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Taxonomy of Listening Tensioning based on Cognitive Dissonance

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Abstract

Based on a literature review of James Tenney's Consonance-Dissonance Concept Paradigms and re-cent studies on musical tensioning based on cognitive theories of psychological tensioning, a classification of listening tensioning will be proposed based on the different types of sub-processes that are encompassed under the label of musical tensioning. The topic of musical tensioning will be approached as a series of differentiated processes. A distinction will be made between elastic and liquid tensioning depending on the sub-processes used. The different timescales of the tensioning process and their relationship to the basic element of dissonance. The types of tensioning will be related to their theoretical frameworks and generative models, and how their implicit or explicit knowledge influences tensioning. Finally, a theoretical framework for tensioning based on Cognitive Dissonance will be speculated.

Keywords: Cognitive Dissonance, Musical Tension, Listening Tensioning, Consonance and Dissonance, Neural Mechanisms.

Introduction

Musical tensioning and dissonance are terms that have been used in a lot of different ways. For example, according to Tenney, there are 5 different paradigms in the use of Consonance Dissonance-Concept(CDC) [1]. The words consonance and dissonance have been used, historically, in at least five different waysexpressing five distinctly different forms of the CDC. Before the rise of polyphonic practice, they were used in an essentially melodic sense to distinguish degrees of affinity, agreement, similarity, or relatedness between pitches sounding successively. During the first four centuries of the development of polyphony, they were used to describe an aspect of the sonorous character of simultaneous dyads, relatively independent of any musical context in which they might occur. In the 14th century, the CDC began to change (again) in conjunction with the newly developing rules of counterpoint, and a new system of interval-classification emerged, which involved the perceptual clarity of the lower voice in a polyphonic texture. In the early 18th century, 'consonance' and 'dissonance' came to be applied to individual tones in a chord, giving rise to a new interpretation of these terms which would eventually yield results in diametric opposition to all of the earlier forms of the CDC. Finally in the mid-19th century, conception of consonance and dissonance arose, in which 'dissonance' was equated with "roughness," and this had implications quite different from those of earlier forms of the CDC. These five different conceptions of consonance and dissonance will here be called CDC-1, CDC-2, etc., through CDC-5; one of these paradigms is related to a theoretical and aesthetic framework.

Regarding musical tensioning, it is usually defined, in the musical literata, as the link between musical events and emotions. According to [2], "tension is one of the core principles of emotion evoked by music, linking objective musical events with subjective experience" . We can create a more abstract definition that explains not only emotional responses to musical flows but a broader response to sound flows, as a complex neurocognitive state that is a structure of emotions, neural states, and information extracted by an objective sound flow. Listening tensioning in a subjective neuro-cognitive psychological state elicited by an objective sound flow. The state includes the way the musical flow is processed and the knowledge extracted from the sound flow. If the sound flow is a musical work, then the listening tension is a musical tension that links a state elicited by an objective musical flow. Subjective means here that there is not a strong correlation between the set of states and the set of musical flows. Sound art and new forms of sound flows that are not emotion-driven require new models of listening tensioning.

according to Lerdahl and Jackendoff musical work, but it is a quite elusive term, because it is not as objective as the musical flow is, and the neural processes that drive this phenomenon are still barely known We can explain the musical phenomena as a process in which several tensions and relaxations occurs [3]. Tension is an evoked reaction to music that engages the listener in the musical flow. Tensioning is related to a stress that requires resolution. So, how the stress is created will determine the type of tensioning.

As we have seen, there are five paradigms of Consonance-Dissonance-Concept (CDC) and their corresponding theoretical frameworks. The CDC is the basic element of a tensioning system, but they are not the only element that generates listening tension. From the point of view of this text, the distinction between the CDC-4 and the other ones in the most important. The CDC-4 is based on Rameau's Theories [4]. The CDC-4 is no longer defined by a feature of the musical materials that are dissonant. What differentiates the CDC-4 from all other paradigms of dissonance is the broken link between the properties of materials and the dissonance. The dissociation between the dissonance and the properties of material makes the difference between the classification of agents as consonant and dissonant blurred and more ambiguous. According to CDC-5, the dissonance level of a musical object can be established by a metric well established; it will be the same regardless of any context (Sensory dissonance). In the CDC-4 and in the Cognitive Dissonance, the metrics to evaluate the dissonance depend on the context. The far from the properties of materials, the more diffuse and relative are the assignations of consonance and dissonance, depending more on the context and not on a single parameter, opening the possibility of disonancing more musical parameters and generating conflict between dissonances associated with the properties simultaneously coded in different parame-ters.

Traditionally, the dissonance – consonance has been the base of the tensioning process and the tension and relaxation process in those two cases are correlated, but the need of a new approach to listening tensioning that includes non-normative tonal music, non-emotional driven music, sound art and forms of conflict between different properties of materials in a multiparametric approach in which the classical correlation between dissonance and tensioning is only a concrete case of a very more abstract theory.

Cognitive Dissonance

Cognitive dissonance (Festinger, 1958) is defined as a type of tensioning generated by a conflict in which a cognitive change is needed in order to resolve the tensioning. Tensioning is always associated with conflict. Cognitive dissonance is related to decision-making theory, and it is usually analyzed in a decision context. In the context of the dissonance associated with the properties of musical mate-rials, the tension is a fluctuation of a tension generated from the properties of a musical material, for example, a dissonant chord, and the relaxation produced but the resolution of this chord into a chord whose property as a chord is consonant. Regarding the cognitive dissonance, the conflict and the decision is whether the cognitive system that is analyzing the sound flow is correct or not, and if a change or not is required in the way the information is processed. The Cognitive dissonance is characterized by a temporal dissociation of the relation of the material properties and the dissonance in the CDC-4 the dissonance is no longer related to the properties of the material, but still has a temporal location related to the subject of dissonance whereas in the cognitive dissonance the dissonance is completely unrelated to the properties of material or the temporal location of subject of dissonance production. According to [5], the listener generates predictions on what is going to happen according to what has happened. The cognitive dissonance is created by the conflict when those expectations are not fulfilled. The Cognitive Dissonance depends on the way the expectative are generated and the violation of those expectative .

The Cognitive Neural Mechanism Underlying Cognitive Dissonance

From a neurologic point of view, according to, "decision associated with a higher level of cognitive dissonance elicited a stronger negative front central deflation that peaked 60 ms [6]. After the decision. This activity shares similar spatial and temporal features with error-related negativity. According [7] to the Relationship Between Tension Ratings and EEG Brain Responses Compared with well-formed sequences, larger N5 and decreased power in the alpha band were shown when listening to the music sequences with structural violations at phrase and period levels. The effects of these distinct brain responses were in parallel with the changes of behavioral tension ratings, in that the close corresponding relationship is indicated by the similar time windows. The modulation of musical structure on tension ratings and brain responses can be explained by predictive processes.

Elements of Tensioning Systems, Time Scales, and Violation of Formal Hierarchies

Subject of the Basic Unit of Tensioning

As we will see, the dissonance is the basic unit of the first temporal tensioning scale. But as we have seen in Tenney, what makes something dissonant can be related to the properties of the dissonant ob-ject or can be measured according to other phenomena, CDC-4. In the same way, the object that carries the dissonance can vary from one paradigm to another. If the dissonance is related to an object with several features, the object can be dissonanced in several ways according to each feature. Although tonal music only considers the relation between pitches as a dissonant feature, we can find in non-tonal music, in sound art, other ways of disonancing musical objects according to different fea-tures. According to smith, each feature of the material can be dissonanced in several ways. For example, a musical object is more dissonant if it is in forte than is in piano.

Even in classical tonal music, we can find examples of dissonances in other features than pitch, for example kerbs, explains the metrical dissonances in the work of Schumann, and the way they are related to the normative dissonances. According to Krebs, the conflict of layers of different metrics creates a conflict that generates metrical tensioning [8, 9]. Cognitive dissonance is characterized by not being dependent on those processes, and it is not located in a concrete temporal position of the work, nor a concrete feature of the work. If we dissociate the dissonance from the properties of materials, the dissonance is then relative to the context; for example, in a tonal environment, a consonance can be perceived as a dissonance . The more relative we get according to the formal structure of the work, to what dissonances are relative, the more cognitive we are. The systems based on the tonal model of tensioning are more related to the properties

[1]This idea was used in the work Cognitive dissonance (2014)

of the material (sensory dissonances). In the basic time scale, to a chord and its dissonance in the middle scales, and then to the centrality of pitches as the generative process that creates the tension and the resolutions through modulating forms.

Regarding the subject of what is the element that generates tension in the more basic time scale, we have three possibilities. The sensory dissonance associated with a concrete feature of a musical object, for example, the dissonance produced in a chord, that depends on the critical band produced by the superposition of the notes (CDC-5). The second is that the dissonance is associated to an object, but it does not depend on the properties of the object but instead it is not necessary dependent on a physical property of the material or depends on the superposition of several ones so the dissonance is applied to an object but is overall measure depends on several features and the context induced by the musical frame, for example, in an intermediate time scale, the same chord can have a different tensioning grade according to the tonality and the development of the work. But the tensioning is still in the object itself. The third possibility is when the dissonance does not depend on a concrete object nor on a concrete moment of time, but on a conflict due to that expectation not being fulfilled. A very dissonant chord from the perspective of material can be very relaxing if it means the full fitment of a conditioned expectative. That is the reason why in atonal music, sometimes tonal chords are perceived as consonant. This third possibility is cognitive dissonance. ¿but which one is the object that is the carrier of tension?

Tensioning Temporal Scales

There is a close relation between tensioning and the time scales of the work that are hierarchically or-ganized. We can find in the musical literata explanations of musical tensioning related to the formal definition of the work. For example, in a tonal framework, moving away from a tonal center will induce tension, and a relaxation will appear when returning to the tonal center [10, 11, 12, 13]. In this type of musical tensioning the musical structure, the theoretical explanation, the construction of the work, and the tensioning are related. IE, the own construction of the work follows a constructive principle that is related to an expected musical tensioning model. The theoretically related tensioning can be measured by correlating the musical phenomena with the tension state.

The musical flow is usually formed by several hierarchies and scales of time in which different tensioning processes are related. The number of levels depends on the formal model of the work. The basic level of tension can be found as a resolution of a dissonance that can last only a few seconds, and a larger hierarchical level that is a musical phrase or the complete work itself. The group of events that belong to the same scale share a common memory and a common architecture of expectancies. In a short memory range, expectancies work differently than in a long-term memory, so we have a different tensioning scale that operates according to different types of memory.

According to (Sun L., Hu L., Ren G., and Yang Y., 2020), the violations of hierarchical structure induced a high-tension experience, which was not completely resolved at structural boundaries, but accumulated subsequent musical passages unfolding. The EEG results showed larger frontal distributed negativities (N5) at GFP peaks, and decreasing power in the alpha band (8–13 Hz) in response to the structural violations. Compared to phrase violations, period violations elicited larger N5 and induced a longer-lasting decrease of power in the alpha band, indicating a hierarchical manner of musical processing. suggest that the reason why the violation of hierarchical structure generates tension is that the brain processes the sounding infor-mation hierarchically. That is the reason why there is a relation between the kind of object that generates the dissonance and its time scale, related or correlated.

There is no such thing as a closed enumeration of the number of time scales or levels of hierarchical tensioning, but we can classify for convenience three different levels of hierarchical tensioning. The basic one, the intermediate level (or levels), and the higher level, that is the work itself. Here we can see that the dissonance associated with the property of the musical objects defined inside the theoretical model that provided the formal procedure of the musical work is itself the basic element of this musical tensioning. The principle of the theoretical musical tensioning is based on the properties of musical materials based on a central parameter. For example, in a tonal classical work. The basic time scale is the resolution of a dissonance (present memory Window); the intermediate scales range from a cadence of a musical phrase to a group of phrases organized with a shared long-term memory. And the high level is the return at the end of the work to the original key (long-term memory). Note that in each time scale the subject of tension and the type of memory are different, for example, in tonal music the subject of tensioning is a sensory dissonance and its resolution, in the intermediate time scale level the subject of tensioning is the grade of the chord that resolve in the tonic, and the large time scale is a modulating structure of tonalities. So we can explain the tensioning model of a tonal work related to the complex superposition of tensioning of these three different hierarchical levels of musi-cal tensioning. The departure from a central tone creates a conflict that is resolved when returning to the central key. Conflict is a key principle to explain tension.

We can think that one line of explanation of the evolution of musical structures is the number of intermediate levels included in the work, so they can have more extreme tensioning and longer durations. In this context, there is an explicit intention to induce a number of temporal scales in the tensioning process. For example, according to According to (Lerdahl and Jackendoff, 1983), in Classical music, we can find four levels (musical section, phrase period, and movement). The basic temporal element is the short-time dissonance and its resolutions.

The medium time in which a sequence of succession of consonances and dissonances resolves into a cadence, and the Long time resolutions in the scale of the formal structure in with a modulation structure that begins in a key, generating conflict by the distance from the original key and returning to the fundamental key to generate a relaxation of the tension, but in this paper, we relate the time scale to the type of memory they are related to. Each type of music is defined by the number of scales of tensioning. The development in Western classical music is based on the augmentation of the intermediate temporal scales

² This idea was applied in the work Centrifugus (2024) creating a conflict between different geometrical centers .

of tensioning. The more temporal scales we have, the longer and sophisticated the work is.

There is a relation between the object that is the basic unit of dissonance and time scales, when the dissonant unit is related to a fixed property of a fixed object it is very efficient in the basic scale of time but when we are in the uppers hierarchical structures of the work the tension is less related to the properties of materials even in tonal music and the tensioning process is less dependent in the properties of the materials, but we can have a complete work of music without cognitive dissonance with a musical listening based on a very structured form based on the tensioning produced by the tonal structure of modulations and materials.

Roles of Tensioning

There are three grades of tensioning: stress, relaxation, and neuter.

Stressing Elements

those that generate tension. Relaxation elements: Those that relax the stress. Neuter element. They do not carry tension or relaxation. In a normative tonal work based on tonal chords, the V grade will a stress genetarot , and the I will a relaxing one. Even though in the tonal normative theory the neuter element is never taken into account, in the cognitive tensioning, the neuter element is the most important one, because we can use it to change the subject of dissonance. Thanks to the neuter elements, we can obtain a lot of semiotic ambiguity, and because we can use them to change the way materials are dissonanced.

The neuter elements do not participate in the actual tensioning process, but the more neuter elements there are, the easier it is to create logtern hierarchical structures based on the change of the role of the elements, which is only possible if we have neuter elements. The fact that we can neutralize an element from a tensioning point of view is the basis for the dislocation of the properties of a dissonant object and its tensioning role, and that there is not a fixed correlation between certain properties of a material of a disonancing or tensioning role.

This can happen even in a tonal context, for example, the same chord from the perspective of the material properties can be a tensioning or relaxing element relative to the actual tonality, so the same chord can be neutralized by a modulation. (This was exploited regarding parametric tonalities in my work, Parametric neutralizations studies in which the same parameters are neutralized by making parametric modulations).

Monoparametric VS Multiparametric Tension

As we have seen, the dissonance (sensory or cognitive) is the basic unit of the temporal scale of tensioning. Depending on its paradigm, the dissonance can be associated with different musical materials or properties of the sounding material.The number of parameters or features that are involved in the tensioning process can vary from one parameter to multiple parameters. In tonal music, most of the tensioning processes from basic dissonance to large tensioning scales are related to a central parameter, which is the pitches. In this type of music, the tensioning is less based on error or cognition conflict, but in the stress distance from the tonal center and its return. In this type of Monoparametric music, there is no conflict in the different codification of dissonance or tensioning distributed in several parameters. We can increase the number of cognitive dissonances by creating a generative multiparametric system with several tensioning parallel processes.

In the Monoparametric generative systems, the stress is generated by the distance from a point. This is an elastic tensioning, like a spring that is tensioned by a force and relaxed when the force is removed. But in a multiparametric generative system, the tensioning is based on the conflict between the different tensioning codifications of each parameter of the prediction driven by cognitive dissonances. Extreme tension can happen in Monoparametric systems, but this type of tensioning is less related to cognitive dissonances. Furthermore, the tension is correlated to the stress, so it is quite predictable. The hierarchical relation between time scales and tensioning works perfectly. We can think of a narrative effect driven by the dramatic meaning; no matter how predictable they are, they will generate tension. The drama like character of the extramusical meaning of Monoparametric systems is quite efficient.

Relation between Tensioning Scales, Subject of Dissonance, and Parametric Thinking

As we have seen, there is a relation between the theoretical model and the explanation of the work and the tension. The knowledge (implicit or explicit) of the musical flow we are hearing influences the way the tensioning is created. That is the reason why we need a Theory and a generative process based on Cognitive dissonance. The knowledge of the musical form creates expectative, surprised, and error-related experiences [14]. If there is no prior knowledge, the tensioning works in a different way.

Some of the cognitive process that generate expectations seems to the learned from the knowledge of the musical flow. Error-related vs surprise-related.

Unfortunately, most literata do not differentiate properly between the tensioning generated by error and that generated by surprise. Surprise happens when a very probable event, but legal according to the theoretical frame, happens. An error is when something happens that is understood as an error (a violation of the theoretical musical rules). This is the reason why there is a Relation to a theoretical frame.

Tensioning Systems

A tensioning system is an structure formed by the set of all the possible neurocognitive states in the listening process, a set of theoretical frames that defines the composition model and the models that predicts how it will be cognized, the basic tensioning unit, the number of temporal scales, the definition of the roles of tensioning, and the subject of dissonance. According to, the tensioning process has several components. The events that trigger tension follow different processes that rely on different neural mechanisms, surprise instability, conflict, and error. We are going to follow the idea that there are several cognitive sub-processes associated with the tensioning process, and we are going to create different tensioning paradigms.

Elastic tensioning is more related to the surprise and instability concept. The surprise concept is associated with an event that is not expected, but it is not an error; for example, we can find in the music of Mozart a lot of examples of surprises, but those surprises do not violate any formal model. According to there are four different ways of creating surprise: schematic surprise, Dynamic surprise, veridical surprise, and conscious surprise. They differentiate in the relation between the violation or no of the rules of the predictive cognitive model and the knowledge of the listener of the musical rules. He defines four different ways of achieving tensioning.

Elastic Tensioning

We use the term elastic (or sensory tensioning) as a metaphor for a spring stressed by a force that generates tension. The basic unit of tensioning is the dissonance associated with a property of material (sensory dissonance), which is associated with a sensory property of a musical object that is usually a chord or an interval. The intermediate time scales are organized around the same parameter, the pitches, but now in a hierarchical set of chords organized around a central pitch. Their relaxing or tensioning potential deepens with the frequency put as central. So the formal concept of the work is based on a parametric centrality that generates the tensioning process. The predictability of the tension is high and related to the generative side. The elastic tensioning is more related to surprise or instability than to conflict or error appreciation. Elastic tensioning is Monoparametric, and if there are more parameters considered in the tensioning process, usually they are aligned with the main parametric process, not making conflict, as for example in the metrical dissonances of Schumann. We can find in some contemporary works an elastic tensioning based on changing the parameter that acts as central. For example, timbre in Ligeti, rhythm in Stravisky (or rhythm complexity in more recent works), or stochastic density in Xenakis.

The stochastic music from Xenakis can also be considered as elastic tensioning because there is a main process that is related to a main centrality. For example, the tensioning is based on the density of objects, although this density is not related to a concrete parameter of the sounding discourse. In elastic tensioning, the stress is obtained even when there is a great fulfillment of the predicted expectations. For example, one of the most predictable sequences of events is a modulant march. The fulfilment of this prediction is followed by the tension. This only happens in elastic tensioning. In Elastic tensioning, the fulfillment of the predictions does not avoid the stress from happening; on the contrary, in a context of cognitive dissonances, the fulfillment of the predictions avoids the arousal of the musical tension. There is no better way to show the difference between elastic tensioning and liquid tensioning than examining the relationship between fulfillment of prediction and arousal of tension. In real life, all works are halfway between these categoriesmore or less near of one category. The same applies regarding a literal repetition of a musical fragment. In elastic tensioning, the repetition of a musical fragment generates the same tensioning; in liquid tensioning, the repetition of a musical fragment does not arouse the same tensioning.

Liquid Tensioning

We call it liquid tensioning because it is not localized in a place or exact time, and it does not have a well-established measure. If we apply a force in a liquid, we obtain a diffuse reaction, and it will not be symmetrical when relaxing the force. This tensioning is less predictable, and the prediction of the tension is not correlated with the generative proccess, so the tension is on the listening side, not on the generative side. This is an error-related tensioning, and it is not related to the sensory immediate perception, but in the secondary cognitive process of the sensory information.

Table 1: Relation of time scales and listening tensioning

Scale	Elastic tensioning	Liquid tensioning
Basic Present Window	Sensory dissonance	Cognitive dissonance
Medium Short-tern	Progressions and cadencies based on parametric centralities	Expectancies based on short-term memory processes.
Long-term	Structure of modulations generating a distance from a center and the return to the center.	Expectancies based on long-term memory processes.
Tensioning subprocess	Surprise, Instability	Conflict, error

But another different approach is that musical tensioning happens when an error occurs that is outside of the theoretical framework, so there is a tensioning when there is a lack of correlation between the constructive tensioning principle. This is the liquid tensioning (Or cognitive) that it is not related to the theoretical frame but to the error in the theoretical frame. This is the cognitive tensioning. And it is related to the conflict generated by the possible different interpretations of the sound flow. Error related tensioning is not correlated to the own musical expectations. Cognitive Musical tensioning is associated with the failure of a prediction, and it is furthermore interwoven with the musical concept that makes certain occurrences an error. Error related tensioning is associated with cognitive dissonance instead of properties of materials.

Musical tensioning is a complex phenomenon in which very different processes work together. We can categorize the tensioning system depending on which of those processes gets the focus. Cognitive dissonance as a paradigm means that there are different systems of tensioning which each of which is based on a different unit of basic tensioning, and that each one of these categories focuses on different was of processing the sensory information. Cognitive Dissonance is not the same as musical tensioning. The Cognitive Dissonance is the minimum unit of tensioning in liquid tensioning. In the same way that the sensory dissonance is the minimum unit in the elastic tensioning .

In a liquid tensioning context, Cognitive Dissonances are dissasociated with time. This allows new forms of disonancing time and using time as a composing material. Paradoxically, with liquid tensioning we can experiment with new forms of material dissonances [15]. The liquid tensioning displaced the subject of creativity from the elaboration of musical material that is integrated in the generative model to the creation of new concepts of musical materials. Following this, the focus is on the listening layer. The subject of creativity is the creation of the framework where the listening can create a new meaning.

In a liquid tensioning system, there is no exact temporal location of the cognitive dissonances, so the time is liberated from this function. This liberation can be exploited to use the time as musical material in in new form in a multiparametric approach where time as a parameter is no longer subjugated to the parameter that is central in the elastic tensioning. This was especially exploited in the work Parametric formalizations studies.

Proposal of a Theoretical Frame for Liquid Tensioning

As we have seen, the theory influences the listening tension in two ways: first, in the way that the music theory creates the generative systems and models, and 2, on the listening side, the knowledge of the structure of the listening flow determines some aspect of the musical tensioning because expectancies and errors depend on the knowledge of the system. There is a lot of music theory about traditional elastic tensioning, but there is not that amount of theory regarding liquid tensioning.

The key points of a theory based on liquid tensioning are: Dissociation between the musical tensioning and the formal structure. The works are built in such a way that there are at least two different layers: a generative process layer and a listening layer. There is no correlation between to generative process and how the listener perceives tensioning. The more dissociation there is between the generative process and the listening process, the more liquid the musical tensioning is. In the elastic tensioning there is an intended correlation between the formal layer and the listening layer.

Dissociation of the features or properties of sound from the musical materials. The use of musical materials that are completely defined around a feature of sound or a parametric centrality to create an elastic tensioning, is avoided. We can generate liquid tensioning only with materials based on cognitive dissonance. Traditional materials based on the sensory properties of sound are changed for musical objects that are not based on parametric centralities. For example, a melody of parameters, changing the concept of scale by the concept of parametric scale, and so on. The fewer musical materials integrated in the generative process, the easier it is to achieve liquid tensioning.

Turning a Monoparametric form into a Multiparametric Process

If we create a formal or generative process that involves several different processes associated each one with different parameters, we can generate conflict between the different elastic tensioning associated with each parameter, as we can see in the music of Schumann, we can generate different dissonances associated with each parameter. If those processes are correlated, they reinforce an elastic tensioning. But if they are independent, the conflict between the different independent processes will generate a liquid tensioning. The more parameters that are dissonanced in a non-correlated way. The easiest way is to achieve a conflict that will generate liquid tensioning. Working with cognitive models and listening conditioning

The rules of the generative process are extracted from cognitive models and cognitive rules rather than traditional musical materials. We can use some models of cognitive science to generate certain listening processes or sound ilusions that are not related to a particular feature of sound. We can use the cognitive models that explain how the perception of a parameter influences others to create musical illusions that provide listening tensioning [16]. Avoiding parametric centralities, as we have seen, elastic tensioning is based on parametric centralities, so creating sound flows generated without parametric centralities is one of the forms of achieving liquid tensioning.

Ambiguity and Multimeaning

Any semiotic references to known materials must be avoided to force the listener to create their own meaning. If the materials are designed to have several ambiguous interpretations, we facilitate the conflict on the listening side. Generating ambiguity in the musical materials creates conflict of interpretations that are the core of cognitive dissonance. The more we can neutralize one material (in the sense that the role of tensioning of this material was carrying is changed or neutralized) the more Cognitive dissonance we get.Examples of generative processes created to generate liquid tensioning and cognitive dissonance.

We can find some examples of generative systems that avoid parametric centralities in the cognitive-parametric music theory elaborated by (Egido F., 2011). In this book, he proposes several formal generative processes based on the creation of parametric materials that do not depend on the properties of the materials or on parametric centralities [17]. For example, he proposes creating formal structures based on parametric modulations instead of tonal modulations; the formal structure is based on modulation between scales of parameters instead of scales of pitches. Those parametric materials are organized formally, creating a process that does not rely on the properties of materials or parametric centralities.

Hi, proposed a generative algorithm system that is based on the superposition of different simple patterns that repeat with a process of growing complexity. The tensioning of the work is created by moments of recognition of the patterns and moments in which this recognition is not possible. This process was determined by the relation between the capacity of the memory to remember patterns on a large scale (out of the present memory window) and the long-term memory.

"Theoretically", tonality is not necessarily incompatible with liquid tensioning, as we have seen in Schumann. We can create dissonances associated with different parameters. If they are correlated, they produce elastic tensioning, but if they are uncorrelated, for example, a strong metrical dissonance in the pitch consonances, we can create conflict between the different noncorrelated processes that generate liquid tensioning. The work for piano solo transcentrality was designed as a proof of concept of this idea [18]. How to generate a work with the maximum amount of cognitive dissonance and liquid tensioning in a pseudo-tonal contexas well as the concept of cognitive consonance. It was generated using a system that created four streams of monophonic lines. Each stream is generated by a patterns that repeat cyclically; those patterns act as a monophonic generators.

Conclusion

The fact that musical tensioning is a complex phenomenon, which involves different neural and cognitive processes, permits a classification of different tensioning categories based on those phenomenon. The fact that those categories are related to explicit and implicit knowledge of theory involving the creative process and the correlated expected perception of the music according to those theories allows the speculation of new music theories about the new forms of listening tensioning [19]. We can classify the listening tensioning systems taking into account the basic unit of tensioning of that system. This way we can differentiate between the tensioning systems based on cognitive dissonance as the basic unit of tensioning, as liquid tensioning, and the tensioning systems based on the sensory dissonances as elastic tensioning, which is based on the dissonance of the properties of materials (CDC-5).

To create a paradigm of musical tensioning related to cognitive dissonance. We can create a new theoretical musical framework based on cognitive dissonance in which there is no dependence between the properties of materials and the dissonance. Liquid tensioning is cognitive dissonance-based. As we have seen, the theoretical frame influences the way the tension is generated. That is the reason why we need a theoretical frame for liquid tensioning.Tensioning refers to a wide spectrum of states and process that requires proper differentiation, and as long as the knowledge of the theoretical frame that generates the sound flow influences the way it is decoded.

This taxonomy is the first one of another ones that will come when new cognitive sciences research sheds light on the complexity of the listening tensioning. Under the tag of listening tensioning lies different processes that rely on different mechanisms. There are not only two listening tensions, but there are more axes and poles about musical tensioning not properly differentiated. Further new taxonomies of tensioning will inspire new theoretical frames and new generative systems.

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