurophysiological Basis of Sound Visual Narrative

Now, time is ripe to look at musical building blocks and their characteristics that will be input of the max/MSP generating generative art depending on the parameters which are supplied by these elements of music. These elements can be called segments. Before explaining how musical segments will operate in this work, I will present an important concept in neurophysiological works which is oddball paradigm.

The oddball paradigm is an experimental framework in psychological research. It involves the presentation of repetitive stimuli sequences, irregularly interrupted by a distinctive "oddball" stimulus. Researchers observe and record participants' reactions to this unusual stimulus. Originally employed in event-related potential (ERP) studies at UC San Diego by Nancy Squires, Kenneth Squires, and Steven Hillyard, the oddball method revealed that the P300 event-related potential, occurring approximately 300 ms after stimulus presentation over the parieto-central area of the skull, exhibits increased amplitude in response to the target stimulus. Importantly, the P300 wave manifests only when subjects are actively engaged in the task of detecting these target stimuli, with its amplitude reflecting the rarity of the targets.

In his 2006 book, David Huron shares one of the experiments he conducted using oddball paradigm method.

> "With an already established key context, the dominant chord would have a high probability of being followed by a tonic chord, and the supertonic pitch would have a good chance of being followed by the tonic. Accordingly, there would be a strong anticipation of what component. The predicted when for this outcome would be less certain. Plausible event onsets might occur on beats 2 or 3, or the downbeat of the next measure. With the advent of the oddball note (D flat), the resulting sonority is now more dissonant, so the reactive response would have a comparatively negative valence for this moment. Both the pitch (D flat) and the onset timing are poorly predicted, so the prediction response would also be highly negatively valenced." (Huron 2006, 312)

What is referred here basically, is that the human brain predicts diatonic constructions of the musical continuum. When expectation is confirmed by the next stimuli that is quite closer to the concept of "Auralize" which is coined by Steve Larson, stimuli match to a positive valence. However, when the musical space starts to consist of a note which is out of the diatonic array that is most of the time unpredictable for listeners, stimuli match negative valence. This means that the tonal hearing is intuitive and if it needs to construct a hierarchy for expectation, the higher order might be "auralize" concept in Larson's work and it always takes place at the end of a series of stimuli in a dynamic continuum as trace-displace-auralize line.

In addition to unexpected notes in an established tonality, I am particularly curious, auditory oddball paradigm might be useful for music segment discrimination. In a recent neurophysiological study demonstrates this point quote

> "An oddball paradigm is an experimental design that uses a sequence of one repeating stimulus called the standard stimulus. This sequence is infrequently interrupted by a different stimulus called the deviant or target stimulus. Potentially the oddball paradigm can be employed in an EEG-based speech discrimination assessment protocol. Speech discrimination indicates how well a person can differentiate between different words. Analyzing EEG measurements such as the Event-Related Potentials (ERPs) may help to achieve the goal of automated assessment process. In this work we compare two listening modes in an oddball paradigm to find a suitable mode for assessing speech discrimination automatically. The two listening modes include passive and active listening. Passive listening is when the listener does not pay attention to what they hear. Active listening is when the listener actively pays attention to the sound. We tested these two listening modes using two Thai words with consonant contrast. We compared the ERP waveform, classification accuracy, and attention during passive and active listening. We found that passive listening produced clearer ERP waveform. However, active listening achieved higher accuracy and engaged less attention. Therefore, we recommend using active listening for an auditory oddball paradigm when assessing speech discrimination." (Charuthamrong et al. 2021, 1)

So far, we have seen how audio, midi and video materials are brought together in a widely used programming language max/MSP in digital arts with the power of generative computational models. Even if this method is widely used in almost all industries, we have also seen that it is likely because of bias towards Schenkerian analysis, there is a certain resistance in some vein of new musicological works towards generative practices in tonal music. Then, oddball paradigm implementation in music experiments demonstrated that the tonal hearing is somewhat predictable, thus it is intuitive. We have also seen that recently oddball paradigm was successfully diagnosed the speech discrimination in active listening that makes us to ask that question, in any active music listening, may oddball paradigm help us to identify some general principles of music segmentation?

Introduction to Methodology

At this part, first I will introduce a set of concepts and describe them briefly and then we will see their explanatory adequacies in the theoretical framework. Finally, I will apply this framework to a post-tonal composition.

A Set of Concept for Analysis

Set: While sets present an ordered list that refers to (0,1,2,3,4,5,6,7,8,9,10,11) = (C, C#,D,D#,E,F, F#,G,G#,A,A#,B,C).

List: An unordered number of items. For example, one item can take only one time in a set, same item can repeat several times in a list. This means that cardinal of sets and length of list are different.

Model: A rhythmic motive which is first time seen in the composition. For example, (0,2,4,5) would be seen in the first bar of a composition, then it may be transformed as (2,4,6,7) at bar 7. While the first set is model, the second set is pattern.

Pattern: A rhythmic motive which represents the prime or transformed form of a model. For example, (2,4,6,7) would be seen in bar 7 a composition, previously it may be seen for the first time in the m.1 as (0,2,4,5). While the first set is model, the second set is pattern.

Short Distance Pattern: If a pattern motive is patterned in the same part, it is called short distant pattern.

Long Distance Pattern: If a pattern motive is modeled in the different part, it is called long distance pattern.

Model Repetition: If a model is repeated somewhere in a composition without a transformation, it is called model repetition.

Pattern Repetition: If a pattern is repeated somewhere in a composition without a transformation, it is called model repetition.

Transposition: Transposition is a concept that is applied to tones and changes their register up or down. Depending on the time and pitch range, it has an impact on all tones or one or more than one tone in a set.

Formal Time: Time which corresponds to largo, andante, allegro etc. or beat frequency 60, 90, 120 etc. The acceleration or deceleration in time conventionally is realized by multiplication or division of quarter notes.

Perceived Time: Perceived time is frequently beat/metronome change proportionally to central beat of a composition. In this form, all notes of a composition of quarter and acceleration and deceleration are provided by beat changes proportional to central beat of the composition.

Metamorphose: A concept which is observed in patterns of model motive which the latter presents the original form. There are three types of metamorphosis.

Pitch Metamorphosis (pm): If a pattern is not an exact repetition, it is likely a pitch metamorphosed as one or more or all tones of a beam group transposed.

Time Metamorphosis (tm): If a pattern is not an exact repetition, it may be a pitch metamorphosed as the time of one or more or all tones of a beam group reshaped.

Pitch and Time Metamorphosis (ptm): If a pattern is not an exact repetition, it may be a pitch and time metamorphosed as one or more or all tones of a beam group transposed and time of one or more or all tones of a beam group reshaped.

Theoretical Framework

First step, open the score of the piece of music analyzed and listen to the composition to find whether beaming groups are intuitive or not. If they match your segmental hearing, it is great since it saves a lot of time. But if not, take step 2.

Beaming groups are important in terms of segmentation of music. If we compare it to language, it seems to be quite similar to word segmentation and syntax in natural languages. In terms of the segmentation, I would like to briefly talk about "garden path sentences" which is a concept in linguistics and a phenomenon in general.

> What is critical about these garden path sentences is that, once one figures out what the intended meaning is, native speakers can identify them as grammatical sentences or at the very least as sentences that have structures that would otherwise be grammatical in them. The problem for us as linguists is that native speakers have a really hard time figuring out what the intended meaning for these sentences is on those first few passes! (Carnie 2012, 16)

Think about the sentence below which has no confusion about what its meaning is.

Anna dressed while the baby spit up on the bed.

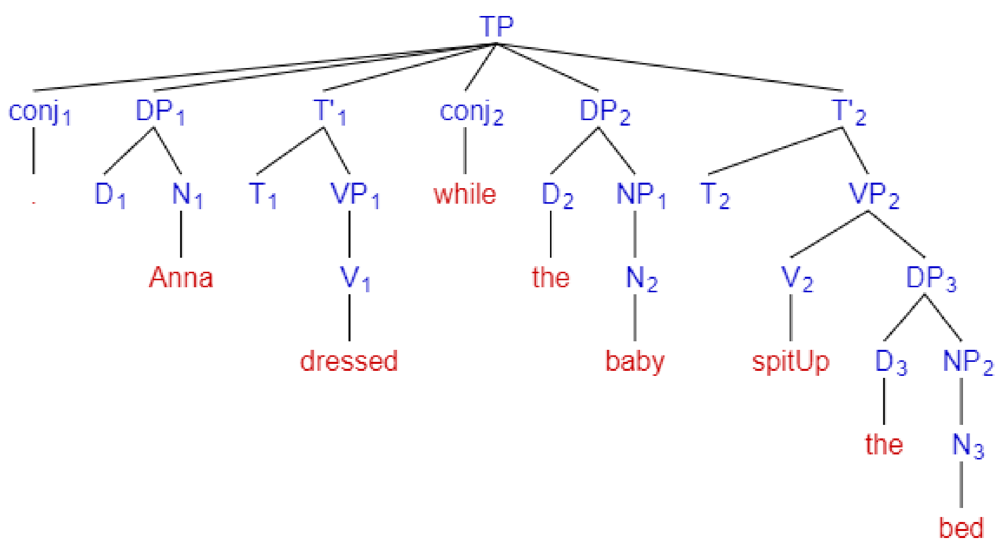

Figure 3 Sentence Parse

However, the while moves to the beginning of the sentence, we have a nasty image of Anna for a while and then "oh, Anna couldn't do this, usual suspect is the baby I guess, I will understand it that way" like inner thought brings many people to last decision about the sentence.

While Anna dressed the baby spit up the bed

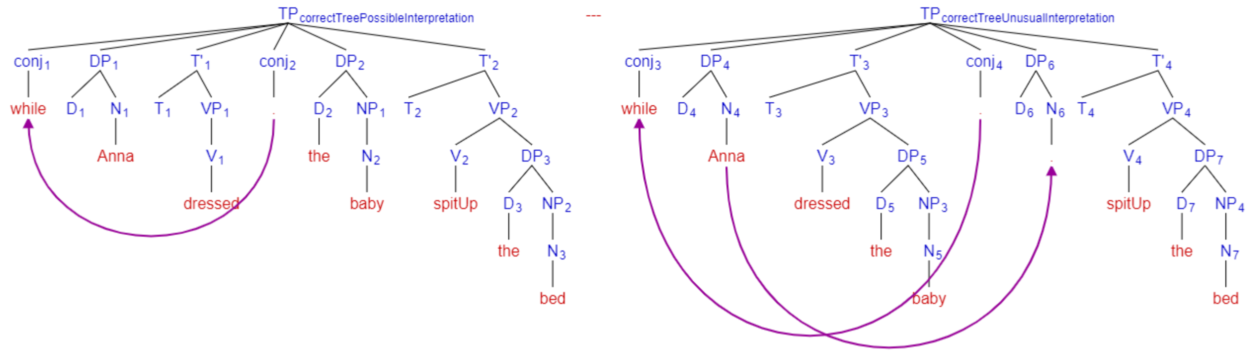

Figure 4 Garden Path Sentences

Another example might be words intertwined with each other e.g. Anot hereaxmplem ightb e wor dsintert wined withe acho ther. Really, hard time to understand what the phrase is, a great energy for the brain to spend and miss the rest of the discourse and failure to a smooth understanding from the whole.

This kind of garden path sentences or intertwined words have some counterpart in music, though it is hard to be sure enough all people hear it in this way, it is always good to say, I don't hear it in that written way, but it makes sense in this way.

Figures 5 and 6 include the same passage (find the same parts with comparison) from Shulamit Ran's "Inscriptions" mvt.i. I don't hear the first beaming group in the original notation in the way it is written but I hear it in how it is paraphrased in figure 6. This paraphrase has also had an impact on the rest of the beaming group.

This decision would be arbitrary for the analyst for now. However, I believe subconscious criteria under this arbitrary decision have closely to do with the oddball paradigm which I explained in the first part of the present work. The general approach is also quite related with Steve Larson's concept "inertia". Accordingly, we expect a musical continuum keep going on in the same pattern, which is easy to follow cognitively, however when the pattern is disturbed with a different motive, this increases the arousal and attention level. The threshold of this attention and arousal and the moment of stimuli emergence give rise to determine the segmentation onsets. In terms of Shulamit

Ran's relevant part of composition, ascending first motive in the fig 5 continues in the second beaming group; then, the last note of the second beaming group deforms the hearing pattern with a large leap that is the moment of the segmentation onset which is paraphrased in fig6. This paraphrasing also reflects on the later motives with the same reason. In the later part of the work, we have more than a hundred segments. We can keep in mind this concept of inertia and oddball paradigm leading way to segmentation criteria in the present work. However, this is a proposal and a deduction which needs to be approved in empirical studies and expand the scope of the categories.

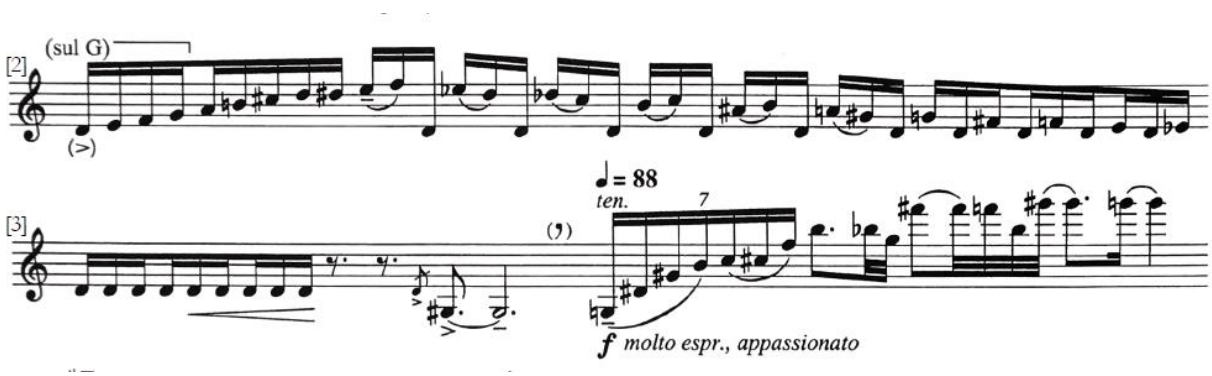

Figure 5 Shulamit Ran Original Segmentation (Beam Grouping)

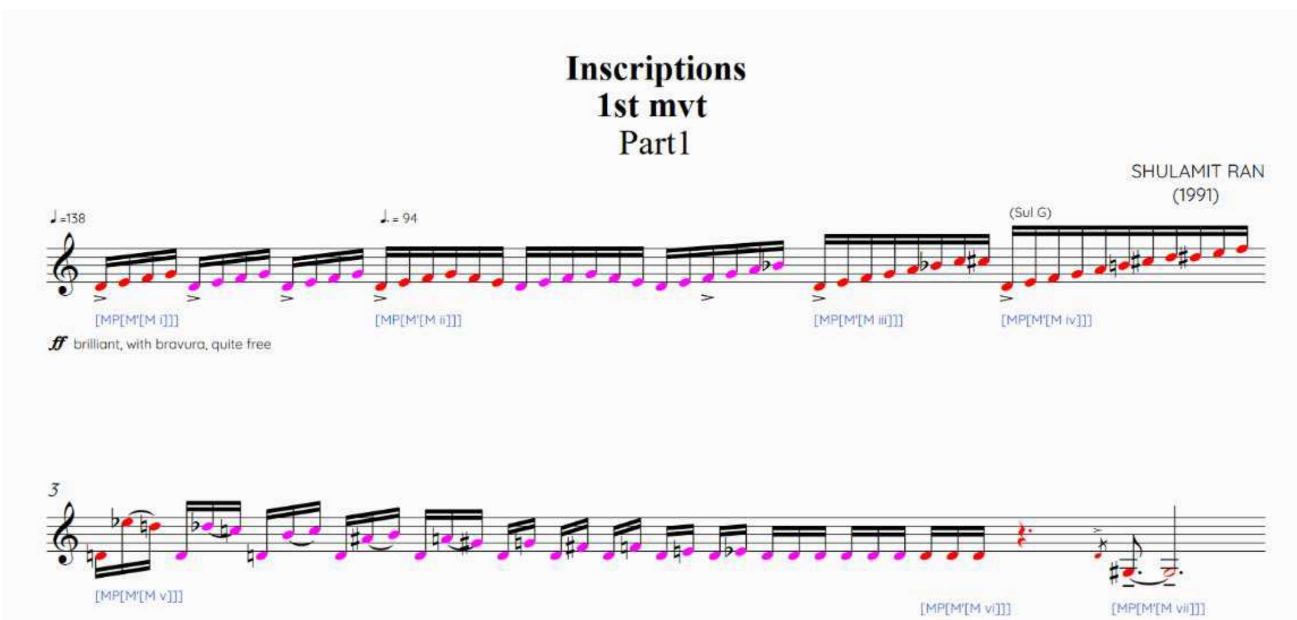

Figure 6 Shulamit Ran Paraphrase Segmentation (Beam Grouping)

So, if the score fails to match our intuition, we need to take the second step. It needs to close the score and take the actual performance into an audio editing program and label the smallest segments you think they are, without looking at or check them with the score, since sometimes it is misleading or distracting to see that you hear is a completely different segment with beaming groups on the score. As you go through, label the segment as "seg1", "seg2" and so on. For audio editing programs, audacity is a free and excellent program for our purposes. https://www.audacityteam.org/download/ . It takes a little time to see a YouTube video on how to mark some points in the audio file and label them. We don't always have to analyze an entire composition. From a phrase to a section of a sonata or concerto form like exposition is totally fine.

Third step, write the score on a notation software e.g. Muse score, Sibelius and compare your segmental hearing and what you see. At points what you hear doesn't match with that you see, then change the beam grouping depending on your hearing you have already marked in the music editing tool.

The fourth step is to mark segments on rewritten score with color coded two important concepts that are "Model" and "Pattern" which is described in the "A Set of Concept for Analysis". These two concepts also require us to look at global organization of compositions and find the sections. If we analyze a sonata form, the first step is to identify exposition, development, recapitulation parts and then focus on each point. This is because of four related concepts: the first two are "short distance model" and "long distance model". While the former is models for the first time encountered in a piece of music, the latter is seen in another section than first section. It means we can encounter a model for the first time in the development section in a sonata form which is called "long distance model". All the same, other related two concepts are "short distance pattern" and "long distance pattern". If we see an exact repetition or metamorphosed repetition of a model in the same section, this is called "short distance pattern" whose model in the same section. If we see an exact repetition or metamorphosed repetition of a model in a different section, this is called "long distance pattern" whose model in the different section. While I have already introduced the concept of "metamorphosis" and mentioned it here again, I am aware it is still a little abstract which I would do my best and it is likely to be crystal clear when we look at the analysis and practices of the current methodology. Closely related with model concept, "model repetition" is another concept that is the exact same of a model in a short or long distance. This relatively easy to grasp set of concepts' marking conventions will be clear in the analysis and practice part. We have seen the theoretical and methodological foundation at this moment.

In this explanatory adequative descriptive part of the formalization, even if I introduced them in the "A Set for Analysis" headline and give descriptions, I am aware of that I haven't answer the need of explanatory adequacy of this description of "Set", "List", "Transposition", "Formal Time" and "Perceived Time" concepts. We also see how they help this method to come into play with an analysis.

Analysis of Sofia Gubaidulina's "Senza Arco, Senza Pizzicato" in Ten Preludes

We are almost there to complete the present work with an analysis of Gubaidulina's one of works which is written in 1974. The crucial question of the first step: Is segmentation of the composition compatible with my own segmentation of sense of hearing. I am lucky enough to say "yes, it is" certainly compatible with my hearing but this doesn't save me from rewriting the score since it requires me to make a color-coded analysis to provide a smooth understanding of the analysis. First is the "Model Analysis".

Model Analysis

Model analysis begins with section control. However, we haven't seen any binary or ternary section in the present composition. Therefore, all models and their patterns will be called "short distant model" and "short distant pattern". How frequently this happens is as much as we can encounter a song or composition without form. Therefore, in later analysis, we will encounter many different long distant models and patterns.

In the present work there appears to be 8 motives as illustrated in fig7. The model's marking convention is simply "m" and, from left to right motives in a row indicate the numbers as is shown in the figure. Now, time is ripe talk about "prime", "set" and "list" concepts.

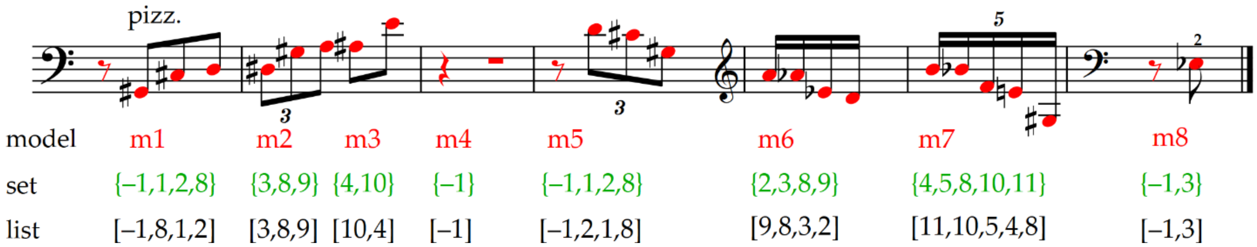

Figure 7 Model Motives

Prime is the numbers of the notes from 0 to 11, representing C,C#,D,D#,E,F,F#,G,G#,A,A#,B notes. In this analysis, rests lead to a segment as is seen in model4 (m4) and they are represented with -1. As we notice there are two rests in m4, but whatever number rests take place, these models will be counted 1 item sets. The numbering of sets as lists are do based. Therefore, the notes that take place in the beginning of a motive can't be marked as "0" but the position depending on "C". For instance, m2 begins with a D#. In this method and analysis, it is not taken as "0" but "3" as its position to the "C". Another point to notice here, the order of the set is not the order of notes that take place in the motive. For instance, in m6, we have A,Ab,Eb,D in the order of how it takes place in the motive. However, this line of notes is written in order of ascending integer number order from 0 to 11 e.g. A,Ab,Eb,D = 9,8,3,2 = 2,3,8,9. Conversely, list numbers follow the order of notes on how they take place in a motive. In the same example of m6, list numbers follow the numbers of notes in the exact order of that they take place in the motive.

Before explaining patterns, I would like to comment on two points. First, m5 is intended to be played as m2 in which it takes place in the original score as m2. However, it is played as it is shown in m5 in the real performance. My intention is not to analyze the score but performance, thus I presented m6 as a different model. Another point, models can start with rests.

Pattern Analysis

Now we are ready to practice pattern analysis which is closely related to models. Fig.8 shows the whole piece which is written with segment practices specifically. In this form, I haven't included the improvisational parts and phenomenal aspects like expression terms.

Whenever we see reds, these are model related stimuli and whenever we see a pink color, they are pattern units which are associated with models. Patterns are marked with the following notation:

Number next to “p (pattern)” shows the general pattern number from left to right. “m (motive)” indicates that pattern belongs to which motive, m6 in this case. Lastly, the number at the end shows repetition number of the pattern of a specific motive, again m6 in this case.

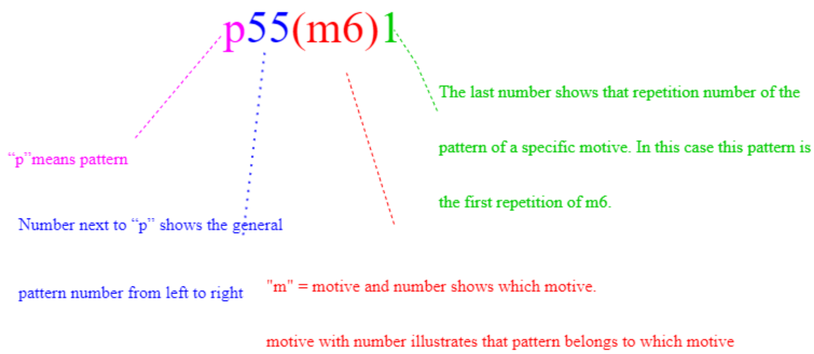

Figure 8 pattern notation

Figure 9 Segment Representation of Senzo Arco, Senzo Pizzicato

Figure 9 Segment Representation of Senzo Arco, Senzo Pizzicato (Continued)

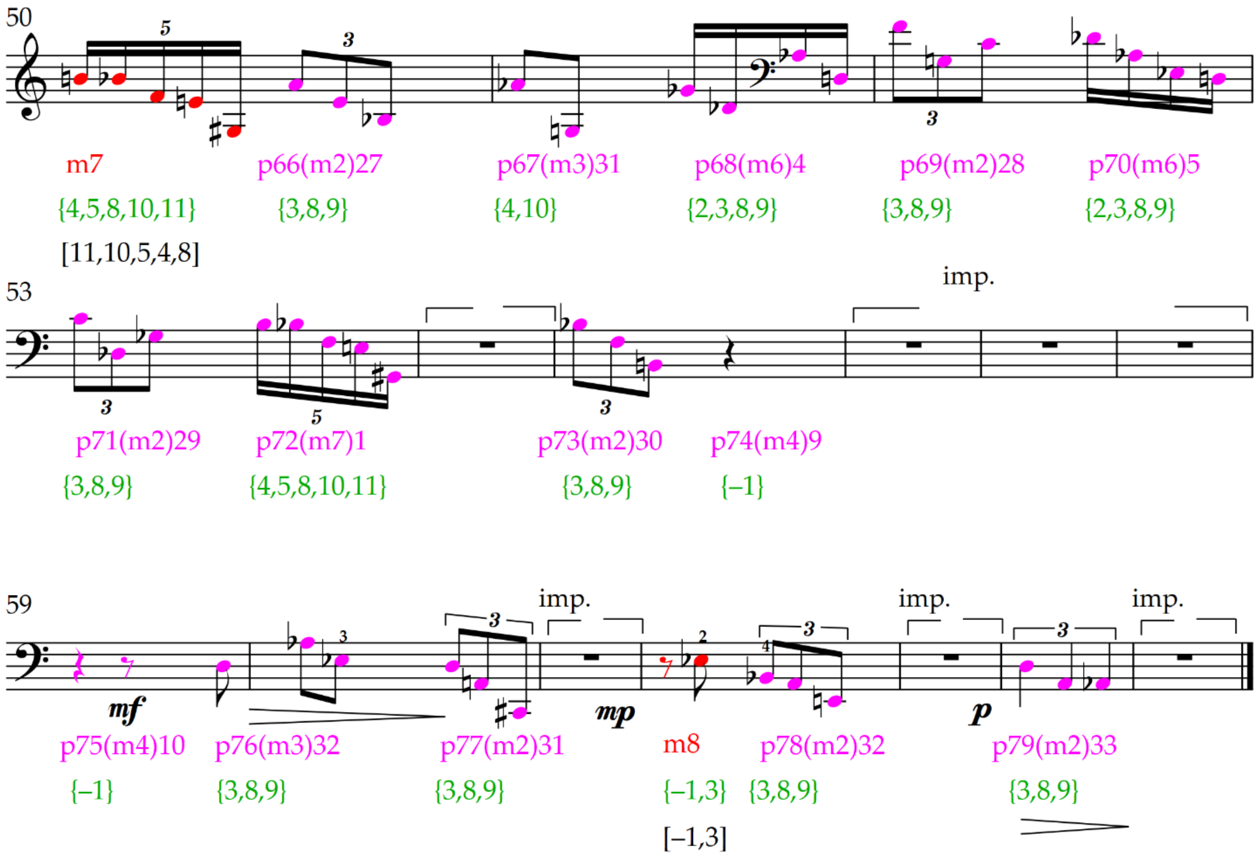

Figure 9 Segment Representation of Senzo Arco, Senzo Pizzicato (Continued)

This association is not cross domain conceptualization, but it takes its basis from the growing body of the composition or improvisation processes itself. However, if someone wants to apply it to embodied cognition drawing a conceptual matching with other domain of perceptions, it is more than welcome for a semantic interpretation. However, when we identify these units in an order, the syntactical structure will generate the semantic of the music. This abstract thought will be down to earth in another following paper.

Let us dive into a little further for the present analysis. Green notation indicates the set structures of the notes. And, if we notice there is no change of set under the pattern motives. This means that rather than dealing with the leaves of a tree, we will instruct the seeds to make the required transformations or metamorphosis. These seeds are model motives in the composition. This is not because of an ideological reason; it is because it makes things way easier when we apply this logic to programming as we do in the later part of the present work.

Another point to realize, I haven't indicated lists of patterns in the score. This is because it has a somewhat lengthy process which can't be properly shown on the surface structure of the staff notation. I will practice this analysis on only one model and one of its patterns. The same logic can be applied to other model-pattern analysis and relationships.

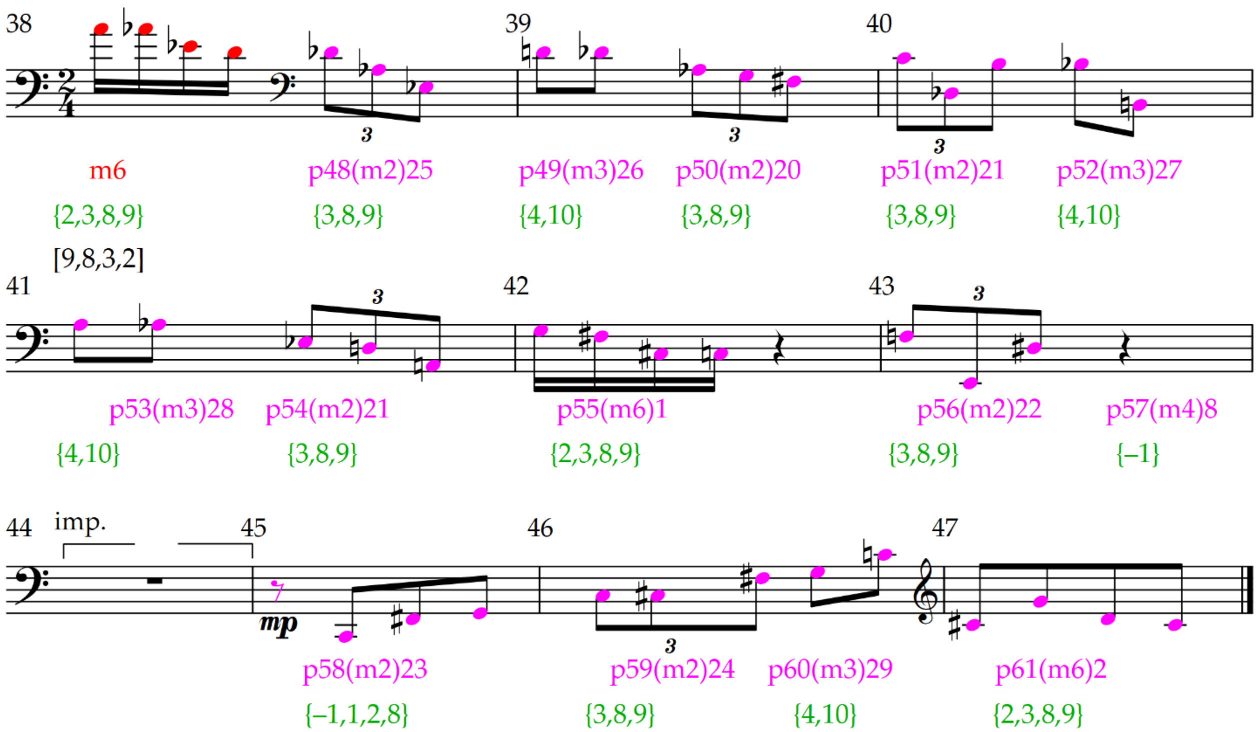

Figure 10 model-pattern list analysis

Fig10 consists of one model and its two patterns in the range of composition from m.38 to m.44. The first pattern of the m6 is p55(m6)1 and second p61(m6)2. I will focus on the latter since it gives us a sense of what a metamorphosis concept is in this analysis.

Step 1 shows that marking, set and list of the segment. As we notice, mark and set are already shown in the staff notation, but list doesn't. As a first step we can take the same list and take each item in parenthesis. As the second step, we will deal with the first items in the model and pattern motives. The first item of the pattern is -8 lower than the model. Therefore, I take the first parenthesized item in another parenthesis which tr(-8).When I apply this, it turns tr(-8(9)). -9+1 = 1, thus, it corresponds to the first note of the pattern motive. The third, fourth and fifth step is recursive. Thirdly, As the second item of the pattern is -1 lower than the model's second item. Therefore, I take the second parenthesized item in another parenthesis which tr (-1). When I apply this, it turns tr(-1(8)). -1+8 = 7, thus, it corresponds to the second note of the pattern motive. Fourthly, the third item of the pattern is -1 lower than the model's third item. Therefore, I take the third parenthesized item in another parenthesis which tr (-1). When I apply this, it turns tr (-1(3)). -1+3 = 2, thus, it corresponds to the second note of the pattern motive. Finally, the fourth item of the pattern is -2 lower than the model's fourth item. Therefore, I take the fourth parenthesized item in another parenthesis which tr (-2).When I apply this, it turns tr(-2(2)). -2+2 = 0, thus, it corresponds to the fourth note of the pattern motive.

Step1

Mark p61(m6)2

Set {2,3,8,9}

List [9),(8),(3),(2)]

Step2

List [tr(-8(9)),(8),(3),(2)]

Step3

List [tr(-8(9)), tr(-1(8)),(3),(2)]

Step4

List [tr(-8(9)), tr(-1(8)),tr(-1(3)),(2)]

Step5

List [tr(-8(9)), tr(-1(8)),tr(-1(3)),tr(-2(2)]

The outcome is list[tr(-8(9)), tr(-1(8)),tr(-1(3)),tr(-2(2))] = [1,7,2,0] = [C#,G,D,C]. This process is all the same for all model-pattern analysis. This gradual transformation of the motive can be called pitch metamorphosis.

In this motive, we have also seen a time metamorphosis in which the pattern p61(m6)2 decreases the time half of the original motive. This time metamorphosis can be denoted as follows.

Take step5's product as List [tr(-8(9)),tr(-1(8)),tr(-1(3)),tr(-2(2))] and take this whole expression into the time parenthesis t(beat/2) reduce to half.

T [t (beat/2tr (-8(9)), tr (-1(8)), tr (-1(3)), tr (-2(2)))] = [t(beat/2(1), (7), (2), (0))] = [t(beat/2(C#), (G), (D), (C))

The whole resulting motive p61(m6)2 is a time and pitch metamorphosed unit.

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