Chronotope: the mutual dependency of time and space in visual music

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ABSTRACT

This article proposes an interdisciplinary and multimodal approach on visual music presenting three different perspectives relating to audiovisual chronotopes; the abstract notion of artistic consciousness in non-representational art, the space-time relationship between sonic and visual elements in the visual music idiom and finally, the notion of emotional intent versus response proposed in recent cognitive science studies. Three recent examples of my own visual music works are described in relation to multisensory stimuli and audiovisual chronotopes, defined in this text.

1. INTRODUCTION

The human sensory experience has increasingly been underpinned by technological advancements of the time. Particularly since the avant-garde period of the early twentieth century, experimental art forms have emerged directly from technology and conversely, have influenced technological means to convey human expression from the concrete to the abstract. Since the invention of the optophonic piano by Baranoff-Rossiné, the early sounds of Russolo's *Intonarumori*, the transformation of color organs and the evolution of sound synthesis techniques through to the expansion of computer music technology, our capacity to innovate and explore new conceptual realms reveals a fascinating quest to push the creative boundaries of technology through all its forms.

With the natural tendency to merge, diversify and share various forms of artistic expression and aesthetics, time and space have become the most malleable assets of the artist's and composer's creative *instrumentarium* through which the combination of music and visuals is most effective in conveying various forms of human emotions and concepts, be it actual or non-representational. Humans perceive and experience events through multisensory processing and information processing, yet it remains a challenging task to create unified artistic gestures without resorting to separate sensory channels. More often than not, audiovisual projects are the result of collaborative processes between practitioners in specialized fields. Increasingly however, new expressive forms emerge from the 'organic amalgamation of sound and image' and become unified through 'historical processes led by aesthetics and technology' [4].

Multimedia technologies are perhaps the natural outcome of a systematic approach to represent abstract concepts in the material world. Conversely, abstract conceptual ideas are embodied in the technological means that unveil and communicate human emotions even further [19]. Systematic ramifications support our creative imagination and fortunately technology imposes some limits prompting new challenges to expand the creative mind. Within these limitations, the incentive for the creatively inclined person is to find solutions circumventing technological barriers. New aesthetic dimensions emerge from the cross-fertilization of ideas and interpretations.

2. AN INTERDISCIPLINARY APPROACH

2.1 Time Space Dichotomy

Chronotope is a term that was coined by twentieth century Russian philosopher and literary critic Mikhail M Bakhtin to refer to how time and space are described and represented in literature. Multimedia and audiovisual art lend themselves well to the term due to the very nature of the art forms concerned. Time and space have increasingly become mutually dependent, especially through the use of technology. The visual music work *Chronotope* (Zavada 2013) combines electronic music, computer art and abstract digital expressionism through non-linear use of technology combined to create mutually dependent time-space structure and form as a single gesture over linear time.

When considering a visual music piece the following notions are to be considered: form, structure, context, genre, aesthetics, semantics and poetics, all within the realm of the imaginary, abstract and conceptual world. Visual music is most often than not, non-figurative, non-representational, yet does not exclude a hidden narrative form, depending on whether recurring and perhaps even non-recurring elements have significant and symbolic essence in the construction and formalization of the work. One must consider the question of cultural significance

and social context in which a visual music piece is created. Paradoxically, works combining several layers of material and media can have contrasting attributes containing both narrative and abstract connotations but remain non-figurative in most cases. Which alludes to the question of representational versus non-representational art.

2.2 Semiotic Metaphor

In his four essays on the dialogic imagination, Bakhtin proposes the idea that in poetic genres, artistic consciousness – understood as a unity of all the author's semantic and expressive intentions – fully realizes itself within its own language… the language of the poet is his language, he is utterly immersed in it, inseparable from it, he makes use of each form, each word, each expression according to its unmediated power to assign meaning as a pure and direct expression of his own intention [3].

The same ideas can be applied in the context of realizing, materializing emotions and consciousness in visual music, where the immersive experience becomes an extension of the composer's mind, an abstract representation of the artist's interpretation of time and space, the world we live in.

Bakhtin makes the case that verbal art must overcome the divorce between an abstract 'formal' approach and an equally abstract 'ideological' approach. In this context, 'Form and content in discourse are one, once we understand that verbal discourse is a social phenomenon — social throughout its entire range and in each and every of its factors, from the sound image to the furthest reaches of abstract meaning' [3].

In terms of chronotopic analysis, meanings exist not only in abstract cognition, they exist in artistic thought as well and we incorporate them into the sphere of spatial and temporal existence (as chronotopes), as well as into the semantic sphere. Bakhtin argues that meanings within our (human) experience must take the form of a sign that is audible and visible for us. Without such temporal-spatial expression, even abstract thought is impossible [3].

3. AUDIOVISUAL CORRESPONDENCES

3.1 Visual imagery in the creative process

The interdisciplinary scientific study of the mind and its processes may open new avenues on how audiovisual information is represented, processed, and transformed. The various degrees by which they may be correlated in visual music may also involve aspects of psychology, philosophy, linguistics, anthropology, neuroscience and artificial intelligence, all of which are foundational aspects of music making and artistic creativity. Cognitive sciences can offer deeper understanding of the unexplored notions of pluri-dimensional thinking during the creative process, which can induce emotional responses in both the creator and observer/listener during the creative process itself and delivery of the work in a specific performance context [13,25,26].

Visual and auditory stimuli take on different meanings when presented in various contexts, spaces and times, creating multisensory congruence involving mechanisms sensitive to audiovisual correlation. According to Blake and Sekuler, our brain has an area called the *superior colliculus*, which is mainly responsible for visual processing [6]. However, besides receiving visual input, cells in this area also receive auditory input from the ears. Because they receive sensory input from the eyes and ears simultaneously, these are called multisensory cells. Interestingly, for these multisensory cells to respond, the auditory and visual stimulation must originate from the same region of physical space (i.e. if a spot of light appears from the upper right portion of the visual field, that cell will respond to sound only if it, too, comes form the same vicinity) [6]. This response, however, is not sufficient for the complete understanding and interpretation of the perceived audiovisual stimulus.

3.2 The creative mind and perceptual feedback

Recent advances in functional neuroimaging have enabled researchers to understand and even predict perceptual experiences with a high degree of accuracy. For example, it is possible to determine whether a subject is looking at a face or some other category of visual stimulus such as a house etc... The right hemisphere is responsible for visual and musical perception, interpreting non-verbal information and spatial processing, whereas the left hemisphere of the brain is responsible for symbolic/linguistic processing of information including the conceptual aspects of art [25]. A priori this is well known information and worth noting in the context of an audiovisual chronotope (defined later in this article) in terms of the cognitive processing of concepts such as time and space.

Physiological responses and neurological activity provide information on how the mind reacts to certain sensory stimuli such as music listening. Functional Magnetic Resonance Imaging (fMRI) and Position Emission Tomography (PET) reveal complex cognitive, motor and emotion-related activity in the brain when a subject listens to music or sound stimuli. In some cases there is a significant dopamine release during the anticipation phase, and that drastically changes where there is release or the subject experiences a change in the state of the music such as a cadenza for example. Recent studies on anticipation and reward systems in music show how hemodynamic responses and dopamine activity were maxi-

mal in the caudate during anticipatory phases, but shifted more ventrally to nucleus accumbens during peak emotional responses [23]. Other studies revealed how neural processing can be localized according to the extraction of specific perceptual features found in music. In particular, when listening to a naturalistic stimulus (e.g. a musical composition), the temporal evolutions of timbral, tonal and rhythmic musical features involve large-scale cognitive, motor and limbic brain circuitry and correlate to acoustic feature extraction procedures [2]. Such experiments illustrate the radical switch in the mind when experiencing key transitions in music during listening tests, affecting cognitive, motor and emotion-related circuits in the brain. Conversely, it would be interesting to develop strategies to observe brain activity during the creative process, and analyze subject response correlation for specific audiovisual cues in both the listening and creative processes. It has also been shown that it is possible to train people to manipulate their own brain activity and improve their visual sensitivity through neurofeedback where real-time brain imaging enables participants to watch their own brain activity on a screen [24].

Juslin and Vastfjall examined the notion of emotional response to music and developed a theoretical framework featuring six underlying mechanisms through which music can induce emotions. One of them being visual imagery, 'a process whereby an emotion is induced in a listener because he or she conjures up visual images … while listening to music '[17]. The emotions are the result of an interaction between music and these images. Juslin notes that listeners appear to conceptualize the musical structure through a metaphorical non-verbal mapping between the music and 'image-schemata'. Further to this it was argued in [17] that musical emotions cannot be studied without respect to how they were evoked (i.e. during the creative process and design). The need to consider underlying mechanisms of emotional response to music is highlighted in [13], particularly during the development of applications where music is intentionally designed to stir emotions by exploiting various crafting means and compositional techniques.

3.3 Audiovisual Poetry and Time

In addition, our perception of time reveals of our emotional state, there is no single, uniform time, but rather multiple times which we experience. Sound and image are parallel brains, they have a direct connection between the brains. Felix [18] poses the following question which relates to the former concept of neurofeedback; Is there a possibility of creating a piece that becomes an experience deep enough that transforms our neuronal conditioning and presents reality anew? Our temporal distortions are therefore a direct translation of the way in which our brain and body adapt to these multiple times" [11].

The former predicament implies audiovisual chronotopes take new forms within extra-musical content, embodying visuals to express visual, spatial and temporal information, insofar as the trans-sensory experience and understanding of the intersemiotic translation (transposition) system [27] to examine the degree of significance between corresponding sensory elements (as demonstrated in [1,8] the translation of visual poetry requires access to a new semantic system that is visually oriented otherwise the "literary" rendering of a visual poem may end up deficient). Thus, examining chronotopes in visual music within a new semiotic framework is essential to find ways of extracting it's underlying narrative.

3.4 Chronotope: The Visual Music Project

The accompanying visual music work *Chronotope* explores the synergy and correlation between diverse forms of media, from the minute motions of human skeletal muscle cells captured on microscopic time-lapse video, to large scale digital areal photographs of the Great Barrier Reef and other typical images of the vast Australian landscape intricately layered into new audiovisual compositions creating astounding abstract universes. *Chronotope* is a representation of the multi-scale world we live in through the blending of senses allowing the composer to express atypical interpretations of natural phenomena and abstract ideas (see Figure 1).

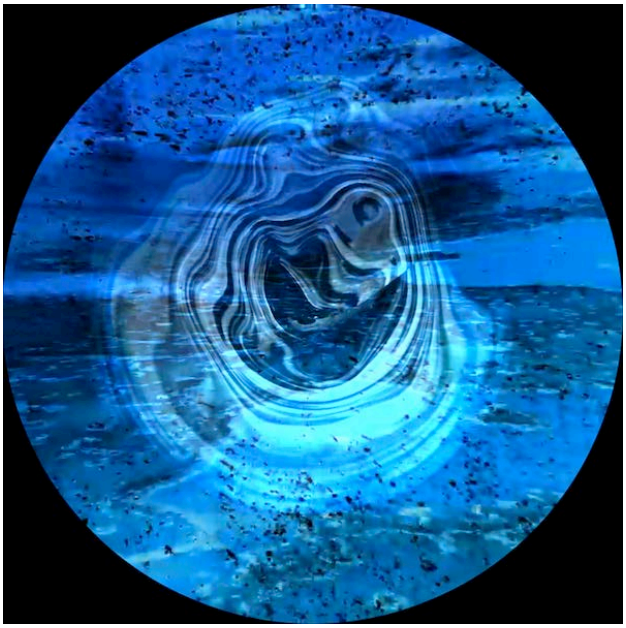

Figure 1. Frame taken from Chronotope Visual Music Project created in Fulldome format by Ivan Zavada.

The work was created in Fulldome[1], an immersive dome-based video projection environment where the

[1] The Fulldome Database http://www.fddb.org/fulldome/

viewer is surrounded by the video projection in a hemispherical angle of view (e.g. planetariums and digital theatres). Visual music in its modern form has the potential to extend human consciousness and perception and evoke specific emotional responses through the combination of sound and moving image [7].

The project's aim was to design an integrated compositional framework combining various layers of electronic media. The main intention was to seek a formalised and systematic approach to manage several influences, meanings and sources, and relate them in a combined holistic way to create a personal audiovisual extrapolation of the creative processes involved to convey a particular emotion throughout the development of the work, both in its creation phase as well as during the listening experience.

3.4.1 Methodology

A cohesive horizontal approach was adopted to represent and experience the author's audiovisual imagery and creative intent by conceiving a multi-platform improvisatory performance system. Multimedia software such as Max provides tools to enable coordination aspects of the creative process itself. In particular, Max's ability to manage internal and external communication paths with other software allows the design of systems to monitor the generation, operation and control of messages, signal chains, and so forth, between various production platforms for a unified artistic gesture.

During the creative process, free improvisation was facilitated via protocols such as MIDI and Open Sound Control, integrating networked communication devices (iPad, iPhone, Motion LEAP, Lemur and MIDI controllers) for live manipulation of visual and sound parameters. Visual elements and motion graphic layers were created in Quartz Composer and VDMX software to create geometric shapes. Java and Python scripts were implemented to process over fifteen thousand images for hemispherical dome projection.

Besides the manifold technical aspects of multimedia layering of visual and sound textures, the ability to mentally process and accurately combine discrete layers of audiovisual material into a unified artistic gesture implies non-linearity of the creative thought process. Improvisational models suggest there is a strong correlation between creativity and improvisation [5,14]. The actualization and combination of real-time performances with offline/non-linear editing techniques can generate contingent and valuable artistic outcomes through feedback and anticipation [20,22].

The combination of materials and correspondences between sound and image implies extra-visual (non-visual) and extra-musical (non-auditory) information in the form of an abstract discourse. Throughout the visual music work *Chronotope* pulsations and modulations are applied to sound, rotations and contrast changes are applied to geometric elements in counterpoint to varying textural visual backdrops. This creates a sense of complementarity, and paradoxically, at some points during the work the sound elements are completely decorrelated with the image sequences and these chronotopic variations create a sense of false synchronization on a primary perceptual level (perceptual decoupling), yet these asynchronous events are still perceived as synchronous due to the relationship between visual motion and its sonic counterpart. Studies in audio-visual speech perception may provide evidence on coherence mechanisms that may differ in the case of visual music correspondences.

An audiovisual work can be static or dynamic in nature; it can take the form of a score, motion graphics, video music or a photo accompanied by sound. In visual music, a chronotope emerges from the mind of the artist when the work is created and, conversely, relates to the imaginary time-space world the artist seeks to materialize, represent and communicate to him/herself and the audience. The following question arises when considering compositional intent, artistic consciousness and emotional response of the listener: how are audiovisual cues, conceptual events and emotional responses correlated in visual music?

3.5 Antipode

A further example is the work Antipode (Ivan Zavada 2012), a network music composition exploring audiovisual correspondences and the relationship between non-symbolic, abstract visual representations and sonic/musical gestures (see Figure 2). The concept relies on a grid whereby corresponding column and row coordinates trigger specific image and sound combinations. The visual score therefore encodes expressive performance features and at the same time suggests musical motifs and textures can be adopted in various musical contexts, instrumentations and configurations and form structural music-emotion rules [21].

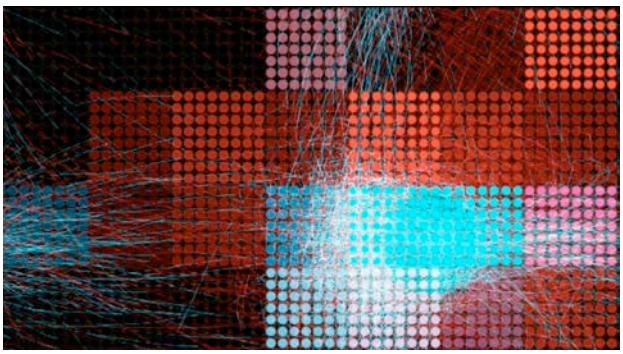

Figure 2. Antipode: a visual music score created for network music performance.

Complex imagery translates into multi-parametric musical information. Colour, shape, brightness, contrast, movement, direction, layers, symbols, space, speed, etc… are variables that can be interpreted in music-related perceptual features such as pitch, rhythm, key, dynamics, timbre, etc… See Figure 2.

3.6 Cognitive Sound Image

The interactive installation Cognitive Sound Image (Ivan Zavada, Deborah Kim 2013) focuses on the cognitive processes in music through the visual representation of performance gestures on the Korean percussion instrument *Janggu* with newly designed *Janggu* symbols and moving images. The aim of this creation is to examine the human perceptual system, and contemplate how the audience perceives *Janggu* symbols projected on screen correspond with the matching sound of *Janggu* and the playing motion/gestures of the performer. The work also explores new ways in which the performer can develop competencies in the ability to perceive, interpret and manipulate visual symbols through moving images and visual textures while performing a combination of pre-composed and improvised *Janggu* pieces as a live performance (see Figure 3).

The speed and dynamics of playing are determined by the texture and brightness of the moving images. This work was designed as a way to extend and modernize Korean Traditional Music. This is perhaps what rolling out of the piece means as you are engulfed in the immersive visual and rhythmic textures.

Figure 3. Cognitive Sound Image: a visual music score and installation for *Janggu* and electronics.

4. AUDIOVISUAL CHRONOTOPE

Emotional energy conveyed through art is paramount in understanding the medium [15], in particular with visual music where audiovisual associations and interconnections create temporal dynamic variations.

There are varying levels of narratives integrated in audiovisual media as well as different levels of perception and cognitive understanding of existing narratives, depending on the spectator's or the observer's awareness and understanding of the implicit narrative. Let's first distinguish between sound as an abstract entity in audiovisual media and the more functional role of sound in enhancing the narrative in a soundtrack for film/video and sharing the role of structuring time and space.

Emphasis is placed on conceptual, non-diegetic development of an abstract narrative. We shall purposefully include the word narrative to refer to the implicit development of a different scale, in a similar manner that cameras can focalize, zoom into specific areas of a movie set, it is possible to focalize on a micro-dimension of time that constitutes the outcome of a work that was created over a much longer period of time but represents the consciousness and creative development of the protagonist, a creator of audiovisual material. Within this context we need to distinguish between the more functional role of sound in enhancing the narrative in a soundtrack for a film or video and sharing the role of structuring time and space as opposed to sound as an abstract element of audiovisual media.

A parallel can be found in Mikhail Bakhtin's essays on the problems of literature and esthetics where he defines the chronotope (literally: "time-space") as the "intrinsic connectedness of spatial and temporal relationships that are artistically expressed in literature". It expresses the inseparability of space and time. "In the literary artistic chronotope, spatial and temporal indicators are fused into one carefully thought-out, concrete whole. Time, as it were, thickens, takes on flesh, becomes artistically visible; likewise, space becomes charged and responsive to the movements of time, plot and history. This intersection of axes and fusion of indicators characterizes the artistic, [audiovisual] chronotope" [3].

4.1 Synchresis versus Synchronicity

Michel Chion refers to as false sync points, or momentary dissociation between the visual and sound content. Breaking anticipated synchrony can be deceptive to the spectator, yet create a sense of space-time realignment in the spectator's mind and malleable perception through the senses. These moments make reference to temporal elasticity such as slow motion animation or time stretching.

Synchresis, the term coined by Chion (combination of the terms synchronism and synthesis) describes the spontaneous link between a particular auditory phenomenon and visual phenomenon when they occur at the same time. The synthesis part of the term implies a coordination of various mediums or layers and has phenomenological implications, and 'is rooted in the mechanisms of

perception and cognition' [9]. This could also be referred to as audiovisual synchrony and differs from the meaning of synchronization implying a coordination of sorts, or alignment/combination of different phenomena occurring at the same time or rate upon capture of the events with a camera or sound recording device – like in the case of cinema. Diego describes this as the parametric relationships between audio and video gestural profiles yet underlines the notion that 'two events occurring at the same time may be spectromorphologically unrelated' [12].

This leads us to the idea of synchronicity to describe events that appear significantly related but have no discernible causal connection [16]. Many visual music works incorporate synchronicity as a vehicle of expression, associating abstract visual concepts such as shape, texture, movement that change with synchronized sound albeit without any causal connection. The listener/viewer experiences audiovisual events as a unified phenomenon although they are not significantly related and the original meaning is lost, similarly to the compositional concept of musique concrète elaborated by Pierre Schaeffer in it's manifestation through the sound object.

From a perceptual perspective, the variation of rate or time scale implies a malleable synchronicity. Much of the postproduction tools available for audiovisual media allow precise methods to achieve synchresis, and at the same time afford the creator to experiment with synchronicity as a new parameter to achieve engaging perceptual effects not possible otherwise and work against the normal expectations of audiovisual association. The image magnetizes sound in space and asks what sound typically leads us to ask about space. In Michel Chion's terms, "loose synch gives a less naturalistic, more readily poetic effect" [9]. With multimedia applications it is a simple matter to dissociate meaning from the visual source, time and space become two separate entities and image-sound associations are recreated by the perception and association of known gestures in the known world [10].

On a more abstract level however, a chronotope (in audiovisual media) refers to the perceptual and cognitive association between time and space represented by sound and image. The faculty of processing and interpreting spatio-temporal information and apply knowledge and experience to perceived phenomena creates a new vehicle for the expression of human thought, emotion and interpretation of the world we live in. Although abstract, it's a new and emerging environment to further our capacity to synthesize mental imagery. Interpretation by an audience will be influenced by variables such as communication modes, context, familiarity with previous works, number of times the work is seen or heard and will affect the perceptual processes and appreciation of the work itself. It becomes a form of multimodal encoding, just like a narrative literary description of an event where it is assumed that only certain elements suffice to portray that event and provide a clear understanding of the story or particular event; like the heat that emanates from the fireplace, emotion emanates from an audiovisual work.

4.2 Defining Audiovisual Chronotope

In the context of visual music, we can define an audiovisual chronotope as a unique multisensory combination involving physical dimensions, namely sound, time and space, to express creative thought and its underlying processes in the abstract world in order to forge an idiomatic artistic identity. A chronotope may reveal information on the creative mind and the context in which the work was designed and may shed some light on the cognitive processes involved in the elaboration and interpretation of a multi-layered artistic gesture involving different media. Visual music, as a unified form of expression, may reveal the way in which humans interpret, organize, categorize, prioritize, and process information through multimedia applications.

5. CONCLUSIONS

This article complements three creative research experiments in visual music, focusing on the correspondence and correlation of auditory and visual stimuli through abstract audiovisual representation. A definition for chronotope was proposed in the context of visual music. Further investigations in cognitive activity during the creative process will open new paths toward understanding audiovisual chronotopes and perhaps unravel the semantic and expressive intents of visual music composition. The essence of the message and expressive audiovisual gestures are not necessarily encoded in the symbols themselves, but unfold throughout the progression and sequence of abstract elements conveying human expression and emotions associated with either layer of the construction (auditory, visual, or a combination of both). Finally, an in depth understanding of the creative processes involved in visual music will lead researchers to appreciate the artistic discourse as an intrinsic social phenomenon throughout its entire range and in each and every aspect of its elements from the sound and the image to the furthest reaches of abstract meaning, through audiovisual chronotopes, enhancing expressive content, conveying human emotion and consciousness and heightening, enriching the spectator's immersive experience.

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