Morphopoiesis
A general procedure for structuring form

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Abstract. Composers have always needed tools to craft their music and theorists need a methodology to analyse compositions. This paper examines a theoretical framework for a general procedure for structuring musical form. It studies the organising principles of the internal attributes of a musical work that give a unit its specific identity, the functional relationships between it and other units, and the ordering and direction of those units. During recent decades, timbre as a basic form-bearing dimension has attracted the interest of an increasing number of composers and theorists. In the light of this interest, a formulation to define the structural procedures of form becomes indispensable as a result of the new content and the new questions which it raises.Different procedures for structuring form have been developed throughout the history of western music. They have always been related to the content, to the musical material used in each period. A brief retrospection is presented, from the Middle Ages to the present, of the evolution of form as a process. This historical survey concludes with a definition of the process of *Morphopoiesis* and suggests a next step in the evolution of musical form. The proposed framework continues with a more in-depth analysis of *Morphopoiesis*, analysing it into four hierarchically-ordered levels. From the highest to the lowest levels respectively these are Cognition & Perception, Motion, Typo-morphology and Transformation. The Transformation level is further refined by a description of the main transformation form types and their sound process domains. An array of researches and theories has been taken into account to form the levels of *Morphopoiesis*. Several theories and concepts are included from works on psychoacoustics, music perception and cognition by McAdams and Bregman, on sound morphology and typology originally introduced by Schaeffer, and on spectromorphology by Smalley. Morphopoiesis integrates all these theories into a general procedure which aims to provide a better insight into how form is structured, and therefore a better understanding of the music itself. Morphopoiesis is a tool for listening to, analysing and making music of all kinds, ranging from electroacoustic music to instrumental and vocal music. It is the abstraction of the creative process at its fundamental level, the form.

1. Introduction

Although it is evident that music takes place in time, it has always been a compositional issue about how form unfolds in time. The word *form* itself can sometimes cause confusion by referring either to a generic type – the overall structure of a composition such as symphony or mass, or to procedures that define how sound units are put together to make phrases and sections. This paper focuses on the latter procedures, on form-creating devices in which small bits of material are treated to many different presentations and combinations [DeLone 1975]. It examines structural processes that determine all the note-to-note – or better, sound-to-sound – details.

For centuries, the main form-bearing musical elements were melody, harmony and duration. From the way these musical elements are used, an experienced listener can easily identify the century in which a composition was written, even the composer by whom it was written. During the last few decades, however, a new dimension has begun to emerge as a form-bearing element, that of timbre[1] [McAdams 1983]. The use of timbre as a form carrier may suggest a new content, a primary material ready to be shaped and to acquire form. The concept of form as unified with content constitutes a key to the better understanding of musical organisation. As Edgar Varèse has said, "Form and content are one. If there is no form, there is no content, and if there is no content there is only a rearrangement of musical patterns, but no form" [Varèse 1936]. The new relationship between timbre and form does, however, bring to the fore some questions. How can timbre be a form-bearing element? What are the procedures that empower it with such attributes? What sort of process should it be run through? How is it connected with musical form?

The change from one type of form-creating device to another is related to the content, in other words, to the sound material used each time. As well as the endogenous evolution of musical elements throughout the history of western music there are also some exogenous influences that have dramatically increased the use of timbre today. Music technology has played a catalytic role in expanding sound possibilities and changing our cognitive and perceptual approaches to sound. Leading research institutes such as the GRM and Ircam in Paris, the CCRMA in Stanford and the Institute of Sonology in The Hague are some of the centres in which a considerable amount of work on timbre and its relation to form has been done and is still being done. In addition, new instruments, both hardware and software, have been introduced which are capable of producing almost any sound one can imagine. Software tools such as the phase vocoder, the sound editor and the sequencer have become easily accessible to composers today. As far as instrumental sound is concerned, again the use of computers and software has made it possible to manipulate an incoming signal instantly during a performance. In addition, in instrumental tradition, new ways have been developed for the manipulation and control of the sounds that instruments can produce: an early example of this is that of Bartolozzi [Bartolozzi 1982] and his 'timbral techniques', the so called extended techniques.

This paper will propose a general procedure for structuring form, a process that could encompass a great deal of electroacoustic music as well as a great deal of the mixed, instrumental and vocal works of recent decades.

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[1] The term *timbre* refers to the intrinsic and extrinsic attributes of a sound to which we can ascribe meaning [Smalley 1994].

2. The phenomenon of Ithaca[2]

Timbre as a form-bearing musical element has undoubtedly been of great interest among composers and theorists since the 1950s, especially those who use the electroacoustic medium. A basic approach that could ascribe formal attributes and musical discourse to timbre is the notion of transformation [Smalley 1997]. This term can be used to describe structural procedures that shape the sound in time. The notion of sound transformation could be defined as the apparently 'natural' continuation of a sound texture or gesture with emphasis on the process of gradual change from something to something else [Landy 1991]. Sound transformation is important because it provides the fundamental procedure for forming timbre. A transformation can give functional meaning to the growth of form. There are several early examples from the electroacoustic repertoire where timbre acquires formal content through its change in time.

The composer Trevor Wishart has stated that he finds the interpolation aspect of a given sound transformation more important than its departure and arrival points [Wishart 1994]. Essentially, his thought is that the way a transformation is developed in time is more important than just the transformational concept itself. Alvin Lucier, in his work *I am sitting in a room* (1970), builds the work through a gradual transformation of speech into singing. The step-by-step disintegration of the speech and the reinforcement of the resonant frequencies becomes the focal point for the listener. As Lucier said, "… what we found interesting was the gradual process itself" [Lucier 1980]. Another early example of transformation can be heard in Jonathan Harvey's work *Mortuos Plango, Vivos Voco* (1980), in which the sound of a struck bell occasionally seems to melt into the singing voice of his son as if this were a natural continuation of the sound [Harvey 1980].

There are, however, other trends and musical styles that keep the sound objects, but change the context: a sort of transformation that concerns a spatial or contextual transformation, not directly a sound transformation. The composer Denis Smalley uses the term 'transcontextuality' to describe a process of transcontextual interpretation where listeners can be involved when the sound sources used in a composition are taken from nature or from cultural activities without change, or when the transformation applied to the sound does not destroy its original context [Smalley 1997]. The concept of transformation will be further examined later in this paper, with an analysis of the main transformation form types and their sound process domains.

3. Morphopoiesis as a general procedure

In an effort to define more precisely a framework for a systematic form-creating device, this paper introduces the term *Morphopoiesis* [3]. It is proposed to give a rather specific

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and descriptive process paradigm of structuring musical form that derives from the interaction between content and form. *Morphopoiesis* offers an abstraction of the primary principles by which a new musical form is built up. It focuses on the procedures of the inner formal characteristics of a musical work which give to a sound its specific identity, the functional relations between it and other sounds, and the motion and direction of those sounds. In contrast with past procedures of musical form which are based on musical elements such as rhythm, harmony and melody, *Morphopoiesis* is mainly based on timbre. It is an analytical tool for analysing, listening to, and making music of all kinds, ranging from electroacoustic music to instrumental and vocal music. It refers to music that concentrates its interest on changes in the intrinsic and extrinsic attributes of the sound in the flux of time.

This process can be more easily and effectively applied, however, in electroacoustic music where the composer, with the help of computers and specialised software, can manipulate, mix and process sound with great precision and detail. In instrumental music, the sound manipulation and control can be achieved either by the use of live electronics, where a computer can receive music as it is being performed and can process it and play it back in real time, or through fixed, pre-recorded electroacoustic sounds which are played together with the instrument(s).

The etymology of the word is simple: *Morphopoiesis* is a composite word consisting of the prefix morpho- which means structure, shape, form (from the Greek *morphē*), and the suffix -poiesis which means creation, formation, production (from the Greek *poiēsis*, which is formed from the verb *poiein* "to make") [Microsoft Encarta 2003].

The process of *Morphopoiesis* consists of four levels which will be further explained after a brief historical overview of the main form-processing types used in the past.

4. Form as a process: a retrospective

It is difficult to distinguish compositional procedures, since most of them imply some transformation of the initial material with the retention of certain essential original features [DeLone 1975]. As a result, these procedures may not be entirely universal but they can be sufficiently general to give us a better understanding of the craftsmanship of musical form in each historical period. In all the structural processes of the past, the complex is created by combination of the simple, which remains discrete and unchanged in the complex unity [Chester 1970]. Today, the notion of discrete and the notion of complex are not the same as they were in the past. Listening theories such as those of Bregman [Bregman 1990] or McAdams [McAdams.1989] and compositional approaches such those of acousmatic or spectral music propose new ways to experience and to understand music. The formal elements have changed and if Varèse's claim that "form and content are one" is correct, then the content has changed as well.

Every epoch in western music from the Middle Ages until the present is characterised by a general type of structural process, although not all music falls into these types. More than one formal method may be used, however, including intermediate types in the same period. Table 1 shows the four main structural processes, including *Morphopoiesis*. Each process is related to its era, the musical texture that characterises it and a representative form. In a more detailed way, Figure 1 represents

graphically the same structural procedures by giving a simple example of each process. Each of them will be further explained below.

Table 1. The structural processes according to their historical period, musical texture and form. The names given for the structural processes have been chosen by the author, among others, in order to describe better their content.

Era	Texture	Form	Structural process
Middle ages	Monophony	Gregorian Chant	Text setting
Renaissance/ Baroque	Polyphony	Canon, Mass	Sectional variation
Classicism/ Romanticism	Homophony	Sonata	Developmental variation
1950-present	Current [4] textures	Current forms	Morphopoiesis

4.1. Text Setting

By the start of what is known as western music in the Middle Ages, church music is vocal, fluid and non-accentual in rhythm [Morris 1935], and the melodies are free and seem to wander, articulated only by the Latin liturgical texts to which they are set. They depend, that is to say, on the length and metre of the poetic stanza. The most common and simple among the formal patterns of this period are the repetitive formulas of the psalm tones of Gregorian chant.

An analysis of Figure 1 below shows that the first contour represents a consistent whole – something that remains consistent, an unchanging quality, which during the Middle Ages used to be based on liturgical texts with its main form type being the Gregorian chant. The music has a start and continues by unfolding the same small group of notes based on modes. It is articulated by the rhythm suggested by the text. There are neither distinctive themes or motifs nor any development or contrast.

4.2. Sectional variation

In the polyphonic music which was written from the Renaissance to the early Baroque, the organisational procedure outlined for musical formation was the *sectional variation* process. The basic musical units comprised melody and rhythm and functioned as a framework which extends itself by repetition while it builds up modulations of the initial notes and by perceptual inflections of the initial melodic, harmonic and rhythmic patterns.

In the second line of Figure 1 the starting point moves to the next step as an inversion, whilst the last step is an inverted retrogradation of the starting point. Along with imitation, both of these are very common techniques for creating musical form by the time of the Renaissance and the early Baroque. Other common forms using the structural process of *sectional variation* include the canon, round, ricercare and motet.

4.3. Developmental variation

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[4] By the word *current* I do not imply a certain era or form, but refer simply to the time I am writing this paper.

In the period of classicism, musical form is built from a network of inter-related motifs that take on new appearances within and between movements by the change of rhythm, melody, dynamics and instrumentation [DeLone 1975].

The third contour in Figure 1 shows the starting point and then demonstrates how the second part (2) of it creates a progression, possibly through the use of a harmonic chain. In the next stage, a new and contrasting idea is reborn from combinations and modifications of elements of the initial idea, but markedly different from the preceding stage. The most representative form of *developmental variation* structural process is the *Sonata-allegro*.

4.4. Morphopoiesis

For the period from 1950 to the present, the term *morphopoiesis* proposes a next step to the evolution of structural process in western music. At its base, *morphopoiesis* describes the way one sonic identity is combined with another through transformation. It is a perceptible process in that a listener is able to hear the process happening throughout the performance. This becomes unavoidable, especially in electroacoustic music where a representation of the music is not always necessary for the performance. Unlike electroacoustic music, in the previous types of structural process the notational representation can give a clear idea of the form of the piece before it is actually heard.
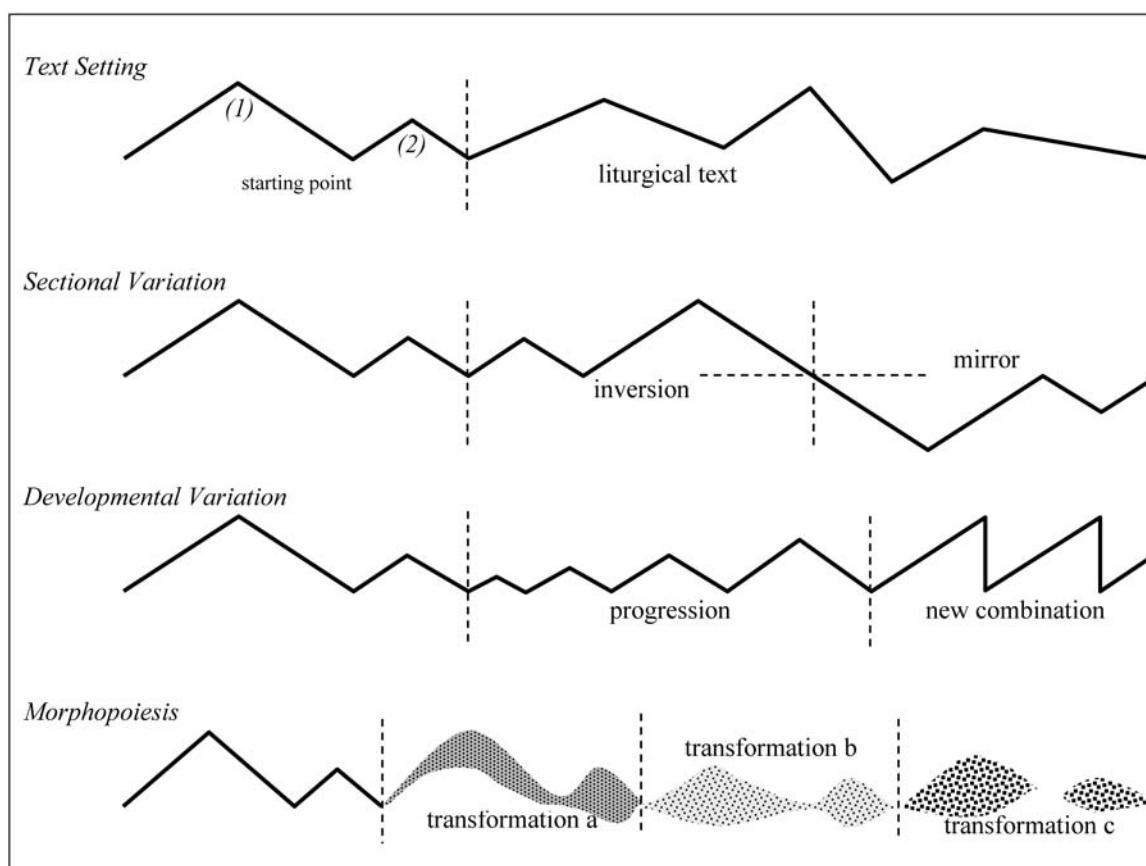

Figure 1. From top to bottom: the evolution of the compositional process from the Middle Ages to the Baroque, and from Classicism to the present.

In Figure 1, the stages separated by dotted lines are not intended to represent a 'natural' musical flow but rather to show an example of some further steps in the

process. The starting point represented by the black thick line is transformed to an even thicker texture in 'transformation a', although it keeps most of the melodic profile [Chion 1983] of the starting point. In the next stage, the spectral elements and the mass profile [Chion 1983] of the sound change more and the overall shape goes a step further away from the previous stage. Finally, in 'transformation c', the two parts of the initial idea are separated by silence and the whole morphology and spectral components of the two sounds now become even more different from the previous stages.

5. Defining structural levels

A hierarchical framework of the four levels will now be introduced, from the fourth or highest to the first or lowest, with the scope to analyse the structural process of *Morphopoiesis* at its primary components. The categorisation of the four levels of *Morphopoiesis* takes into consideration the research done by several theorists and practitioners in areas such as music perception and cognition by McAdams and Bregman, sound morphology and typology originally introduced by Schaeffer, and spectromorphology by Smalley. *Morphopoiesis* integrates these theories into a general procedure that aims to provide a better understanding of how form is structured.

Table 2 summarises the levels and the descriptors of each level. A detailed explanation of each of them follows.

Table 2. The four levels of Morphopoiesis and its structuring formal elements

Levels	Description
Fourth Level (Higher)	Cognition – Perception
Third Level	Motion – Texture - Gesture
Second Level	Identification – Classification - Description
First Level (Lower)	Transformation – Sound Process

5.1. First Level

The first level placed at the base of the structural process of Morphopoiesis is the transformation. This describes the form type of the gradual change from one point to another and the sound process(es) used for it in the flux of time. Transformations can normally be applied in a point to point form. This results in several other variations, of which the simplest are that of Binary transformation – from point A to point B (AB) – as well as Ternary transformation (ABA), Arch transformation (ABCBA), and so on (*see* Table 3). In addition, transitions from point A to point B may be realised *via* cross-stage steps called *transitional chains*. As a result of this process, for a binary A to B transformation extra steps can be added in between the start point and the end point to create a *transitional chain*. The degree of the gradual transformations can vary from fast to very slow, from a rapid succession of gestures that changes in time to a slow textual evolution. Landy suggests that sound transformation should happen gradually within a minimum of about four seconds in order for it to be perceived by the listener [Landy 1991].
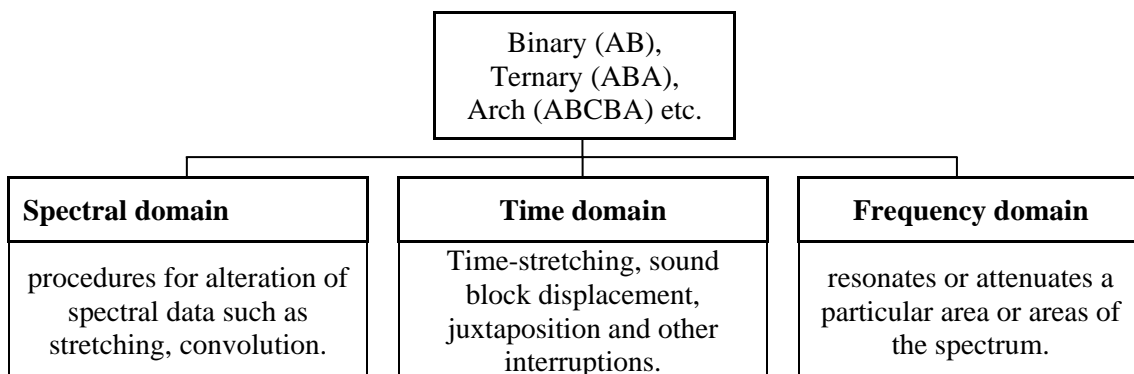
In addition, the first level of *Morphopoiesis* clarifies the sound process used for the transformation in its totality (*see* Table 3). That is, in addition to the independent process, the sound units themselves can undergo a general sound process which characterises the whole transformation. In practice, however, the technique most likely to be used is that which involves more than one sound process of the same domain, and even a combination of different domains. Nevertheless, it is not always necessary for a sound transformation to be interwoven by a sound process too, although this is most common.

Three are the main types of sound process:
1) *Spectral domain* – procedures for the alteration of spectral data such as spectral stretching and convolution;
2) *Time domain* – with techniques such as sound block displacement, time-stretching, interleaving, freezing and interruptive effects in time before certain blocks emerge; and
3) *Frequency domain* – processes like filters which resonate or attenuate a particular area or areas of the spectrum.

From the early 1970s, the composer Trevor Wishart developed a large number of procedures for sound processing almost all of which can vary through time. The Phase Vocoder is used to provide most of his spectral transformation tools such as spectral morphing, shifting, stretching, cleaning, banding, tracing, blurring etc. Wishart has said that, "the musical structure of the piece was conceived in terms of such transformations between sound types …". A more detailed documentation for all these tools can be found in his book *Audible Design* [Wishart 1994].

Table 3. The main transformation form types and their sound process domains.

Binary (AB), Ternary (ABA), Arch (ABCBA) etc.		
Spectral domain	**Time domain**	**Frequency domain**
procedures for alteration of spectral data such as stretching, convolution.	Time-stretching, sound block displacement, juxtaposition and other interruptions.	resonates or attenuates a particular area or areas of the spectrum.

Another process domain could be considered to be that of Context, or Space. However, the transformation realised in both of these is not directly related to timbre. In fact, the timbre remains unchanged while the aspect of context or space changes. Although the musical potential of context and space is of great interest, it is beyond the scope of this paper, since their transformational attributes are not directly related to timbre.

5.2. Second Level

The second level of Morphopoiesis considers the typo-morphological procedure; the specific identity of the sound material, the functional classification and relationship between it and other sound units, and the detailed description of those sounds. Once the type and process of sound transformation has been defined, the next level is required in order to study the sound material available as pure sounds without any contextual

influence and to evaluate and arrange them into groups and categories. After being identified and classed, the sounds are described in great detail according to their intrinsic and extrinsic attributes. Schaeffer [Schaeffer 1966], in his description of *Solfège de l'objet Sonore*, proposes seven morphological criteria: mass, harmonic timbre, dynamic, grain, allure, melodic profile, and profile of mass [Chion 1983]. Under these criteria, the whole structure gets a clearer and smoother direction through unified and coherent sound identities.

A proposition by Landy categorises binary sound transformations in five ways according to the following categories, four of which are parametric and one is contextual sorted: *1*) comparable ... incomparable sounds, *2*) discrete ... continuous, *3*) short ... long, *4*) representational ... abstract, 5) same sound ... different context [Landy 1991]. This categorisation does, however, assume an *a priori* integration with level one and it does not take into account the next two levels. Another example is that of Fischman, who has provided the following seven suggestions: Differentiability, Similarity, Duration, Linearity, Spatial movement, Diversions and Context which, depending on the circumstances and the context of a composition, may help in producing convincing results of sound transformation [Landy 1991].

5.3. Third Level

The next level in ascending order attributes motion and sets stronger relationships between spectral typologies and morphologies. The definition of motion and its classification into six categories (bi-directional, uni-directional, linear, curved-linear, reciprocal and centric/cyclic) proposed by Smalley is a comprehensive guide that characterises both small units and whole phrases or sections. The energy of motion is expressed through spectral and morphological changes. When the changes refer to the internal structure of the sound, the music is primarily textural without forward motion. In music which is primarily gestural, the changes refer to the external structure of the sound driving the material forward. All degrees of combinations between texture and gesture can appear within a single composition. An in-depth examination of the motion and growth process is provided by Denis Smalley's texts [Smalley 1994].

5.4. Fourth Level

The fourth and highest level of Morphopoiesis studies the relationship between sounds and the brain's interpretation of them. Perception and cognition are deliberately placed on the highest level to enable the listener to grasp a large-scale pattern if there is one, to understand the balance between units, or to connect the primary with the secondary parts of the music. This final stage is the level that aims to integrate all the previous levels into a whole.

Many recent experiments and theoretical approaches by researchers such as Stephen McAdams [McAdams 1989], Fred Lerdahl [Lerdahl 1992], Albert Bregman [Bregman 1990] and others have shown that structuring musical form itself is not enough if it cannot be understood by the listener. It informs the composer about the constraints and possibilities of the apprehension of musical form in terms of the perceptual processes and memory structures which are activated as form is accumulated in the mind of a listener. The interaction between composer and musical form depends on an understanding of both music cognition and perception.

There are several examples of music, such as total serialism and aleatoric music, where the form processes and the sounding music do not always have any audible connection. Morphopoiesis is a form process that must be heard when the piece is performed. It is a systematic framework for the way we listen to and appreciate music. It is necessary if a listener is to become aware of the new content while distrusting preconceived ideas and relying first and foremost upon what is heard.
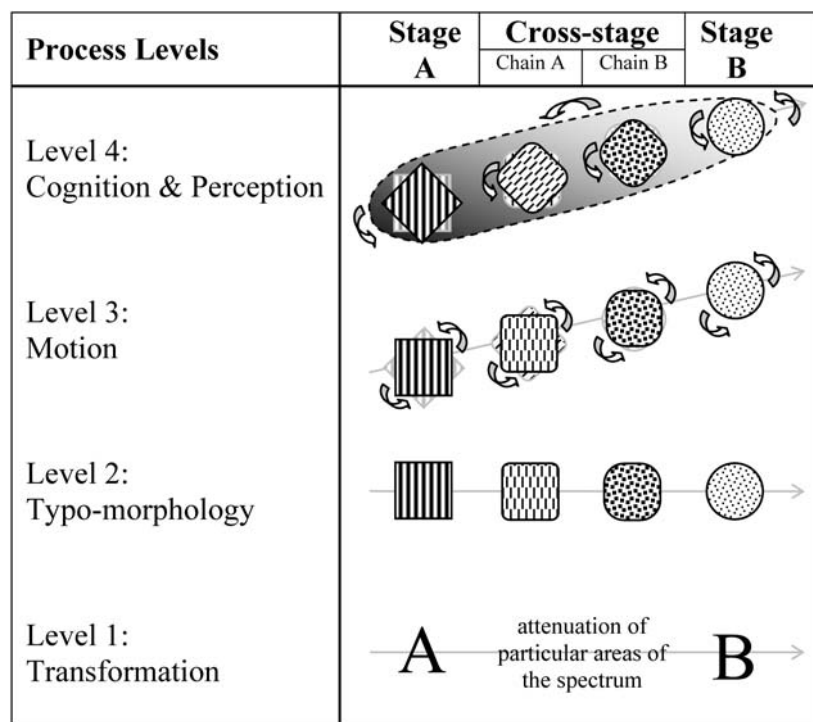

Figure 2. The four levels of *Morphopoiesis* with an example of a Binary A to B transformation.

The representation in Figure 2 presents this process in greater detail. It begins with Level 1 at the bottom where the two points A and B are identified and the two intermediate stages are being determined. This model can already be identified as a *Binary* transformation with a two-stage *transitional chain*. The *sound process domain* of the model is further clarified and its particular effect is revealed, which is a sound filtering process. This involves a continuous attenuation of particular areas of the spectrum. The *sound process domain* is considered to be an overall process that passes across the whole transformation. The use of the typo-morphological characteristics of the sounds at the second level helps the sound material to be placed in order and classified into different types and groups according their morphological characteristics. At level 2, the corners of the square graphic representation of the sound take on a more and more rounded shape until they eventually become a circle. Concurrently, the sound filtering process is applied gradually. At level 3, the individual sonic units acquire motion; a rotating motion is achieved through spectromorphological variation. At the same time, a slow ascending motion adds direction to the rotational motion leading the listener to expect possible outcomes. Finally, at the top level, the primary sonic units lose their individual identity and contribute to a totality. The whole transformation sounds like a spinning gesture that moves upwards while its spectral density attenuates and eventually moves to the destination point. The same time, the sound qualities change from rough (square) to rather glossy (circle). It becomes a compound sound

object that bears functional elements able to create expectation and tension, to create music.

6. Conclusion

The concept of *Morphopoiesis* suggests a general procedure for structuring musical form. It studies how the smallest sound units are put together to make phrases and sections: to make music. It summarises the work done by numerous practitioners and theorists over recent decades on the organised use of timbre and its perception. Although the knowledge and the experience acquired over all these years covers a great many of the aspects and approaches to this process, they were disparate and widely-scattered without a single unifying thread to connect the elements. I hope that the unified approach proposed in this paper can offer a systematic and in-depth tool to both theorists and composers, a tool for the better understanding and appreciation of a considerable amount of the music today. That is, music which focuses on changes to the inner and outer attributes of the sound in time. This is best represented by the majority of electroacoustic music, as well as by a number of instrumental and vocal works.

Unlike conventional procedures of form which are based on musical elements such as rhythm, harmony and melody, *Morphopoiesis* is related mainly to timbre. The use of sonic attributes as a form-bearing dimension has undoubtedly opened up new possibilities for the composer. At the same time this new content has raised the question of what is the procedure of structuring form by means of timbre. On the basis that timbre can be a main form-bearing element and that content is strongly related to form, then this new content must suggest a new form as well. However, there is no past reference at all, at least in western music, to describe such a procedure. *Morphopoiesis* provides a basis that aims to identify and clarify a general procedure capable of giving an exegesis about the relationship between content and form. It also offers an analysis of the primary principles on which the potential new musical form is built.

The better understanding and refinement of structuring procedures can help us to appreciate and create a more successful articulation of the musical form. This is important because form can be considered as one of the main components by which coherence in a musical work can be achieved and through which a listener can experience music at its finest qualities. Although this can be true for any music of any time, this same general truth claims the process of *Morphopoiesis*.

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