Compositional Strategies in Light and Sound Installations

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A Thesis
in
The Special Individualized Program

Presented in Partial Fulfillment of the Requirements for the Degree of
Master of Arts (SIP) at Concordia University Montreal, Quebec, Canada

February 2013

CONCORDIA UNIVERSITY
School of Graduate Studies

This is to certify that the thesis prepared

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Entitled: Compositional Strategies in Light and Sound Installations

and submitted in partial fulfillment of the requirements for the degree of

Master of Arts in the Special Individualized Program

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ABSTRACT

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Adam Basanta

This thesis explores various compositional strategies in light and sound installations using luminosonic objects: objects which appear to emit both sound and light. Contrary to accounts of media installations which are analyzed from a visual art perspective, in this research, audiovisual installations are analyzed through the application and adaptation of musical concepts and language to the installation context. In particular, selected audiovisual installations are analyzed with respect to the constitution, or compositional dynamics, of audiovisual materials. This analysis results in a typology of audiovisual relations, represented within a three-dimensional compositional state-space. Furthermore, the production of audiovisual, spatio-temporal compositional structures within the installation context is investigated in relation to the embodied, mobile spectator. The elucidation of audiovisual materials and spatio-temporal structures is illustrated through analysis of selected works, as well as through original artistic output. Finally, several implications of this interdisciplinary research are suggested in relation to the fields of audiovisual installation and contemporary music composition.

Acknowledgments

I would like to thank my supervisory committee for their knowledge, help, and encouragement throughout the past two years.

As well, I would like to thank both private and public institutions that have provided funding throughout my course of study.

To my family (Aba, Ima and Kai), thank you for all your support, encouragement, love and excitement. You put me on a path, and I am following it.

Last but not least, thank you Jenny for everything. We made it.

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Note: All video examples referred to throughout the text are available online at the authour's website: http://www.adambasanta.com/thesis/video.html

Chapter 1: Introduction and methodology

1.0 Introduction

In the last twenty years, the worlds of experimental sound composition, sound art installation, and digital media art have undergone a marked shift towards the integration of auditory and visual media. This trend extends beyond the wide-ranging praxis of audiovisual artworks, and includes a recent proliferation of publications, academic scholarship, curatorial efforts, and the establishment of new pedagogical institutions. However, despite the wealth of recent writings on the history and theory of audiovisual production (Daniels and Naumann 2009, Daniels and Naumann 2011, Rainer et al. 2009), this research has focused almost exclusively on screen and image-based audiovisual production, neglecting for the most part other forms of audiovisual relations. Furthermore, with notable exceptions (see Chion 1994, Coulter 2009 – who nonetheless stay within the confines of image-sound relationships), the majority of literature on audiovisual relations does not provide an analysis of the compositional dynamics between auditory and visual counterparts: the manner in which auditory and visual media are combined, and the manner in which this relationship evolves in time. Particularly, few attempts have inquired about the nature and constitution of integrated audio-visual materials and their interrelations into spatial and temporal formal structures.

1.1 Research question

In response to current audiovisual scholarship and in relation to my own practice of audiovisual installations, I will undertake an examination of compositional strategies

used in media installation works for self-illuminating light emitting[1]-objects and spatial sound. I call such objects *luminosonic*, a term combining *luminous* and *sonic*, which I will use to refer concisely to material audiovisual objects which appear to emit both sound and light. My inquiry centers on two related questions with regards to the use of sound and light in media installations:

(1) How can light and sound media be placed in relationship to one another, and in this sense, function as integrated, composite compositional material?

(2) How can such audiovisual materials be developed compositionally in time to articulate temporal audiovisual formal structures, and how do such temporal forms operate spatially in an installation context?

In order to account for the ways in which luminosonic objects can be used as compositional material, and the ways in which such materials may operate spatially and temporally in installation works, I will provide a brief summary of relevant studies and artistic work (chapter 2), engage in a typological analysis of audiovisual light-and-sound materials (chapter 3), suggest several techniques through which spatio-temporal formal structures may be developed in light-and-sound installations (chapter 4), and summarize my findings with concluding remarks (chapter 5).

1.2 Methodology

Throughout my inquiry, I engage in a first-person qualitative analysis of selected

[1] In phrasing my inquiry as such, I am interested in any object that emits *light* – rather than image – as its primary perceptual feature. A self-illuminating object – for example, a light-bulb, a table lamp, an LED strip, a television set – is a light emitting object which illuminates its own surface in addition to casting light on its surroundings. This is in opposition to a light projection, in which the illuminating object is often ignored in favour of the projection surface (i.e. the screen) or its content (i.e. the image). This distinction is similarly framed by Popper (2006, 430).

installations using luminosonic objects. This experiential analysis is complemented by the use of musical concepts to describe perceptual and compositional aspects of light and sound relations. Through the analysis of my own perceptual experience of selected installations works, I develop a typology of audiovisual compositional dynamics used in luminosonic objects, and glean ways in which artists enact spatio-temporal structures in installation contexts.

Concurrent with my analysis of selected installations, I engage in creative practice in the field of audiovisual installations using luminosonic objects. The creation of original audiovisual installations allows the examination and evaluation of compositional strategies gleaned from my analysis of existing works alongside the development of original compositional strategies.

1.2.1 Musical language as metaphor and analytical vocabulary

Throughout my analysis and creative practice, I apply musical concepts to describe relations between sound and light, as well as their distribution through space and time. This technique is used first and foremost because of my formal training in music composition and my concurrent practice as a composer of contemporary music. Naturally, I conceive of my own light and sound installations from a musical or compositional perspective, with issues regarding large-scale developmental forms figuring prominently in my installation work. Furthermore, it seems appropriate to apply musical concepts to audiovisual installations as numerous historical precedents of artistic integration of sound and light media – from Castel to Xenakis – utilize the parallels

between pitch and colour, sonorous and luminous intensity, and sound and light rhythms to describe temporal development of audiovisual media. Finally, this approach seems appropriate as most works analyzed in this thesis are created by artists whose primary practice (La Monte Young, Iannis Xenakis), education (Bernhard Gál, artificiel, Robin Minard) or conception of installation work (Bernhard Leitner) is rooted in the practice of musical composition.

Despite the above reasoning, the application of musical frameworks in the context of installation art occasionally results in conceptual dissonance; that is, at times, musical concepts are inadequate to account for certain aspects of audiovisual practice in the installation context. However, fleshing out this conceptual dissonance – accounting for the ways in which the application of a musical concept is helpful, as well as the ways in which it fails – leads to the emergence of new models of understanding in the field of audiovisual installations. In turn, the development of such hybrid, interdisciplinary perspectives allow a deeper, renewed, and modified understanding of the field of music composition.

I view the compositional dynamics of audiovisual material as a form of orchestration. Traditional notions of orchestration allow a single musical idea (for instance, a short melody alongside a chordal accompaniment) to manifest in various ways through orchestrational choices: choice of instruments, pitch ranges, dynamics, and

various articulations.[2] Applied to audiovisual composition, orchestration may be viewed as a spectrum of combinatory possibilities between sounding and non-sounding media. Through the orchestration of light and sound parameters (for instance, morphology or temporal texture), a single audiovisual event emerging from a luminosonic object can manifest in various ways. Similarly, the notion of orchestration is useful in the analysis of ensembles of luminosonic objects, as it allows the application of orchestrational vocabulary (chord, chord-voicing, instrumental section,[3] unison and counterpoint) to combinations of luminosonic objects.

1.2.2 Analysis of existing works

My analysis of selected light and sound installations integrates existing theoretical writings (Chion 1994, Coulter 2009, Whitelaw 2008) alongside original contributions. Original contributions are guided by first person experiential analysis of selected works. Where possible, this involves visits to installations in presentation sites. In cases where visits were impossible,[4] analysis of video documentation – while imagining a potential first person installation viewing – replaces site visits. While contact with the artists discussed has been limited, occasional discussions of selected topics take place via electronic communications and in-person interviews.

Each selected artwork is analyzed to reveal (1) compositional dynamics of

[2] A single note can be articulated in many ways. A staccato articulation is short in duration and percussive, while a legato note is longer in duration and involves a smoother attack and slurred transitions between subsequent notes.
[3] As in "string section" within the orchestra.
[4] Due to lack of traveling funds, or the impermanent nature of the installation itself.

luminosonic objects, and (2) ways in which audiovisual materials develop spatially and temporally within an installation context. A list of artworks cited in this document is provided in appendix A. Relevant excerpts of video documentation are used throughout the thesis, and are available at the following web resource:

http://www.adambasanta.com/thesis/video.html

1.2.3 Integration of artistic practice

My analysis of selected audiovisual installations is complemented by the creation of original light and sound installations using luminosonic objects. The creative output relevant to this document can be traced from early attempts at light and sound composition using luminosonic objects (*Object / Field*[5]), subsequent expansions using larger luminosonic object ensembles in site-specific locations (*Diagonal (for Eastern Bloc),*[6] *Contour (for a hallway)*[7]), and culminating with the counterpart to this thesis, *Room Dynamics,*[8] which incorporated previous research with renewed focus on large-scale spatio-temporal structure.

Through my creative practice, I seek to examine and evaluate compositional strategies gleaned from analysis of existing installation works within an artistic context. Furthermore, the engagement in creative practice allows the development of original audiovisual typologies and spatio-temporal strategies which may not emerge through

[5] Presented in April 2011, as an informal studio viewing at Matralab, Concordia University, Montreal, QC.
[6] Presented in June 2011, Eastern Bloc Gallery, Montreal, QC.
[7] Presented in October 2011, Scotiabank Dance Centre, Vancouver, BC.
[8] Presented in June 2012 at Eastern Bloc Gallery, Montreal, QC; September 2012 at The Bridge Gallery, Charlottesville, VA; October-December 2012 at Artscape Wychwood Barns, Toronto, ON.

analysis of existing works. Throughout the creative process and following completion, I subject my original work to analysis from complementary points of view: that of the practitioner, and that of the spectator. The self-reflective analysis is in turn evaluated through subsequent artistic production, resulting in a recursive loop between analysis and creation, with each stage building on the former.

Chapter 2: A brief summary of approaches to audiovisual installations in arts and sciences

In order to provide the artistic and scholarly contexts for my research, this chapter will present a brief review of relevant literature pertaining to the use of light and sound in artistic contexts, analytical writings in audiovisual studies, relevant scholarship in the neurosciences, as well as accounts of spatial issues in media installations.

2.1 Artistic integration of light and sound from antiquity to present day

Contemporary use of luminosonic objects in audiovisual art is preceded by a rich history of sound and light media pairs in audiovisual production. The history of artistic production using light and sound, from antiquity to present day, can be traced through several parallel trajectories.

One trajectory historicizes current audiovisual practices using light and sound through the concept of *gesamtkunstwerk*: the envisioning of a "synthesis of the arts, or total work of art" (John 2009, 143-145). This historical trajectory may be traced from Wagner and through to post-WWII intermedia practices (143-145). The pairing of light and sound media seems especially promising for artistic works attempting synergetic unison, as the two media are often portrayed as parallels, pure and abstract in their constitution[1] (Xenakis 2008, 199; Popper 2006, 427-429; Schwierin and Naumann 2009, 19).

Several authors trace the development of audiovisual practices using sound and

[1] The supposed abstract nature of music is in itself a questionable and historically overstated concept, which has been subject to much critique. A detailed discussion of this topic, unfortunately, falls outside the focus of this document.

light through the age-old engagement with synaesthetic perception and the related (yet distinct)[2] occupation with "models of correspondence and color-sound analogies," both of which date back to the early Greeks (Emrich, Neufeld and Sinke 2009, 414; Jewanski 2009b 340). The development of fully developed color-tone analogies outside of "symbolic and cosmological models of the prehistoric period that sought parallels between all natural phenomena" (Jewanski 2009b, 339) can be traced though the writings Kircher, Aguilonius and Newton in 17th century Europe, leading to Louis-Bertrand Castel's development of "pure color-tone [analogies]" in relation to the colour organs (340-341). Successive modifications of Castel's system throughout the 19th and early 20th centuries were spurred in part by scientific discovery that light consists of waves, rather than particles (342-345). Subsequent colour-tone analogies were developed throughout early Modernist art: personalized systems of light and sound correspondences were developed in painting by Kandinsky, Klee, and Mondrian (Gottdang 2009, 246), mirrored in music through the integration of coloured light in works by (suspected-synaesthese) composers Rimsky Korsakov and Alexander Scriabin (Kienscherf 2009, 214-216). Contemporary musical examples integrating light and sound correspondences are found in works by composers Wolfgang Rihm[3] and Georg-Friedrich Haas,[4] who occasionally work with "light as a rhythmic element" in their music (216). An in-depth historical survey of synaesthesia in the arts can also be found in van Campen 2008, while scientific

[2] The two are often confused, although "in a neurological sense synaesthesia differs fundamentally from efforts expose similarities between sense modalities, in particular between sounds and colors in terms of a hidden correspondence or a higher formula" (Emrich, Neufeld and Sinke 2009, 414).

[3] Specifically, the integration of autonomous light in a passage from *Die Eroberung von Mexico* (Kienscherf 2009, 216).

[4] Specifically, the integration of light in *Hyperion*, for orchestra and light, in which light acts as "a virtuoso solo instrument… [and] as a control element for the musicians of the orchestra… [replacing] the conductor" (Kienscherf 2009, 216).

accounts of the phenomena may be found in Cytowic 2002.

Finally, several scholars detail links between the aesthetic goal of synaesthesia and the development of technical apparatus.[5] Beginning with Castel's and Krüger's colour organs – "a device… controlled from a keyboard, with which music can be visualized" through color-tone correspondences (Jewanski 2009a, 77) – the influence of technical apparatus on audiovisual aesthetics intensifies in early attempts to create visual music by Fischinger, and later, the Whitney brothers, who created "[analogous] production processes… for the generation of sound and images" (Schwierin and Naumann 2009, 21). The linking of technical apparatus and synaesthetic aesthetics continues via the psychedelic turn of the 1960's in multimedia spectacles involving "the spontaneous real-time composition of light and film in concert with music" (James 2009, 176), finally arriving at the current norms of popular music concerts and club culture (178-180). With the turn towards digital means of audiovisual production, the linking of audiovisual production and interactive performance becomes increasingly common, as analog electronics and pattern playback practices give way to current use interactive software (Kwastek 2009).

2.2 Parallel developments: Audiovisual studies and Neuroscientific research

The proliferation of audiovisual artistic practices and scholarship is supported by

[5] The use of the term synaesthesia as technical analogy in contemporary practices of transcoded audiovisual art – in which sound and light are combined to produced "fused" audiovisual experiences – has recently been subject to critique: "synesthesia (sic), by definition, occurs in the perceptual system of a synesthete (sic)" rather than the crossed connection of a technical apparatus (such as a video synthesizer, or computer software) (Whitelaw 2008, 267). Whitelaw suggests an alternative model to synaesthesia based on neuroscientific research of cross-modal binding, in which "fused" audiovisual works can be understood as "cross-modal objects" (259).

the increased study of cross-sensory effects in the neurosciences over the last two decades. Since my research involves examination of cumulative effects produced by simultaneous auditory and visual media, I will briefly survey relevant research in studies of audiovisual perception and cognition.

Current neuroscientific research rejects the historical notion of independent sensory channels, instead favouring perceptual models that account for intersensory effects. However, the question of exactly how cross-sensory effects are produced has been the subject of ongoing research. Welch and Warren (1980) review several early theories, including the "modality appropriateness hypothesis" which argues that dominance in intersensory bias is based on the appropriateness of the modality to perceive the given event (660). The authors offer a predictive model which accounts for the perception of intersensory bias as a cumulative effect of stimuli characteristics (spatio-temporal parameters, intensity, size orientation, etc.), the strengths of each modality (in terms of precision, accuracy, reaction time etc.), the perceiver's personal and general history (especially, the assumption of "unitariness of perceptual event"), and the perceptual systems' allocation of attention (based on appropriateness of the modality) (662-664).

Contemporary research on cross-sensory effects has been guided by the notion of the brain as a "complex dynamical structure" (Cosmelli, Lachaux, and Thompson 1977, 733) where neuronal responses to sensory stimulation "must be conceived as a network of overlapping ensembles which arise in various coherent configurations depending on the animal's context" (Varela 1999, 46). Shimojo and Shams have challenged the modality

appropriateness hypothesis (and by implication, aspects of the predictive model offered by Welch and Warren), concluding that cross-modal interactions depend "on the structure of the stimuli" rather than the appropriateness of a sensory modality to a given task. In general, a modality carrying a "more discontinuous (and hence more salient)" signal will present dominant intersensory bias (Shimojo and Shams 2001, 508). The authors describe vision-dominant cross-modal interactions in spatial tasks (506), as well as audition-dominant effects over duration, intensity, motion and number of visual stimuli (506-7). Additionally, van Wassenhove et al. found that "vision can modify auditory temporal perception," while "distortions in subjective duration" may be explained in part through the "intrinsic features of the stimulus" (1) and their ecological relevance (3). Additional accounts of cross-modal integration, including interactions involving somatosensory, olfactory, and gustatory faculties are addressed in Calvert, Spence and Stein (2004). Shimojo and Shams' theory of intersensory bias, as well as the examples of audiovisual cross-modal integration (provided by the aforementioned authors), offer valuable insight regarding the perception of audiovisual materials, and by implication, manners in which audiovisual perception can be actively manipulated in artistic contexts.

Research on intersensory effects has permeated into the related fields of musicology and music cognition. Studies examining intersensory effects resulting from gestural performance in instrumental music conclude that performance gestures modify the reported experience of listening for subjects of all backgrounds (Vines et al. 2006, Schutz and Lipscomb 2007). The perceptual and communicative aspect of musical gestures is further explored in Godøy and Leman (2010). Furthermore, a growing number

of scholars have begun to challenge the notion of listening as a passive process, while emphasizing the roles of embodied action, listening intentionality and context on the resulting experience (Walker 2000, Iyer 2004, Krueger 2009, Small 1998).[6] The effect of context on a listener's experience is also explored in writings in ecological musicology (Clarke 2005, Windsor 2000, Windsor 2004). Such writings are relevant to the contemplation of the influence of bodily movement and contextual determinations in the fields of sound art and audiovisual installation.

2.3 Analytical perspectives on audiovisual compositional dynamics

While numerous recent publications provide historical accounts of audiovisual work (Daniels and Naumann 2009, Daniels and Naumann 2011, Rainer et al. 2009), there are relatively few publications analyzing audiovisual relations. Nearly two decades after its initial publication, Michel Chion's *Audio-Vision* (1994) remains the most in-depth investigation of compositional dynamics between sound and visual media. Chion provides an in-depth examination of "added value" as the reciprocal "expressive and informative" (5) enrichment of sound by image and of image by sound. Chion elaborates on this concept, coining the term "synchresis" to describe "the spontaneous and irresistible weld produced between auditory… and visual phenomenon" (63). Chion provides several observations regarding the perceptual results of added value, such as "spatial magnetization" of sound by image (44, 69-70) and the temporalization of vision through sound (12). Finally, Chion introduces the concepts of vertical and horizontal dimensions of audiovisual relations as a means of comparing content appropriateness and

[6] Noë 2000 offers a similar critique with regards to works of visual art.

temporal development of simultaneous image-sound combinations (35-36). Coulter (2009) builds on Chion's writing, offering an analytical model for the classification of media pairs in works using electroacoustic music and moving images (Coulter 2009, 27). In particular, Coulter offers the terms concomitant, isomorphic, and heterogeneous media pairs to distinguish several forms of compositional dynamics between auditory and visual counterparts (27-29, 32-33). However, both Chion and Coulter concentrate their analysis exclusively on image-sound relations, neglecting the analysis of non-screen based audiovisual genres.[7]

While falling short of discussion of audiovisual compositional dynamics, publications in the field of light art detail compositional possibilities of self-illuminating light objects. Sloterdijk (2006) writes extensively on the affordances of light as an artistic medium, concentrating on light's cultural-political significance in Western culture. Yvonne Ziegler surveys the use of quotidian light-emitting objects within the gallery setting, including numerous examples of art works using light bulbs and domestic lamps (2006). Additionally, Ziegler reflects on the ready-made status of such objects (Y. Ziegler 2006, 574-5), their use as "an anthropomorphic metaphor" (579), and the manner in which their meaning is negotiated in relation to the gallery setting (583-4).

Several writers in the field of kinetic light art explore compositional possibilities of dynamic processes in light-art work. Nicolas Schöffer's notion of "luminodynamism" theorizes relations between "[objects] charged with luminousness" and their effect on the

[7] Chion and Coulter's examination of audiovisual relations within the context of image-sound relations is problematic due to the inherent complexity of images, which are perceived as both sensory impressions and complex semantic signifiers: an image of an apple signifies both the fruit, as well as *the image* of a fruit. This complication is compounded by the near-infinite possibilities of sound-image combinations (see further discussion in chapter 3).

"rhythm of structures," portraying such spatio-dynamics as "temporal architecture" (1996, 399-400). Surveying the works of Thomas Wilfred, the ZERO group, and GRAV collective, kinetic art historian Frank Popper describes several compositional vocabularies used in kinetic light works, including morphology, "intensity, concentration [and] dispersion," rhythm and movement of light (2006, 431; 435; 447; 427).

Several publications concentrate on light and sound works by specific artists, which provide significant detail in description and criticism of works (Xenakis 2008, Duckworth and Fleming 1996,[8] Kuhn 2000, Gál 2005, Adcock 1990[9]). The collection of writing on Xenakis' audiovisual *Polytope* projects (Xenakis 2008) is particularly relevant, as they present theoretical, technical and compositional insight regarding Xenakis' audiovisual oeuvre.

2.4 Perspectives on the use of space in media installation contexts

Several writers explore the relationship between media architectures and the surrounding environment. Blesser and Salter suggest the term "aural architecture" to describe the interaction of sound with the "composite of numerous surfaces, objects and geometries" in the physical environment (Blesser and Salter 2007, 2). A sound source may "[illuminate] a space in the same way the light does" (343), rendering the architecture "aurally perceptible" (15-16). Detailing the use of light as a sculptor of space in light-art works by James Turrell, Carsten Höller, and Anthony McCall, Zyman describes ways in which light "transforms and deconstructs space by marking, occupying,

[8] An examination of Young and Zazeela's audiovisual installations.
[9] An examination of James Turrell's light art oeuvre.

illuminating and dramatically staging it," while commenting on the manner in which the use of light as a sculptor of space problematizes the relationship between object and viewer (Zyman 2006, 469).

The modification of space using audiovisual media is prefigured by kinetic art pioneer Nicolas Schöffer, who describes the "the constructive and dynamic integration of space in plastic work" through his theory of "spatiodynamism" (1996, 397-398). The modulation of such space using light is explored by his concept of "luminodynamism" (398-9), while the term "chronodynamism" is used to theorize the integration of sound and light "temporal [architectures]" (400). Following, James and Nagasaka detail "spatial significance" in interactive multimedia installation works within an architectural context (2011, 278). Investigating relations between "[forms of] media implemented and its effect on the correlating space," the authors detail case studies in which media has been used to "[transform space in terms of] perceived form, sense or function" (279), as well as cases in which media influences "temporality…[in affording] a sense of time" (281).

Several writers explore the relationship between spatial media architectures and the mobile spectator. Olafur Eliasson describes the relationship between space and the perceiver as a "relationship of co-production" (2006, 65), while sound-art scholar Brandon Labelle outlines possibilities of temporalizing space in media installations "through the bodily flow of an individual whose decisions as to where to be" co-produces their own experience of the work (2006, 73; 162). Likewise, sound artist Bernard Leitner conceives spatial relations in his sound installations as a relationship between "built structures of sound," architectural space, and the body (Leitner). Finally, Dziekan analyzes several aspects of United Visual Artists (also known as UVA) sound and light

installation *Chorus*, focusing on the composition of "spatio-temporal relations that exist between site, the performed work and audience perception" (Dziekan 2011, 66).

Although most writings on the relationship between spatial media architectures and the mobile spectator are rather theoretical, sound artist Robin Minard offers several compositional strategies for the treatment of space in sound installations including the "conditioning of space… [through] the creation of a static or uniform spatial state" (Minard 1999, 75) and the "articulation of space… [through the use of] different musical elements localized at different points in space" (Minard 1996, 19). Through the elucidation of the two aforementioned compositional strategies, Minard offers a starting point for the contemplation of spatial positioning as compositional parameters in audiovisual installations.

Chapter 3: Composing with luminosonic objects

When creating a media work using luminosonic objects, each compositional decision – choice of light-emitting object, spatial arrangement, and audiovisual dynamics – shapes the spectator's negotiation of meaning.[1] In this chapter, I will examine compositional possibilities offered by a singular luminosonic object: (1) affordances[2] of external signification, and (2) the modulation of perceptual meaning using audiovisual compositional dynamics. The former involves the relation between the object and its referential value[3] or external associations, and thus can be seen as a process common to all visual artworks using light-emitting objects. In contrast, the latter is a process unique to luminosonic objects, in which sound and light relations (or audiovisual behaviour) constitute the perceptual meaning of a particular luminosonic object: how does it behave, what is its behaviour like, and how does it differ from normative behaviour.

3.1 External Signification

Despite the use of sonic materials, initial impressions of luminosonic objects are primarily visual. This may be attributed to the highly developed nature of the visual modality in humans, as well its privileged status in Western culture as a modality related to both the faculty reason and the perception of objective reality (Howes 2005, 324). Furthermore, the visual "reading" of luminosonic objects is strengthened by their

[1] Of course, the negotiation of meaning is influenced by subjective factors, such as the perceiver's personal history, experience with media works, and cultural background, to name a few. Despite individual variations, artistic and compositional choices constrain the negotiation of meaning within certain ranges of possibilities.

[2] The term affordance is used in relation to the extension of the Gibsonian term (Gibson 1979) to the realm of artistic signification in ecological musicology (see Windsor 2004).

[3] I will use this term to discuss the ability of objects to refer to (or signify) the external world. The differentiation between symbolic, iconic, and indexical relationships (cf. Pierce 1931-1958) is irrelevant to this line of inquiry, and is of little significance to the analysis of luminosonic objects throughout this thesis.

inclusion within the visual art gallery setting and its associated critical practices (cf. Yvonne Ziegler 2006).

It follows that external signification of light-emitting objects are primarily motivated by visual experience. As such, the artist's compositional choices regarding the use of light as an artistic medium, and the selection of particular light-emitting objects for inclusion in a given work, constrain and focus the potential external associations within a certain range of referential affordances.

3.1.1 General associations of light

The foregrounding of luminescent energy in an artistic presentation context results in the perception of light as a central medium of artistic exploration. The use of light *as a medium* contrasts with its everyday use as a background sensory trace whose primary function is the illumination of objects. Thus, an encounter with luminosonic objects will likely evoke general associations relating to the status of light and illumination in cultural history.

Cultural engagement with light is steeped in metaphysical, mystical, and political implications (Sloterdijk 2006, 46). Light, in Occidental thought, "enables the dawn of the world;" a guarantor of existence, light is central to the heliological viewpoint which underlies Western thought, extending back to ancient Egypt (47-48). In Judeo-Christian metaphysics, light is inextricably tied to the concepts "good" and "God" as the premiere act of divine creation. Light symbolizes a "self-registration" of divine consciousness: absolute light is dazzling, while insufficient light creates shadows (49-51). The symbolic status of light extends to Western enlightenment as "a probe for the technological and

political permeation of the world" (53). Following, the "postmodern twilight… of post-historical loss of all perspective… [reveals] the failure of [enlightenment's] optical promises" (54).

Likewise, light-emitting objects afford general associations when used artistically in a gallery context. If electricity can be seen as the modern parallel for fire[4] – a powerful, potentially destructive force harnessed for human needs – artificial light refers to "physical energy or metaphor for energy" (Y. Ziegler 2006, 574); human control over such energy can be used as a "symbol of power" (574). Singular light emitting objects – similar to the use of candles in religious contexts – may be associated with an "anthropomorphic" presence: an individual that has come and gone, or the trace of one's individual agency (579). While the inclusion of light-emitting objects in artistic contexts afford the above associations, its coercion "into visual compressions and configurations… [may] rob it of its ubiquity and… define it as an aesthetic presence" (Fuchs 1997, 15).

3.1.2 Referential values of light emitting objects

Luminosonic objects come in all shapes and sizes, from the functional to the specialized, the homemade to the mass produced. Viewed as a compositional decision, the artist's choice of light-emitting object (whether in terms of broad categories or specific objects) constrains the viewer's personal and cultural associations; what is the object, and what it attempts to express.

[4] I wonder if my fascination with viewing unstable, flickering light bulbs can be likened to the near-universal fascination of staring into a flame or candle.

The category of *quotidian* light-emitting objects may be considered in opposition to *specifically constructed* light-emitting devices. The former acquires its status "as everyday [object] because of [its] functionality," a found object whose "perception and evaluation... is dependent on [their] context" (Y. Ziegler 2006, 574). Such objects are "re-encoded" in relation to their presentation context, a negotiation which relies on the tension between their everyday function and value and their use as a signifying aesthetic object (574). In contrast, specifically constructed light-emitting devices may or may not bear similarity to everyday light-emitting objects, and thus may not afford the wealth of everyday associations exhibited by their quotidian counterparts.[5]

Quotidian light-emitting objects may be differentiated as *generalized* or *distinct*. *Generalized* quotidian objects are defined by their object-type: an unadorned light bulb, a table lamp, or a neon light fixture. In contrast, a *distinct* quotidian object evokes specific associations informed by collective or cultural memory. For instance, imagine a lamp adorned by the communist iconography of the hammer and sickle: the chain of associations begins with its historical identity and cultural significance,[6] followed by the perceiver's personal association with the artifact. In the remainder of this thesis, I will concentrate mostly on *generalized* quotidian objects.

The associations evoked by light-emitting objects are often motivated by personal memories or shared cultural media documents (books, movies, television etc). Given the relative homogeneity of Western media, general agreement of broad associations relating

[5] For example, consider the differences between Bernhard Gal's *Klangbojen* (sound-buoy) and United Visual Artists' *Triptych*. In the former, specifically designed light-and-sound buoys are floating in a river: both the design and title reinforce the association of the quotidian object "buoy". In contrast, the latter involves three LED blocks installed in three adjacent doorways: while the blinding light emitted by the LED blocks may conjure associations of a light-saturated, inaccessible room beyond the doorway, this affordance is less apparent.

[6] Cultural significance, of course, will vary between various cultures and sub-cultures.

to particular quotidian light objects is likely. For instance, the naked light bulb generally results in impressions of historical artifacts, an unadorned or unfinished quality, nostalgic memories, and "warm" light. Other light-emitting objects similarly afford general associations: the fluorescent bulb (industrial or office settings, "cold" light), desk lamps (functional, domestic, mass produced), "vase"-shaped table lamps (domestic, nostalgic, ornate, 1950's North American household), and LED's (contemporary, digital, futuristic). These general associations, coupled with the re-encoding of the object within the presentation context of an art gallery, may allow the artists "to illustrate social, cultural and political phenomena" (Y. Ziegler 2006, 587).[7]

3.1.3 Referential values of spatial arrangements

While referential value is often dependant on a specific object's subjective and cultural coded-ness, spatial arrangements[8] and positioning of objects may also be considered for their referential affordances. In such cases, spatial aspects project meaning back on to the individual objects, modifying their original associative potentials.

The meaning of any freestanding object is (at least partially) negotiated in relation to the perceiver's body. Spatial differentiation extends outwards from the "positions and coordinates of the body" along the axes of "[vertical]-horizontal, top-bottom, front-back and right-left" (Tuan 1977, 35). Likewise, symbolic functions of spatial relations extend outward from the body and project onto architectural structures, social orders, value systems and cosmological understanding (37-43). In this sense, a light bulb hanging well

[7] This ability, of course, presumes that both artist and viewer share the same cultural backgrounds, and thus, are privy to the same cultural codes.
[8] The relation of spatial arrangements to the embodied spectator and the presentation space is addressed in detail in chapter 4.

above a perceiver's head bears a very different bodily and by extension, symbolic meaning than a bulb hanging at a person's waist. The former is unreachable, towering over the individual, illuminating the entire room. The latter is within reach, out of place or "in the way"; it may be circled or approached, encountered intimately or obscured. As well, the lighting fixture's affordance of meaning is negotiated in relation to its spatial positioning within an architectural construct. As Bachelard notes, the very difference between "outside and inside form a dialectic of division, the obvious geometry of which blinds us as soon as we bring it into play in metaphorical domains" (Bachelard 1994, 211). Furthermore, general architectural categories of immensity (183) and miniature (148-9) as well as specific architectural features such as corners, angles ("cold", 146) and curves ("warm... has nest-like powers", 146) afford symbolic and behaviour-altering meaning, even within the supposedly neutral "white-cube" setting of the gallery.

Finally, referential value or associations of light-emitting objects depend on the number and consistency of spatially arranged lighting fixtures. For example, a single light bulb carries different associations than an arrangement of 12 light bulbs. Although the referential object is identical, a single bulb (for instance, Sonami's *Conversation with a lightbulb*) is anthropomorphized as "alone", while a collection of bulbs (for instance, artificiel's *condemned_bulbs*) carries associations of a group, population, or constellation. Furthermore, meaning is afforded through comparison between an individual "member" and its constituent group. Specifically, meaning is afforded in relation to the constitution of the group as a whole. Is the object an identical, standardized copy of its neighbours, and thus part of a homogenous group (for instance, in artificiel's *condemned_bulbs* or to

a lesser degree[9] in my own work, *Room Dynamics*)? Or on the contrary, is the object part of a heterogeneous population of singular individuals (for instance, in Basanta, Stein and Stein's *Music for 12 lamps*[10])? In each case, the affordance of meaning is dependent on relations between individual objects, their spatial position, and the constitution of their population.

3.2 Audiovisual relations, perceptual meaning and the substantiation of audiovisual objects

The compositional techniques described to this point are applicable to most works of visual art utilizing light fixtures as static visual elements: that is, they are not unique to works that use a combination of light and sound, or works in which the manipulation of electrical signal creates a dynamic light composition. When such compositional choices (for instance, choice of object, spatial position etc.) are utilized in works with luminosonic objects, their affordances are in dialogue with the temporal development (or behaviour) of sound and light exhibited by each object.

The notion of audiovisual behaviour is central to any work utilizing luminosonic objects. By definition, luminosonic objects *appear* to emit both light and sound. Thus, it is the *nature* of the audiovisual relationship which defines the object perceptually ("I am experiencing a simultaneous light and sound stimuli emerging from a lamp") and conceptually ("I see and hear a 'singing lamp'"). In this sense, light and sound become an

[9] artificiel's *condemned_bulbs* features identical light bulbs set up in a uniform grid, with each bulb at a near identical height. In contrast, while *Room Dynamics* features 12 identical 100w incandescent light bulbs, each bulb is placed in a unique spatial situation (in the middle of the room, near a column, near a wall, in a corner) and in a variety of heights. Thus, although the group dynamics found in *Room Dynamics* is homogenous in terms of light emitting objects, their spatial arrangement is heterogeneous.

[10] This collaborative work involves performance and installations using 12 luminosonic table lamps. Each lamp is discreetly outfitted with a transducer, turning the surface of the lamp into a speaker. However, while all luminosonic objects are domestic table lamps, each object varies in size, dimension and design.

integrated, *composite* material; in turn, it is the product of both sensorial energies which allows the substantiation of a luminosonic object.

This substantiation grounds and modifies referential value or associations which arise in response to the object. That is, meaning is not created solely through a process of recognition ("What object is this?") but rather through a negotiation of the object's identity in relation to its behaviour ("How does this object behave? What is this behaviour like? How is it different from the normative behaviour of this particular object?"). This negotiation operates on several simultaneous levels: perceptually (through intersensory bias), ecologically (through affordances of audiovisual stimuli), and semantically (through evaluation of audiovisual behavior within an aesthetic context).

The *behaviour* of luminosonic objects may afford a sense of agency which precedes its energetic manifestation. In a discussion of cross-modal binding in the context of transcoded audiovisual art, Whitelaw suggests that "cross-modal objects... direct us to the signal that underpins both sound and image, as well as to the map, or domain of correlation, between modalities" (Whitelaw 2008, 259-260). Extending this line of thought, the audiovisual behaviour of luminosonic objects may direct spectators beyond an underlying "mapping" or "signal," and towards the perception of agency,[11] mechanism or process; a previous causality, which happens to manifest through sound and light. In this sense, variation in orchestration of audiovisual dynamics have the potential to change the perceptual identity of the luminosonic object, as well as the manner in which it is perceived as a semi-autonomous agency.

[11] In this sense, luminosonic objects may strengthen the ability to use of light-emitting objects as "an anthropomorphic metaphor" (Y. Ziegler 2006, 579).

3.3 Towards a typology of composite sound-and-light materials

In order to explore orchestrational possibilities of audiovisual dynamics in luminosonic objects, I propose a typological model which can (1) account for the compositional dynamics of sound-and-light as composite material, and (2) account for dynamic changes in audiovisual behaviour. While this typological model is developed primarily through analysis of selected works and thus, may be used as an analytical tool, it can also be used as a guide for creative practice. As such, I will attempt to (3) relate compositional strategies with perceptual results.

3.3.1 Precedents in studies of audiovisual relations

Numerous publications provide historical accounts of audiovisual works (Daniels and Naumann 2009, Daniels and Naumann 2011, Rainer et al. 2009). In contrast, only few writers provide insight towards a typology of audiovisual relations. Michel Chion (1994) and John Coulter's (2009) research provides an important precedent. However, both writers focus on image-sound relations in the context of screen-based media. Their observations are thus adjusted to fit my focus on the compositional dynamics between sound and light in media installation work.

Chion's inquiry centers on "added value" in the cinematic arena, defined as the reciprocal "expressive and informative" (Chion 1994, 5) enrichment of sound by image and of image by sound: "Sound shows us the image differently than what the image shows alone, and the image likewise makes us hear sound differently than if the sound were ringing out in the dark" (21). Chion details numerous examples in which such "added value" occurs on a semantic level as sound enhances, compliments or opposes the

semantic or expressive content of an image, leading to a "product of… mutual influences" (22). Chion suggests "added value" may also manifest through the "temporal animation" of image by sound or vice versa, re-rendering the overall qualitative temporal experience (12). In particular, sound may vectorize an image by virtue of its internal teleology, "orienting [it] toward a future, a goal… creating a feeling of imminence and expectation" (13-14).

Chion identifies "synchresis" (a combination of synchrony and synthesis) as a special subcategory of "added value" describing "the spontaneous and irresistible weld produced between auditory… and visual phenomenon" (63). Synchresis may occur "independently of any rational logic," leading to perceptual agglomeration of disparate image-sound combinations. The strength of synchretic experience may depend on "[functions] of meaning... contextual determinations... gestaltist laws... [and] rhythm" (63-4). The phenomenon of synchresis is exemplified in cinematic fight scenes: synchronous overdubs of hyper-real impact sounds weld irresistibly with the visual image of "punching". Notably, the synchretic effect remains strong despite awareness of the meticulous construction of the audiovisual scene in post-production and the inescapable chasm between the hyper-real "punch" sound and its relatively unimpressive real-world counterpart.

Chion suggests that relations between auditory and visual media may be compared through vertical and horizontal perspectives (1994, 34). Most likely stemming from his training as a composer, vertical and horizontal dimensions follow a musical conception: the vertical dimension delineates audiovisual harmonic relations while the horizontal dimension delineates audiovisual temporal relations (35-36). The vertical

dimension allows comparison of content-appropriateness between auditory and visual media. Audiovisual consonance involves conventional reinforcement of image with an appropriate sound, while audiovisual dissonance involves "a discord between [the] figural natures" of image and sound components (Chion 1994, 37-38). However, consonant or dissonant relations between sound and image are not tied to realism, but rather, to the conventions of the medium. For instance, the hyper-real "punching" sounds accompanying a fight scene appear consonant in the cinematic context despite their lack of realism; replacing a "punch" sound with the sound of a "gong hit" results in dissonant audiovisual relations, as the "gong hit" is an unconventional sonic reinforcement in said context.

The horizontal dimension allows comparison of temporal relations between image and sound. Chion details horizontal relations extending from audiovisual unison – sound and image operating in synchrony – to audiovisual counterpoint, in which each medium "possesses its own formal individuality" (36) despite the simultaneity of sound and image tracks. By referring to the musical term counterpoint – literally, "point against point" – Chion allows the conception of concurrent audiovisual media as two individual "voices": one auditory, and the other, visual.[12]

Figure 3.1 provides a graphic adaptation of synchresis in relation to the vertical and horizontal dimensions of audiovisual media. The vertical, harmonic dimension

[12] Chion notes several problems in the use of musical conceptions of harmony and counterpoint in film criticism. Chion presents a potential problem of utilizing harmony and counterpoint – devices used to relate between "notes… the same raw material" – to describe audiovisual phenomena, which involve two different sensory materials (Chion 1994, 35-6). Furthermore, Chion argues for the dominance of vertical audiovisual relations in the cinematic medium, which in turn result in misdiagnosed and imperceptible audiovisual counterpoint (38-9). However, the latter problem seems specific to the cinematic medium, especially due to the double function of both film sound and image as sensory experiences and semantic signifiers (38). Thus, the problem of misdiagnosed audiovisual counterpoint may be avoided in the extension of musical concepts to audiovisual analysis of non-image based media.

ranges from audiovisual unison (image-sound correspondence perceived as a "realistic" manifestation of an object or event), through consonant harmony (image-sound correspondences that reinforces conventional medium expectations despite their lack of realism, and are thus perceived as strongly correlated), and on to dissonant harmony (image-sound relation are weakly correlated due to their lack of content-appropriateness). The horizontal dimension ranges from audiovisual unison (image-sound relations that are in perfect synchrony, drawing attention away from the use of two separate media), through temporal animation (non-unison audiovisual correspondence which are nonetheless related or complementary, with one media temporally animating the other) and on to audiovisual counterpoint (image-sound relations which are perceived as two independent voices).

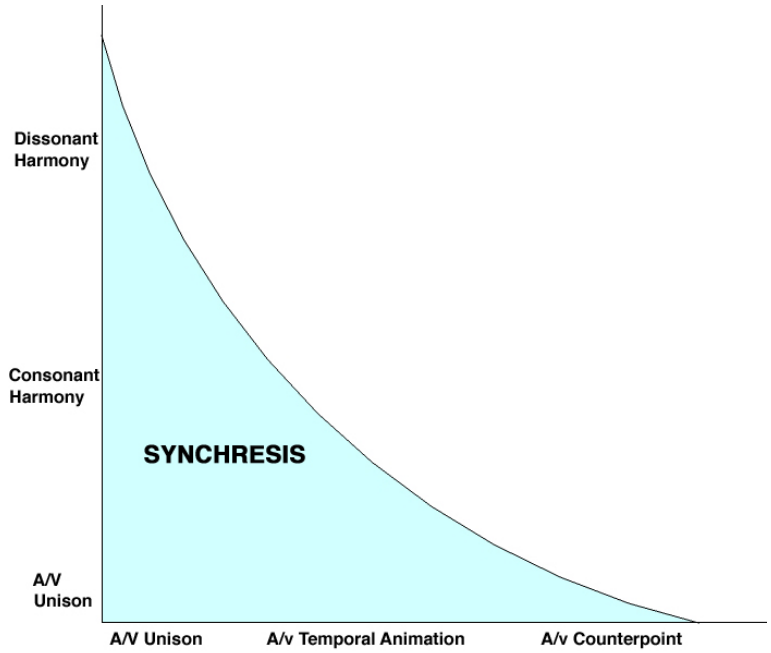

Figure 3.1: graphic representation of Chion's vertical and horizontal dimensions

Figure 3.1 shows the phenomenon of synchresis is shaded in light blue. The perception of synchresis is dependent on the relationship between harmonic and temporal

relations. For instance, in order to maintain synchresis using harmonically dissonant media pairs it is necessary to maintain audiovisual unison relations on the horizontal dimension. That is, the morphological congruency of the image-sound combination (for instance, a "punch" image accompanied by a "gong hit") supersedes the discord in content appropriateness between image and corresponding sound. Likewise, maintaining synchresis using media pairs exhibiting audiovisual counterpoint necessitates a unison harmonic relation: as both image and sound represent the same "content", disparity in their temporal correspondence is overlooked, leading to the maintaining of a synchresis (Chion 1994, 38-39).

Using Chion's writing as a starting point, Coulter offers a model for the analysis of media pairs in "electroacoustic music with moving images" (Coulter 2009, 26). Coulter suggests the classification of media pairs through comparisons of content (of both auditory and visual media, on a continuum ranging from referential to abstract) and structural relations between media (on a continuum between homogenous to heterogeneous relations). Coulter elaborates that structural relations between media pairs – in other words, compositional dynamics – may be described as isomorphic, concomitant, or heterogeneous. In providing these terms for the classification of audiovisual media pairs, Coulter enables a differentiation of two types of compositional dynamics which result in synchretic experience: isomorphic and concomitant media pairs (27-28). Likewise, Coulter coins the term "heterogeneous media pairs" (32-33) to describe audiovisual which do not result in the experience of synchresis. In this sense, Coulter's classification illuminates certain "corners" of the synchretic region portrayed in figure 3.1.

Isomorphic media pairs exhibit shared formal "features that act as catalysts in the process of integration" (Coulter 2009, 27-8). Despite the use of two perceptual modalities, isomorphic media pairs "[activate a] solitary [mental] schema" (28). For instance, the coupling of a "punch" image sequence with conventional sonic reinforcement in a cinematic fight scene activates a single mental schema (the schema for "punch" or "impact"), regardless of its multi-modal sensory input. In this sense, isomorphic relations result in a powerful degree of synchresis. Conversely, concomitant relationships occur "when two (or more) schemas are simultaneously activated [or overlaid]" (28). This overlaying leads to audiovisual integration through "highlighting and masking" of features based on their support of homogeneity (27). For instance, the coupling of a "punch" image sequence alongside a synchronous sound of a "gong hit" triggers two schemas in terms of referential content (a schema for "punch" and a schema for "gong"). However, synchresis is maintained due to morphological similarities and synchronous attacks.

In contrast to isomorphic and concomitant relationships, heterogeneous media pairs are perceived as two different media which just happen to be experienced simultaneously. Each medium triggers its own schema, and highlighting based on similarity is rare. Although the experience of synchresis is unlikely (there is no "irresistible weld"), heterogeneous media pairs may still exhibit added value, as sound and image are constantly reflecting new meanings on one another. Figure 3.2 overlays Coulter's notions of isomorphic, concomitant and heterogeneous media pairs over top of Chion's theoretical concepts.

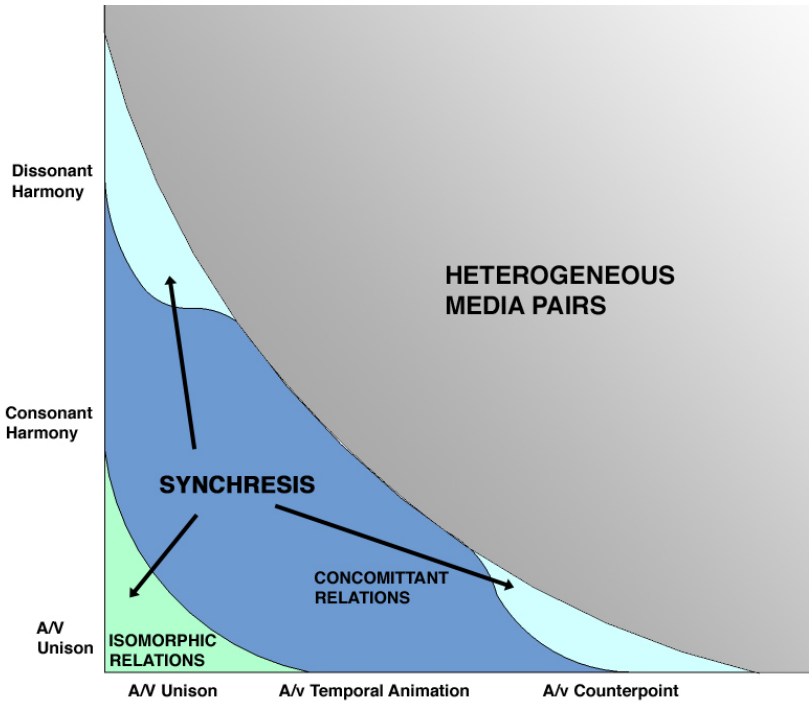

Figure 3.2: Overlay of Coulter and Chion's concepts.

While Chion and Coulter's study of audiovisual relations provides an important precedent for the classification of audiovisual typologies in luminosonic objects, both attempts share several shortcomings. Most notably, although their analyses offer several key categories of audiovisual relationships, they fail to provide further detail in terms of sub-categories. While this shortcoming is understandable given the near-infinite possibilities of sound-image combinations, the broad categories of audiovisual relationships offered by both scholars provide inadequate detail when applied to the relatively limited range of light and sound combinations. Furthermore, neither authour fully accounts for the "strength" of synchretic experience: the degree of perceptual and conceptual "irresistibility" experienced in relation to a particular audiovisual synchretic "weld" (Chion 1994, 63). In other words, the compositional relationships between media pairs suggested by each authour (harmony/dissonance, unison/counterpoint,

isomorphy/concomitance/heterogeny) are not correlated to perceptual experience and accompanying affect.

This lack of correlation raises significant problems with regards to the use of Chion or Coulter's insights in a compositional context. First and foremost, the lack of perceptual correlation makes it impossible to engage in informed decision-making regarding the use of particular audiovisual compositional dynamics and their resulting perception and affect. Furthermore, without an ability to correlate audiovisual compositional dynamics with the "strength" of synchretic experience, it is impossible envision notions of *hierarchy* or *hierarchical motion*[13] between different types of audiovisual relations. That is, due to these shortcomings, and the limitations they place on compositional possibilities, Chion and Coulter's analyses are inadequate tools for compositional design of audiovisual works.

3.3.2 Towards a spatial model for audiovisual typologies

I will delineate in detail compositional dynamics of sound-and-light as composite, integrated material in a manner that (1) accommodates dynamic changes in audiovisual relations and (2) correlates the compositional dynamics of audiovisual materials to perceptual results. Audiovisual typologies are identified through analysis of existing audiovisual installations and creative experimentation. Each typology will be represented in a spatial model (or compositional state-space) of audiovisual relations, which could

[13] Akin to the musical hierarchical motion between a dominant chord and the tonic.

function as either analytical tool or compositional aid[14] for the creation of new works using luminosonic objects.

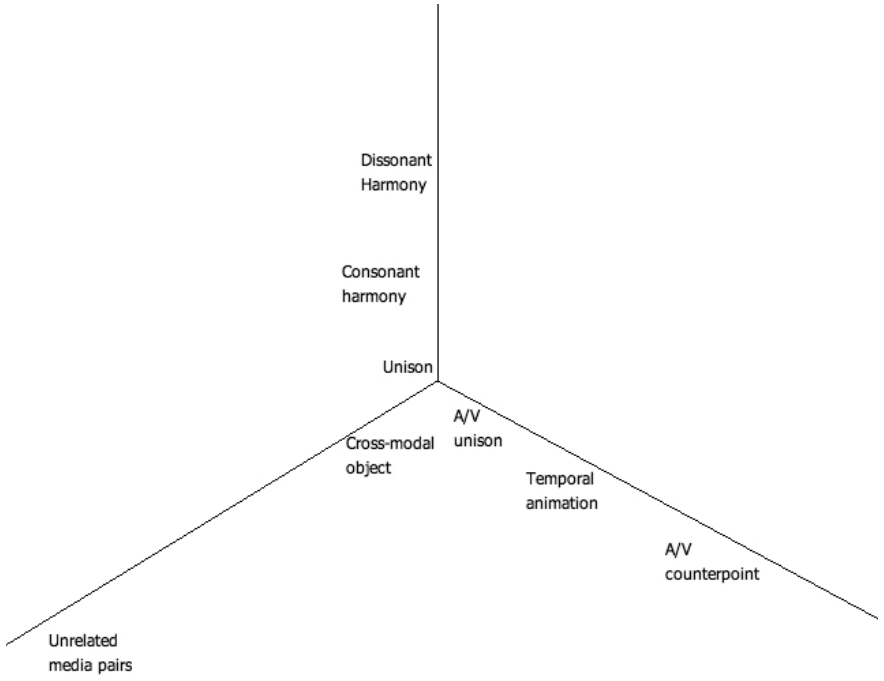

Figure 3.3: Three-dimensional model of audiovisual relations.

My spatial model maintains Chion's conception of vertical and horizontal axes of *audiovisual harmonicity* and *audiovisual temporal relations*. In order to correlate these compositional devices with perceptual experience, I will add a third axis measuring *perceptual bond*: the strength of synchretic experience (see figure 3.3). The axis of perceptual bond ranges between the percept of a "cross-modal object... [in which] stimuli in different modalities are 'bound' into correlated wholes" (Whitelaw 2008, 259) and the percept of unrelated (heterogeneous) media pairs, in which the two media are independent save for their simultaneous manifestation. The addition of a third axis of comparison between media pairs results in a three-dimensional spatial model of

[14] Note that while my model may be useful as a guide for possible typologies of compositional dynamics in luminosonic objects, the manifested light and sound in each typology can be orchestrated in various ways. Orchestrational possibilities – beyond categories of compositional dynamics – are not addressed in the model.

audiovisual relations. Each typology will occupy its own "volume" within the model: a range of possible variations of harmonic, temporal, and perceptual relations which nonetheless correspond to a single category of compositional dynamics. While each typology occupies its own "volume", overlaps between neighbouring typologies may exist.[15]

The three-dimensional spatial representation allows the discerning of similarity and difference between audiovisual typologies through spatial proximity or distance along the three axes. Furthermore, the compositional state-space of audiovisual relations allows the development of paths of successive audiovisual typologies, which remain embodied by a single luminosonic object. This approach allows the conception of temporal development between subsequent audiovisual typologies as motivic devices which may be repeated, developed, varied or opposed.

3.4 Audiovisual typologies

Throughout this section, I will identify and describe each audiovisual typology and subsequently place them within the spatial model, resulting in a functional, compositional state-space of audiovisual relations. Beginning with the two extremes of the spectrum, I will identify isomorphic audiovisual relations, which appear as a homogenous, "cross-modal objects" (Whitelaw 2008, 259), and their diametric opposite, heterogeneous media pairs. Following isomorphic and heterogeneous typologies, I will detail a spectrum of audiovisual relations ranging between the two extremes, tracing a

[15] In subsequent graphic representations, lines delineating typological boundaries are portrayed as absolute in order to enhance intelligibility. In reality, the boundary lines between any given typology are blurry, depending in part on the individual perceiver and the preceding compositional context.

path away from unison relations along the harmonic axis, followed by a correspondent tracing along the temporal axis.

3.4.1 Isomorphic media pairs

The isomorphic sound-and-light typology is placed at the meeting point of the harmonic, temporal, and perceptual bond axes. This typology is defined by the shared formal features manifested: sound and light behaviours are deemed "realistic" in terms of their content-appropriateness, triggering a single mental schema to process both stimuli (cf. the properties of isomorphic media pairs in Coulter 2009), while exhibiting synchronous morphological features in the temporal realm. The combination of unison relations in both harmonic and temporal axes results in the perceptual substantiation of a "cross-modal object" (Whitelaw 2008, 259), the point at which synchresis is strongest and most irresistible. The experience of isomorphic audiovisual relations is "sticky," as the percept of a cross-modal object is strong and rewarding, structuring subsequent audiovisual events (268). As a result, subsequent audiovisual relations which deviate away from isomorphism – for instance, a short time delay between light and sound stimulus, or signal processing of the sound component – may still be perceived as cross-modal, synchretic objects. Isomorphic media pairs can be divided to two sub-categories: physical isomorphy and mapped isomorphy.

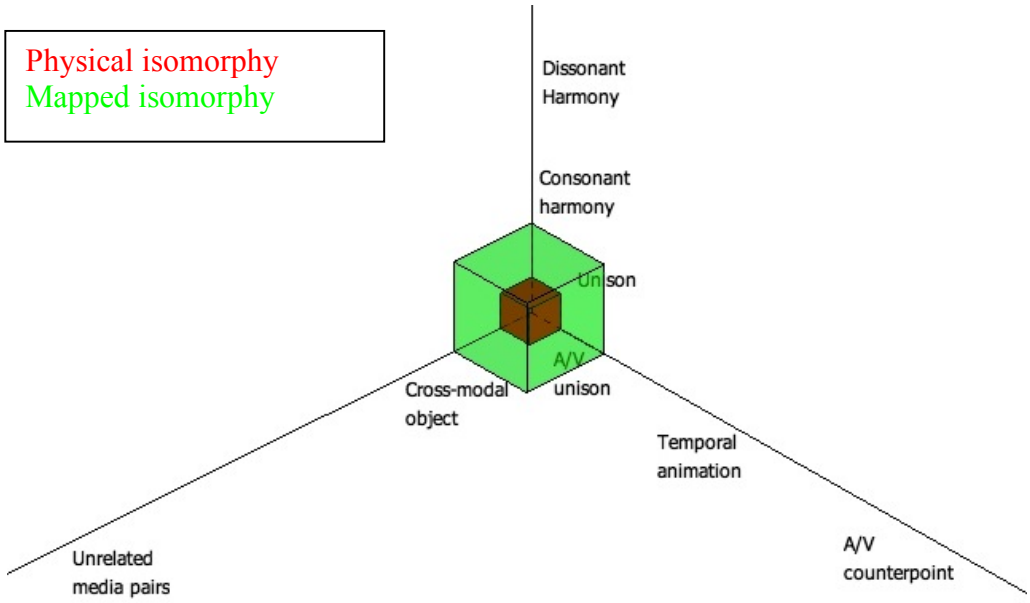

Figure 3.4: Physical and mapped isomorphy.

3.4.1.1 Physical isomorphy

In physical isomorphy, shared formal features result from the physical coupling of media. In other words, the symmetry of content and morphology in audiovisual relations originates in an underlying physical system which simultaneously produces both media. For example, in artificiel's *condemned_bulbs* (see video example 3.1),[16] 1000-watt incandescent bulbs are activated through a modulation of electrical voltage to each bulb. Due to the size of the bulbs, the application of electrical voltage results in simultaneous light and sound, as the excitation of the carbon filament is amplified by the natural resonance of its glass encasing. The combination of bulb illumination and resonant buzzing of filament is appropriate in terms of content (sound and light behaviours are consistent with our expectation of audiovisual manifestation of electrical energy) and corresponds to unison temporal relations (there is no sound without light, no light without sound). Other examples of physical isomorphy can be found in Nam June Paik's

[16] Each typology discussed in this section refers to video support examples, which may be viewed in the online web resource www.adambasanta.com/thesis/video.html

Exposition of Music-Electronic Television (in which sound and light are a product of electromagnetic manipulation of televisions) and Robin Fox's *Laser show* (in which the sonic waveform undergoes analog conversion[17] to a laser-based oscilloscope).

3.4.1.2 Mapped isomorphy

In contrast to the physical coupling of media, mapped isomorphy operates through cross-media parametric mapping. For instance, video example 3.2 – an excerpt from my own work *Room Dynamics* – highlights a mapped isomorphic relation between sound amplitude and light intensity. Although the distance between the light bulb and the accompanying loudspeaker hanging above it may be as great as 2 meters, the cross-modal bond (in other words, synchresis) is surprisingly undiminished: spectators frequently report that the sound was in fact coming from the light bulb, illustrating Chion's notion of spatial magnetization of sound by vision (Chion 1994, 44; 69-70). Other examples of mapped isomorphy can be found in Chris Ziegler's *Forest 2 - cellular automaton* and Ziegler and Modler's *Neoson*.

Physical and mapped isomorphy can be distinguished technically, with the fixed physical nature of the former contrasting with the inherent flexibility of software mapping. However, this technical difference can manifest perceptually, as the ability to modify parametric relations between light and sound allows various perceptions (or strengths) of the cross-modal bond. For instance, a mapped isomorphic relation between the amplitude of a light "tremolo"[18] and spectral brightness of a simultaneous audio

[17] Although this example of physical isomorphy can be framed as a mapping process, it is defined by its physical and static nature. In opposition to software mapping described below, the "mapping" in physical isomorphic typologies cannot be changed or modified.
[18] A rhythmic undulation of light intensity.

signal results in mapped isomorphy that may not be strongly perceived as a cross-modal object.[19]

3.4.1.3 Discussion of isomorphic relations in popular and experimental contexts

Both physical and mapped isomorphic relations are common typologies in experimental and popular audiovisual contexts. The popularity of isomorphic typologies is due in part to the limbic reward that follows the percept of a strongly bonded cross-modal object[20] (Ramachadran and Hirstein 1999, 21-23). In an evolutionary sense, "discovering correlation and… 'binding' correlated features to create unitary objects or events must be reinforcing for the organism – in order to provide incentive for discovering such correlations" (21). This reward extends to discussions of aesthetic pleasure resulting from the perception of cross-modal objects in artistic contexts (Whitelaw 2008, 271; Ramachandran and Hirstein 1999, 21-23). The limbic reward caused by isomorphic typologies may elevate their hierarchical status in a manner similar to the tonic chord in a musical work: the return to an isomorphic typology can provide a sense of arrival, conclusion, and aesthetic pleasure.

Furthermore, the perception of luminosonic objects *as* cross-modal objects – as seen in artificiel's *condemned_bulbs* and excerpts of my own work *Room Dynamics* – is relevant in relation to theory and practice in the related field of electroacoustic music.[21]

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[19] This is due to the less salient nature of the mapping process, as well as the potential departure from rhythmic unison on the temporal axis.

[20] The reward offered by the limbic system as a result of the recognition of cross-modal correlations is explained through an evolutionary rationale (Whitelaw 2008, 268; Ramachandran and Hirstein 1999, 21-3).

[21] The relevance of this discussion extends beyond my own background as a composer of electroacoustic music. Several of the works analyzed in this text have been created by artists with a background in electroacoustic composition and sound art. Notably, Artificiel, Hans Peter Kuhn, Iannis Xenakis and Bernhard Gál all began their careers or pursued parallel paths in electroacoustic and/or sound art contexts before or while embarking on the creation of audiovisual works.

With regards to the two aforementioned works, imagine a scenario in which a blindfolded spectator only experiences the sounds of luminosonic objects in the installation space. In such a presentation, sounds would be perceived as disembodied from their unseen source, a basic theoretical concept of electroacoustic music scholarship[22] (Schaeffer 1966, Smalley 1996, Truax 2001 to name a few). However, by removing the blindfold in the installation space and re-binding sound and light via their isomorphic relations – that is, recasting them as cross-modal luminosonic objects – the formerly disembodied sound is re-embodied within a physical object. This re-embodiment contains tension, as the perceptual certainty of cross-modality ("the sound is definitely coming from the light object") conflicts with observational knowledge of everyday life ("light objects do not usually make this sound," or "I am not normally able to perceive this sound").

While some source-ambiguity may remain, the re-embodiment of sound may be significant in terms of accessibility of works, as it avoids potential barriers to accessibility associated with the disembodiment of sound (McCartney 1999, 252). In my own experience using re-embodied sounds (through the application of isomorphic relations) using luminosonic objects, I have found that listeners are considerably more tolerant of noisy and abrasive sounds; that is, these sounds became more accessible – and perhaps, generated greater affect – due to their re-embodiment in a light-emitting object with which listeners were familiar with from everyday experience.

3.4.2 Heterogeneous media pairs

The polar opposite of homogenous, isomorphic typologies is defined as heterogeneous media pairs. In this typology, audiovisual relations are perceived to be

[22] This concept is referred to as "schizophonia" in soundscape studies (Schafer 1994, 90).

different in both "harmonic" content and temporal development, resulting in a lack of cross-modal binding. Despite the lack of cross-modal binding, heterogeneous media pairs exhibit mutual influence on one another. However, this mutual influence falls under Chion's definition of "added value," rather than synchresis (Chion 1994, 5). The heterogeneous typology is positioned in the polar opposite corner from isomorphic typologies in the audiovisual compositional state-space.

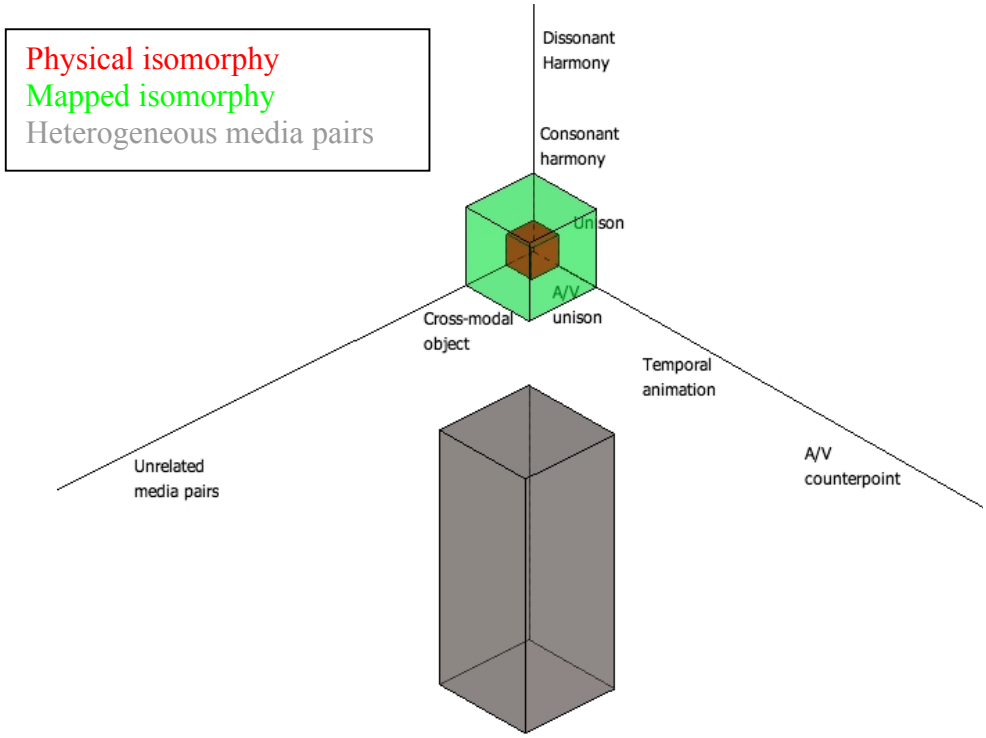

Figure 3.5: Heterogeneous media pair typology.

The audiovisual oeuvres of German sound artist Hans Peter Kuhn and composer Iannis Xenakis showcase two approaches to heterogeneous media pairings using luminosonic objects. Kuhn's audiovisual works continually re-visit the "[motif] of architectural stillness alongside musical movements" (Kuhn 2000, 27). For instance, in *A Vertical Lightfield* (video example 3.3), the slow undulation of undimmed neon bulbs is coupled with brief auditory disruptions. This relationship is conceptualized as a multi-

tempi composition comprised of the slow tempo of neon bulb undulations, the fast tempo of individual sounds, and the medium tempo of sound occurrence.[23] Coupled with the metaphorical tempo of the perceiver (their mood, purpose, daily occurrences previous to the experience of the work), Kuhn aims to create a multi-modal "meta rhythm": a personal adaptation of Chion's concept of added value. Kuhn rejects the immediate reward of isomorphic audiovisual relations – the notion of "telling the same story twice" in two simultaneous media – and rather, aims to construct an additive meaning by "telling two separate stories… [each on a] different plane… in parallel."[24]

Xenakis' *Polytope de Cluny* provides an interesting correlate to Kuhn's compositional dynamics, while articulating a similar conceptual justification. The surviving partial documentation of this work (video example 3.4) showcases the heterogeneous nature of media relations described in Xenakis' original dramaturgical sketches: a strong contrast between "the musical aspect… continuous and acoustic in origin… and the light show… discontinuous and electronic, with light flashes in movement" (Xenakis 2008, 205). While Xenakis' description of roles assigned to sound and light are the inverse of Kuhn's orchestration, both examples exhibit heterogeneous compositional dynamics. Much like Kuhn, Xenakis aims to create light and sound behaviours which bear no strict relation to one another, but rather, showcase "an encounter between two different musics, one to be seen and the other to be heard" (Xenakis 2008, 206). The conception of two "different musics" is extended to the realms

[23] Personal correspondence.
[24] Additionally, Kuhn utilizes minimal, static light in a heterogeneous relation to the sounding component in order create a condition for listening, thereby overcoming the confusion experienced by unfamiliar audiences in sound installations. However, this use of light is so different from the accompanying sound in terms of form, complexity, and function that it no longer fits the description of a luminosonic object: the relationship between sound and light is so heterogeneous that the light objects and accompanying sounds are no longer perceived as an integrated composite material.

of perceptual and compositional functions: "light occupies time, for its effect depends on rhythm and duration while music shapes space" (231). In this sense, heterogeneous media pairs showcase the manner in which 20th century compositional[25] techniques – as opposed to the classical devices of unison, harmony, and counterpoint – may be useful devices in the structuring of audiovisual events.

The use of isomorphic and heterogeneous typologies is often justified on conceptual grounds.[26] As a result, works exhibiting either typology tend to use them exclusively, discarding the possibility of modulation to other audiovisual relations. In an effort to develop a navigable compositional state-space through which a developing sequence of audiovisual relations can be articulated, the following sections will explore the middle grounds between isomorphic and heterogeneous relations, beginning with an delineation of the harmonic axis.

3.4.3 The harmonic axis

Following Chion's definition, the harmonic dimension of audiovisual relations compares content-appropriateness between auditory and visual media pairs. Both sound and light events remain in temporal unison, while the "appropriateness" (or plausibility) of light-and-sound relations may vary. The notion of content-appropriateness is entirely contextual: as a result, a change in context may result in two different percepts of audiovisual harmonicity despite the identical nature of audiovisual materials.

[25] The use of heterogeny can be similarly linked to the independent relationship of music and choreographed gesture in collaborative dance works by John Cage and Merce Cunningham.
[26] In the case of isomorphic relations, as an attempt to approach synaesthesia (Whitelaw 2008, 259) or enhance accessibility; in the case of heterogeneous relations, as a means to combine two media in order to create a novel composite percept.

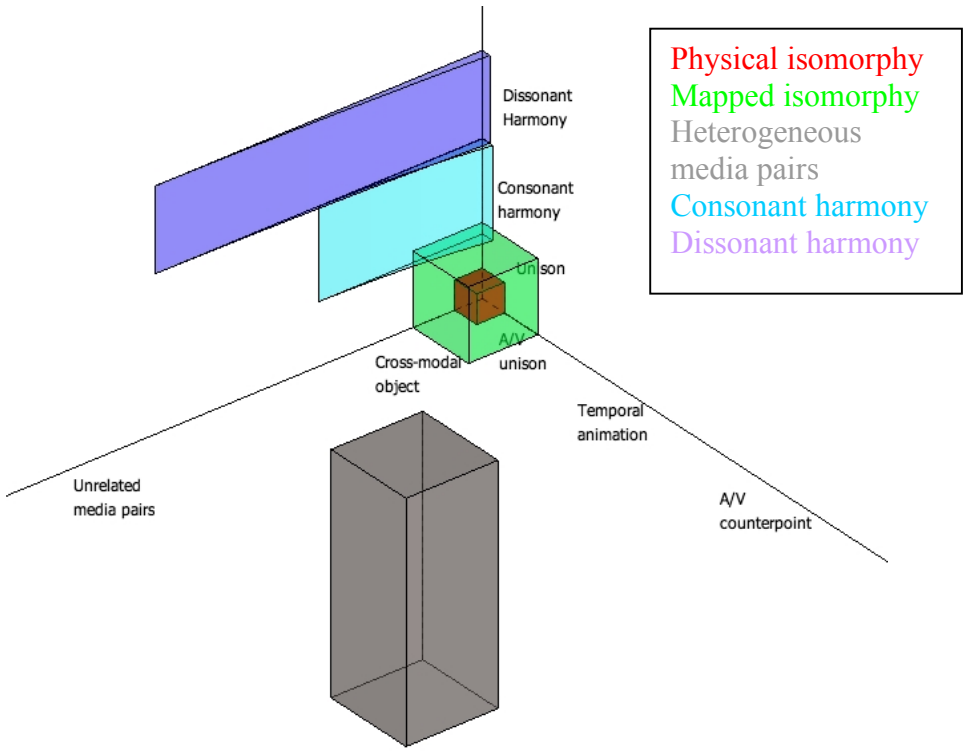

Figure 3.6: Consonant and dissonant harmonies.

3.4.3.1 Consonant harmony

As we move away from audiovisual harmonic unison – the percept that "this is the actual sound made by the light object," showcased in artificiel's *condemned_bulbs* and sections of my own work *Room Dynamics*[27] – we reach audiovisual consonant harmony: an appropriate or conventional reinforcement of light events using sound (or vice versa). In opposition to audiovisual harmonic unison, spectators are aware of the contrived nature of light and sound combinations; however, they allow themselves to

[27] Note that this percept is only factually true in the case of artificiel's *condemned_bulbs*. However, the technical reality is secondary to the perception of "unison" experienced by spectators in sections of *Room Dynamics*.

indulge in the illusion, as the temporal unison of light and sound media make the audiovisual events ecologically plausible.

An analysis of United Visual Artists' *Array* (video example 3.5) provides an example of audiovisual consonant harmony. In this excerpt, columns outfitted with LED strips appear to produce various audiovisual behaviours. The red light column – conceptualized by the artists as an "agency" moving through the audiovisual grid (UVA) – manifests light activity alongside a distinct sounding accompaniment in temporal unison. While there is no particular reason for this *specific* sound to be coupled with the red light column, the combination of light and sound events seems appropriate given the digital aesthetic vocabulary. In other words, the relationship between light and sound is plausible given the ecology of the work: it is the sound the light column *would* make if it *did* make sound. The combination of content appropriateness (consonant harmony) and temporal unison results in a strong perceptual bond between sound and light and the percept of a cross-modal object.

3.4.3.2 Dissonant harmony

Moving further away from audiovisual unison along the harmonic axis, one arrives at dissonant audiovisual harmonic relations. Following Chion, I define audiovisual dissonance in luminosonic objects as manifesting "a discord between [the] figural natures" of light and sound components (Chion 1994, 37-8). Consider an excerpt from *Room Dynamics* (video example 3.6) in which mapped isomorphy gives way to consonant harmony (via the increased application of resonant filters), and finally to audiovisual dissonant harmony (a flashing light simultaneous with the sound of a piano

note). The dissonant audiovisual event lacks the ecological plausibility found in UVA's *Array* despite onset synchrony and morphological symmetry between light and sound intensity. Using Coulter's concept of concomitant audiovisual relationships, the two schemas triggered by this event (a light bulb and a piano) are so different in content that highlighting only occurs on the perceptual level, but not on the conceptual level.

Figure 3.6 illustrates the manner in which audiovisual dissonance begins to challenge the percept of a cross-modal object despite temporal unison relations. A great degree of audiovisual dissonance may approach the perception of unrelated media pairs. However, when the percept of a cross-modal object is maintained, audiovisual dissonance presents an interesting tension between the perception of re-embodied sound and the ecological dissonance of this re-embodiment. Spectators may be certain of the physical source of sound, now re-embodied in a physical object, while remaining uncertain of the means with which the unexpected sound has been produced by the luminosonic object. The combination of source certainty alongside the uncertainty of means-of-production can be considered an audiovisual variation of Smalley's notion of "second order surrogacy" in electroacoustic music theory, in which "vestiges of… gestural activity [are] surmised from the [sound-and-light media]" while eluding "a realistic explanation" (Smalley 1996, 85).

3.4.4 The temporal axis

While the vertical axis provides a measure of content appropriateness between simultaneous audiovisual media, the horizontal axis allows a comparison of temporal relationships between light and sound behaviours. Movement away from the synchrony

of audiovisual unison may entail variation in the onset of media, or a degree of independence in the morphological development. At times, the behaviour of two media-"voices" may relate to the musical device of heteronomy (two voices performing complementary variations on a similar idea, occasionally coalescing), rule-based polyphony (for instance, the rhythmic alteration found in the "hocket"), or counterpoint (literally, "point against point"). Non-unison temporal relations can, of course, be combined with various forms audiovisual harmony. Two main categories of non-unison temporal variation – temporal animation and rule-based counterpoint – are described below.

3.4.4.1 Temporal animation

Adapting Chion's concept, sound or light may temporally animate its media counterpart, texture the overall qualitative temporal experience, or vectorize its media-counterpart "towards a future, a goal… [an] expectation" (1994, 13-14). Temporal animation usually involves a simultaneous onset of both light and sound behaviours, followed by morphological variations of both media. My adaptation of Chion's term applies to morphological variations that appear complementary and avoid the percept of heterogeneous media pairs.

An example of temporal animation is found in Chris Ziegler's *Forest 2 – cellular automaton* (video example 3.7). In this short excerpt, the visual light-texture moving through the neon bulb assemblage temporally animates an ambient, low frequency sound. Despite the obvious discrepancy between relatively continuous sound and intermittent spatial texture of light-emitting objects, the parallel morphological development is

complementary; it provides "added value" as spectators re-evaluate the sound in relation to the lights, and vice versa. While falling short of the percept of a cross-modal object – the binding of "different modalities… into correlated wholes" (Whitelaw 2008, 259) – light and sound seem to correspond to a quasi-causal relationship, or at the very least, a form of dialogue. This link may be explained through the metaphor of "energy exchange": the light texture may be perceived as a form of disruption caused by a dominant sonic layer, or alternately, the light texture may be perceived to be causal of amplitude disruptions in the sonic layer. In either case, the two media manifest a complementary relation, and are perceived as composite (though perhaps unstable) materials. Therefore, they cannot be classified as heterogeneous media pairs.

Video example 3.8 (a pedagogical excerpt designed by the author) illustrates the manner in which temporal animation can coax the perception of synchresis through the phenomena of intersensory bias. In the example, a sine tone (emerging from a speaker placed above the visible light bulb) fades in, remains static and fades out, while light intensity undulates at various speeds. Listening to this example with one's eyes closed, the sine tone is clearly perceived as a static element. However, when concentrating on the visual image of the light bulb, my[28] perception of the sine tone changes: with each undulation of light intensity, I hear a slight amplitude modulation of the sine wave, or the addition of upper partials to the fundamental frequency. That is, despite the morphological divergence of sound and light behaviours, the luminosonic object is perceived as a cross-modal object. In fact, the synchresis described above extends beyond the mere bonding of two separate sensory stimuli into a single correlated whole: rather,

[28] A similar description of this experience has been reported by several colleagues who viewed this example in an informal setting.

one signal is found to change the perception of its counterpart in a manner similar to the McGurk effect.[29]

The influence exerted by one sensory modality on another is explained through the study of intersensory bias. The current explanatory theory postulates that cross-modal interactions depend "on the structure of the stimuli": a modality carrying a "more discontinuous (and hence more salient)" signal will present dominant bias (Shimojo and Shams 2001, 508). With reference to the aforementioned example, the discontinuous signal (light intensity) exerts bias over the continuous signal (sound intensity). Although a simple reversal of the compositional roles exhibited by light and sound in this example does not result in strong intersensory bias, the general theory provided by Shimojo and Shams may be useful for further artistic investigation of temporal animation in luminosonic objects.

[29] Discovered by McGurk and MacDonald, this effect demonstrates the "influence of vision upon speech perception" (McGurk and MacDonald 1976, 746). The effect is illustrated through the overdubbing of "utterances of the syllable [ba]" onto a video of a person repeating the "lip movements for [ga]" (746). The resulting percept reported corresponds to the syllable [da] (746).

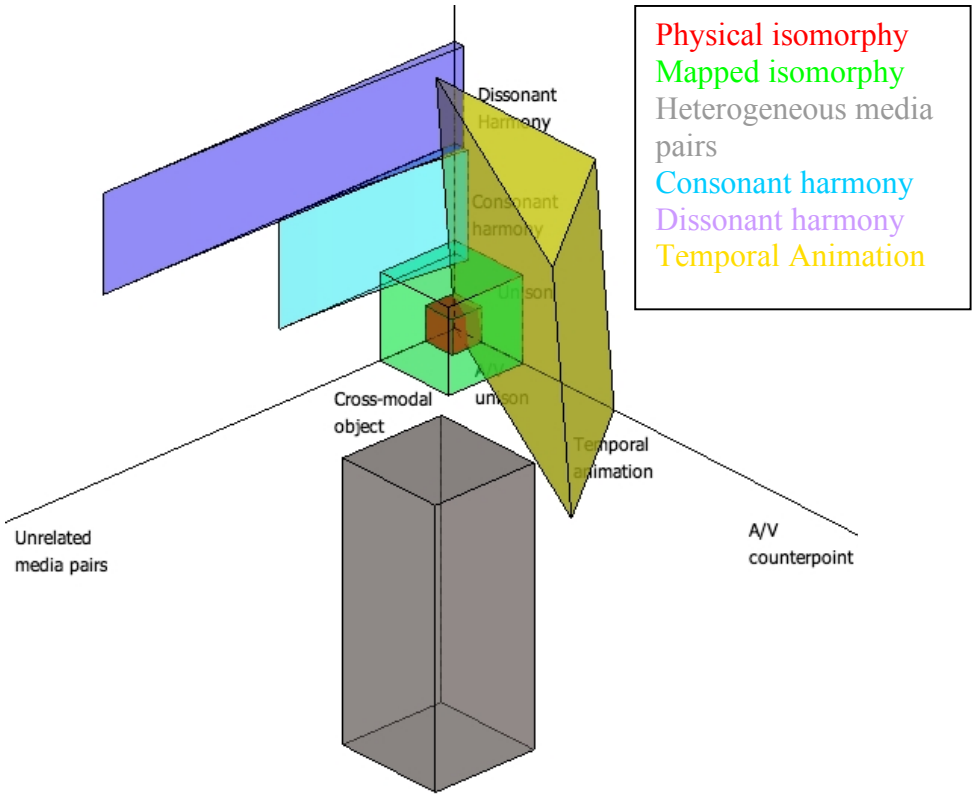

Figure 3.7: temporal animation, view 1.

Temporal animation is placed along the temporal axis of the spatial model of audiovisual typologies. The degree of cross-modal binding between temporally animated media pairs varies depending on the harmonic relation between light and sound, as well as the proximity to audiovisual counterpoint. This has been represented visually through angling of the temporal animation "state-space" away from the percept of a cross-modal object along the perceptual bond axis, as seen in figures 3.7 and 3.8. Figure 3.7 illustrates the placement of the temporal animation typology in relation to the temporal axis, while figure 3.8 illustrates the placement of the same typology in relation to harmonic and perceptual bond axes.

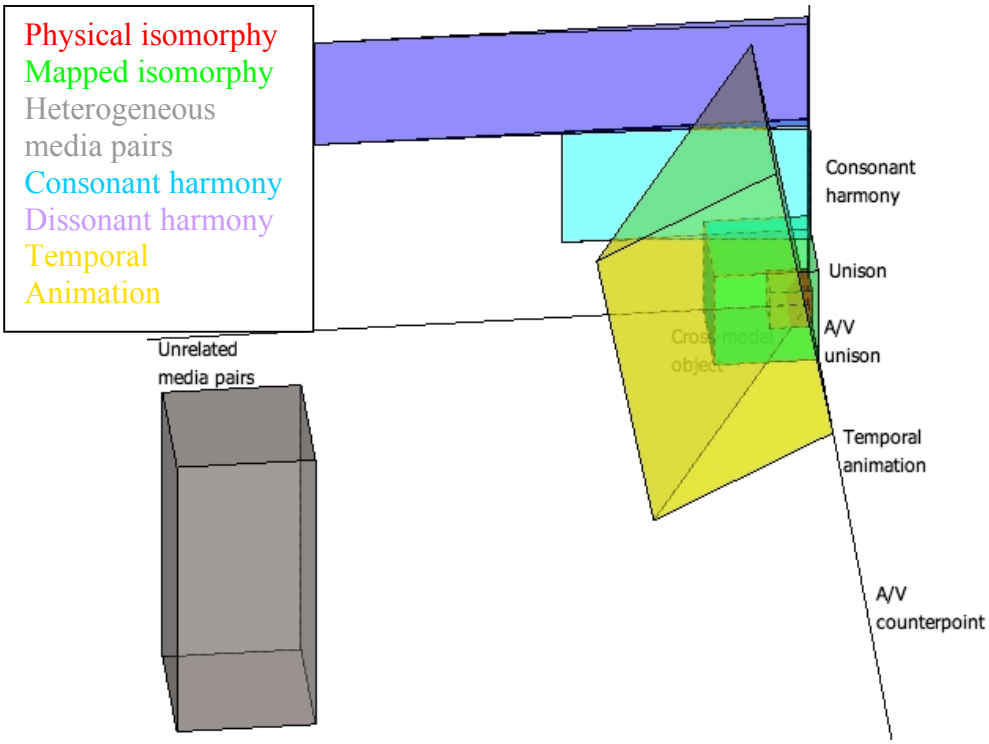

Figure 3.8: temporal animation, view 2.

3.4.4.2 Rule-based counterpoint

Increased discrepancy in temporal morphological relations between media pairs results in the percept of two independent media-"voices: that is, audiovisual counterpoint. However, audiovisual counterpoint need not result in the percept of heterogeneous media pairs (as discussed in the works of Kuhn and Xenakis). Rather, some forms of simple rule-based counterpoint may retain a strong cross-modal bond despite the independent temporal development of each media.

The hocket is a simple counterpoint technique dating back to medieval music, "produced by dividing a melody between two parts, notes in one part coinciding with rests in the other" (Oxford Dictionaries Online). Translated into sound and light behaviour in the following pedagogical excerpt (video example 3.9), a mapped

isomorphic relation between sound and light intensity gives way to an audiovisual hocket in which light intensity alternates with sound intensity.[30] Despite the independence of each voice, the relation between them seems to bind the divergent morphologies into a single cross-modal luminosonic object.[31] Again, this bond may be rationalized through the ecological metaphor of "energy transfer", in which finite electrical energy is routed to two competing circuits: as electrical energy is routed to create sound, it saps energy from the light intensity circuit, and vice versa. The "energy transfer" metaphor also applies when using smooth sound and light intensity curves, as seen in video example 3.10. The application of an audiovisual hocket in an artistic context is evident in an excerpt from *Room Dynamics* (video example 3.11), in which an audiovisual hocket alternates with isomorphic mapping throughout a spatially dispersed ensemble of luminosonic objects.

The placement of the rule-based counterpoint typology within the spatial model of audiovisual relations falls in a fairly limited range along the temporal axis, as it must always corresponding to audiovisual counterpoint. However, depending on the complexity of the rule, as well as the harmonic relation between light and sound, various degrees of cross-modal bond are possible.

[30] It is noteworthy, that as the speed of the hocket increases past ~3Hz it is difficult to ascertain a difference between isomorphic mapping and audiovisual hocket (see video examples 9 and 10), despite 3Hz being well below both visual and auditory fusion rates.

[31] The relation of the hocket to the phenomena of bonding can also be illustrated in the auditory realm. Bregman details the manner in which two intervals of a hocket may be grouped to one auditory stream when (1) the rate of alternation is slow to medium and (2) the intervallic distance between the two notes is relatively small. As the rate of alternation and intervallic distance increases, the stream segregates to two separate melodies (Bregman 1990, 50; 139-30; 147; 153).

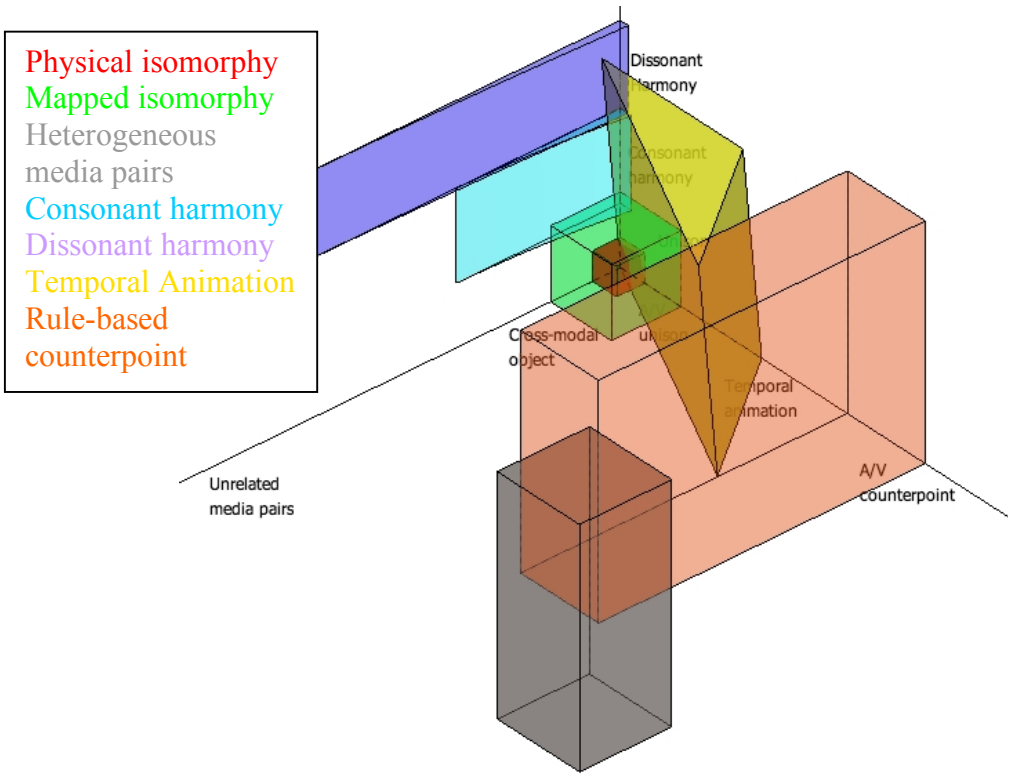

Figure 3.9: rule-based counterpoint.

3.4.5 Coincidence-as-metaphor

The coincidence-as-metaphor typology can be found in Bernhard Gál's *Klangbojen* and *RGB*. This typology involves light and sound behaviour which coincide in time but do not exhibit the morphological congruency found in isomorphic typologies or audiovisual harmonies. Rather, this typology manifests through a combination of dynamic sound and static light, with light media operating as an indicator of presence.

For instance, in Gál's *Klangbojen* (video example 3.12), eight "sound buoys" (literal translation) are positioned along a river. Each "sound buoy" contains an LED and a loudspeaker. As a multi-channel sound composition plays through the buoys, the respective lights do not correspond to sonic morphologies; instead, light indicates the

presence of sound metaphorically and spatially.[32] A similar technique is utilized in *RGB*, an intermedia installation for coloured light, sound, and three quotidian objects: a toaster, aquarium, and ventilator (Gál 2005, 40). Each object is coloured with a particular coloured light, and accompanied by a sound composition. In this work, the coincidence of sound and coloured light extends beyond the indication of presence, as couplings of objects and saturated audiovisual ambiences are negotiated in the realm of metaphorical meaning (Barthelmes 2005, 13-14).

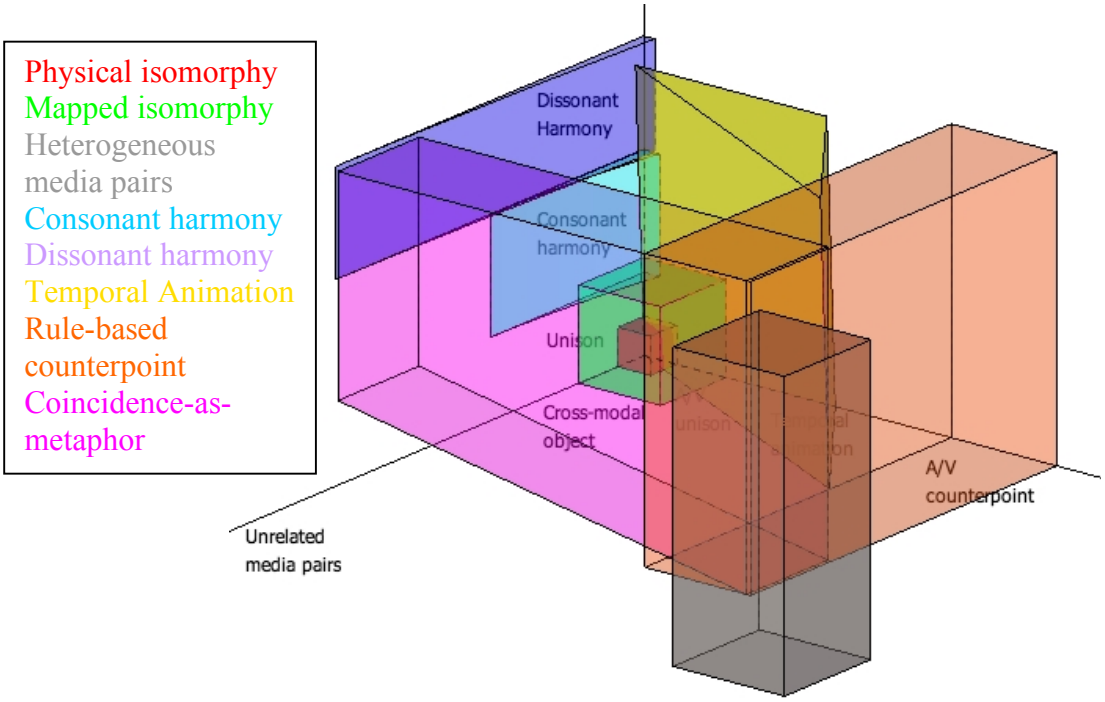

Figure 3.10: Coincidence-as-metaphor.

This typology is placed within the spatial model of audiovisual relations in a manner that allows a range of harmonic and temporal variations between sound and light media. Note, however, that temporal unison or morphological congruency is avoided, as the coincidence-as-metaphor typology does not exhibit this relationship. Furthermore, the positioning of the coincidence-as-metaphor typology along the perceptual bond axis does

[32] Personal correspondence.

not correspond to the percept of a cross-modal object: again, this percept requires stronger morphological congruencies than simultaneity of onset. While the coincidence-as-metaphor typology exhibits added value – the reframing of one media by the presence of another – this reframing operates with the spectator's explicit understanding of the two media as separate in both form and function; light and sound are drawn together solely through simultaneity of manifestation and the metaphorical suggestion which that entails.

3.5 General comments on spatial model for audiovisual typologies

The population of a three-dimensional model with eight audiovisual typologies results in a functional compositional state-space of audiovisual relations (see figure 3.11). While additional typologies may be identified through analysis and creative practice, the current model improves Chion and Coulter's research in terms of detail. Each identified typology offers various potentials for manifestation – various ways in which sound and light may be orchestrated – while relating to one another in terms of compositional dynamics (harmonic and horizontal axes) and perceptual meaning (axis of perceptual bond).

A focus on the relation between compositional dynamics and perceptual attributes has been maintained throughout the identification and placement of typologies within the three-dimensional model. This focus allows an examination of the interaction between compositional techniques and the perception of various strengths and "shades" of synchresis.

This model can be used for analysis of audiovisual relations in works using luminosonic objects. Furthermore, the identified typologies may be used as a basis for the

analysis of audiovisual relations in other forms of audiovisual production. While analysis of screen-based media using this model offers various complications,[33] it may be useful in the analysis of various object-based audiovisual practices in media arts.[34]

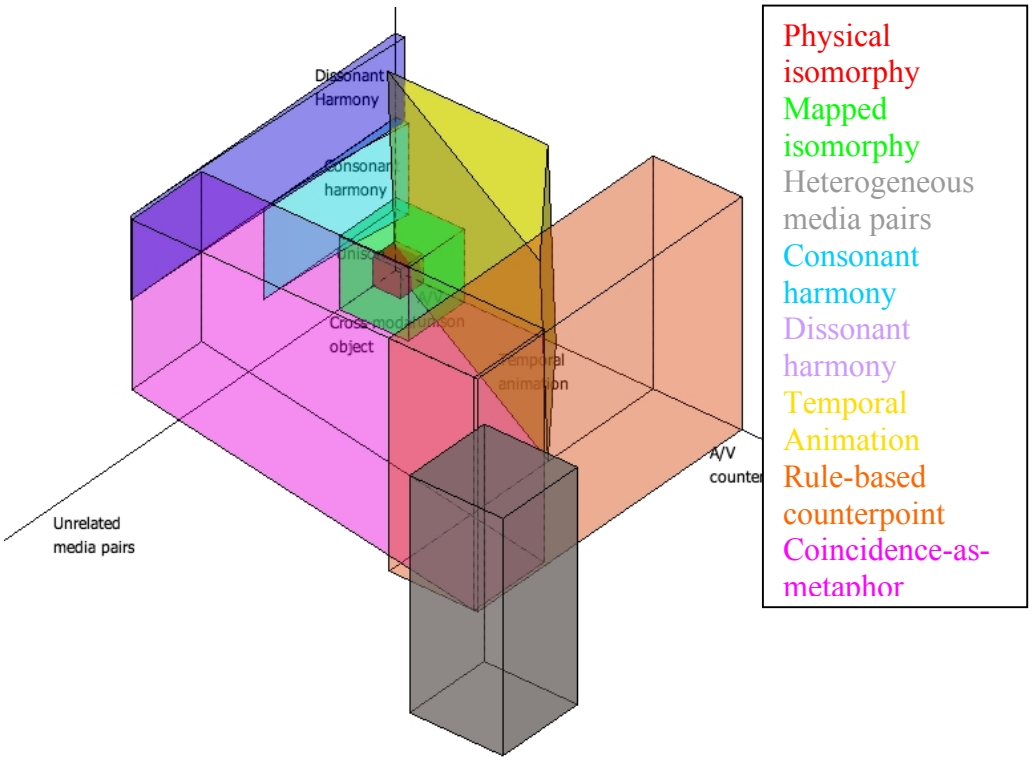

Figure 3.11: three-dimensional model populated by eight general typologies of audiovisual behaviour.

Finally, this model may be useful in the development of new compositional practices in audiovisual media, whether using luminosonic objects or not. The identified audiovisual typologies can be used as vocabulary for the development of new works; in this sense, the very act of analysis provides awareness of possibilities for compositional practice. Due to the correlation of compositional parameters (harmonic and temporal relations) and perceptual results, identified typologies can be used compositionally with

[33] For instance, see Chion's reservations regarding the use of the term counterpoint in audiovisual screen-based media (Chion 1994, 35-40). Furthermore, the notion of audiovisual harmony increases in complexity when analyzing screen-based media that veers from abstract imagery.
[34] In particular, audiovisual practices related to robotics or the activation of mechanical objects.

awareness as to their possible perceptual meanings: the way in which luminosonic objects substantiate themselves *as* audiovisual objects.

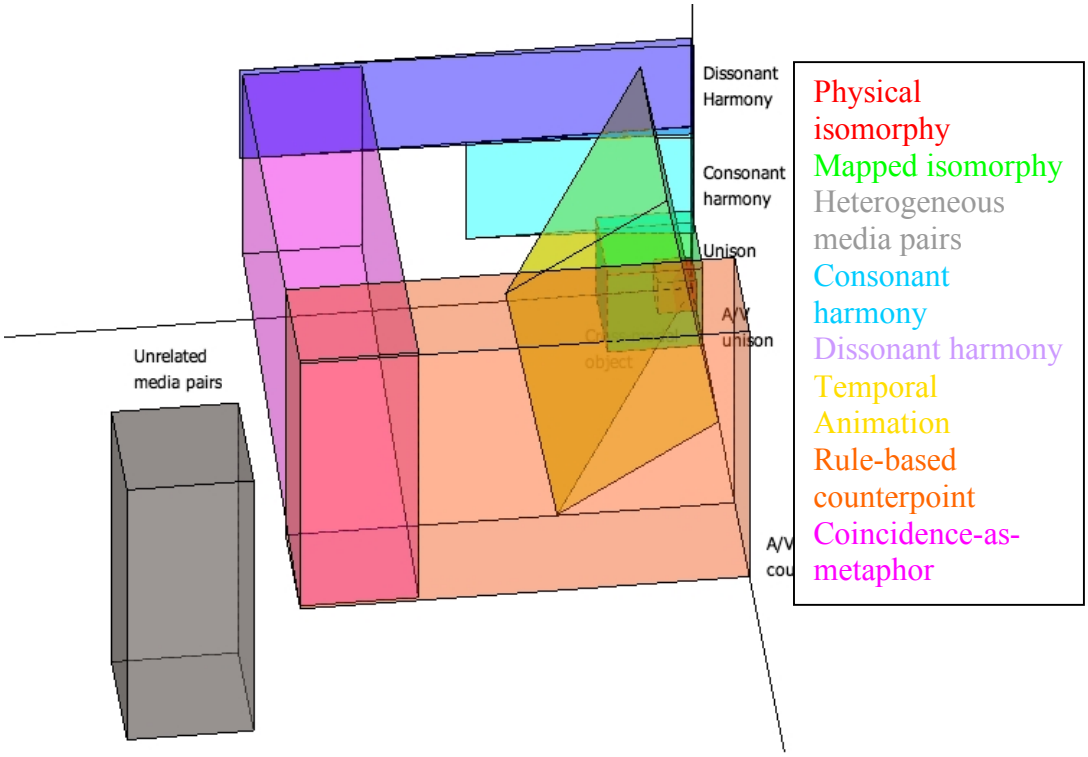

Figure 3.12: three-dimensional model, with focus on axis of perceptual bond.

Furthermore, the construction of a spatial model for audiovisual relations provides additional tools for creative practice using luminosonic objects. This spatial approach allows the compositional exploration of hierarchical movement between audiovisual typologies. For instance, a movement between unrelated media pairs, via audiovisual counterpoint, temporal animation, and arriving at mapped isomorphy (a return to the rewarding percept of a cross-modal object) may be likened to a musical modulation towards the tonic. The tracing of a "path" or succession of audiovisual typologies offers the possibility of composed "phrases" of subsequent perceptual audiovisual relations. In turn, such "phrases" can be used as a motivic unit: repeated, varied and opposed. That is,

we arrive at a notion of audiovisual composition in which the succession of various states of compositional dynamics can be conceived as a formal developmental device.

Chapter 4: Spatio-temporal strategies in installations using luminosonic objects

In the previous chapter, I addressed the compositional dimensions of singular luminosonic objects, focusing on (1) their potential associative dimensions, and (2) their constitution using audiovisual compositional dynamics. In this chapter, I will address the ways in which such objects operate in time and space, and suggest methods with which formal structures can be composed using spatially-dispersed, temporally evolving luminosonic objects.

The examination of spatio-temporal strategies in installations using luminosonic objects involves three interrelated topics: (1) the interaction between luminosonic objects and architectural space, (2) the interaction between media architecture and the mobile spectator, and (3) the interaction of composed audiovisual structures within the relatively uncontrolled installation environment. I will unpack these questions sequentially, beginning with the examination of interactions between light and sound media and its architectural surroundings, followed by reflections on the potentiality and difficulty brought forward by the introduction of a mobile spectator. Finally, I conclude with a survey of spatio-temporal strategies that engage both space and spectator, based on empirical observation and experiential analysis of several audiovisual installations.

4.1 Ensembles and Architectures: Sound and light in space

Most works involving luminosonic objects utilize ensembles of such objects, which are physically dispersed throughout the presentation space. Much like an instrumental ensemble, each luminosonic object can be considered as an individual entity or as part of a larger whole.

Regardless of the particular spatial arrangement of these objects, the overall ensemble may be considered as an architectural construct. This architectural construct, however, amounts to more than a spatial arrangement of dormant objects. As producers of light and sound, the architectural qualities of luminosonic object ensembles are interwoven with the audiovisual media architecture manifesting within the installation space. In this sense, one can discuss architectural features of object-ensembles (for example, a grid formation) or their resulting dynamic audiovisual manifestation (for instance, the audiovisual activation of one corner of a grid formation).

4.1.1 Polytopy: overlaid architecture, overlaid spaces

I define media architectures as the unified, formal structure of spatially dispersed, or space occupying, media[1] objects (for instance, luminosonic objects, but also screens, speakers etc.) and their resulting media projection (for instance, light and sound). Such architectures never operate in a void; they are always embedded within an existing architectural context.[2] The use of audiovisual media architectures thus implies an overlay of multiple architectures and multiple sensory-spaces: to borrow Xenakis' term, a polytopy[3] of overlapping sensory-energetic media-spaces (in our case, light and sound) overlaid and embedded within an existing architectural setting.

Reflecting on Xenakis' polytope works,[4] Sterken coins the terms "energetic" and "material" spaces to distinguish between media architectures and the physical

[1] The term media usually refers to ephemeral media such as light, sound, smell, moisture, as well as projected images.
[2] Even when presented in the "non-space" of theatre black box.
[3] Literally, a combination of the Greek words for *many* (poly) and *spaces* (topus) (Xenakis 2008, 198).
[4] *Polytope de Montreal* (1967), *Polytope Persepolis* (1971), *Polytope de Cluny* (1972), *Polytope Mycenae* (1978), and the *Diatope* (1978).

architectures containing them. Sterken describes “material space” as “defined by the traditional, classical architectural tectonics: walls, ceilings, floors, windows, etc.” (2001, 263). ”Material space” is primarily used as an “interface between the inside and the outside, between the domesticated and the untamed” (263). In contrast, “energetic space” is “defined by sensory qualities” existing within a “material space” (263). ”Energetic space” can be constructed using visual and aural (Blesser and Salter 2007, 59-60) architectures, as well as through the use of heat and smell (Sterken 2001, 263).

Sterken’s terms are useful for examination of two elements of media-architectures: the physical architecture of the presentation space and the architectural qualities of the audiovisual media manifesting within it. However, this separation is misleading, as in reality both energetic and material architectures are constantly defining one another. This is especially relevant in consideration of installation art works, in which “the space, and the ensemble of elements within it, are regarded in their entirety as a singular totality” (Bishop 2005, 6). However, used as relational terms to describe *interactions* between energetic media architectures and the material architectures in which they are embedded, Sterken’s terms provide a starting point for analysis of spatio-temporal structures in media installations.

4.1.2 Composition of space and site

The relationship between media architectures and the material spaces in which they are embedded is one of mutual self-definition. Media installations, considered as a type of installation art, are an “art form that takes note of the perimeters of [a particular] space and reconfigures it” (Suderberg 2000, 4). This process of spatial reconfiguration

using sound and light architectures is in essence, a transformation from or particularization of a *space* into a *site* or *place*: "what begins as undifferentiated space becomes place as we get to know it better and endow it with value" (Tuan 1977, 6). Although all media installations engage in this transformative relationship, different degrees of transformation between space and site can be distinguished based on the type of material architectural space in question and the manner in which it is reconfigured.

4.1.2.1 Site-independent installations

Site-independent installations are often presented in spaces designed to minimize spatial and architectural qualities: primarily the black-box theatre and at times the white box gallery. In such works, the presentation space – although far from neutral – is treated as a "container" for media content. That is, the relationship between energetic and material space is reduced to functional accommodation of size and dimensions. While the presentation space is transformed into a site, this transformation is created solely through the particularities of the media architecture.

Chris Ziegler's *Forest 2 – cellular automaton* and artificiel's *condemned_bulbs* are examples of site-independent works. In each case, a theatrical black box or gallery white box are populated by a media architecture of luminosonic objects. Both works exhibit minimal interaction with physical architectural features or the identity of the presentation space. Architectural identity, in other words, a sense of site, is created solely by the luminosonic ensemble.[5] In both works, the luminosonic ensemble is arranged in a

[5] Another work in which (non-luminosonic) energetic media is the primary creator of a sense of "site" can be found in Olafur Eliasson's series of immersive environments *The Mediated Motion*. In this work, light, sculptural elements and atmospheric conditions (moisture, fog) transform empty gallery spaces to a site (Bishop 2005, 77).

grid-formation, allowing spectators to move within the media architecture while largely ignoring the architectural "container" in which it is embedded.

4.1.2.2 Site-responsive installations

Site-responsive installations exhibit some interrelation between material and energetic spaces beyond the use of presentation spaces as a "containers" of media. Such works engage material and energetic space in a dialogue by creating media architectures that highlight, confront, or respond to the physical[6] architectural surroundings. In such works, the creation of a "site" is a collaborative process between energetic and material architectures. As such, while site-responsive installations can be relocated to new presentation spaces, they will necessitate adjustments for each selected location. In this sense, site-responsive installations correspond to Robert Irwin's categories of "site-dominant" and "site-adjusted" works (Irwin 1996, 572).

Chris Ziegler and Paul Modler's *Neoson*, Xenakis' *Polytope de Cluny* and my own work *Room Dynamics* are examples of site-responsive works.[7] In these works, the placement of luminosonic objects responds to the particular architectural features of the chosen presentation site. In *Neoson* and *Polytope de Cluny*, the media architecture highlights the natural contours of the site, tracing the perimeter of columns and ceilings.

In *Room Dynamics*, a media architecture consisting of 12 sound and light producing luminosonic objects[8] is placed within an otherwise empty presentation space in

[6] Generally, the historical identity of the site is not a central part of the response process, though a historical site may be chosen due to its architectural features.
[7] Despite the fact that neither *Neoson* or *Polytope de Cluny* were remounted in alternative spaces, and despite Xenakis' inclusion of the location in the title of the work, an adaptation of either work would be quite possible, as neither engages explicitly with the specific historical and thematic identity of the presentation space.
[8] Specifically, 12 incandescent bulbs coupled with 12 small speakers.

a manner that responds to its size, architectural features and movement pathways. Luminosonic objects are placed throughout the presentation space – near walls, occupying corners, and dispersed throughout the empty room – and suspended in various heights, creating a three-dimensional, irregularly curved luminosonic architectural shape. While media architectures in *Polytope de Cluny* and *Neoson* reinforce the existing architectural contours, the luminosonic architecture in *Room Dynamics* emphasizes interaction between permanent-material and temporary-energetic architectures: the height and positioning of luminosonic objects form asymmetrical slopes towards particular corners of interest, creating a sense of gravitational pull towards certain architectural features. The sense of "gravitational pull" is designed in relation to the spectator's movement pathways, as the contoured luminosonic architecture "opens up" near the entranceway (through higher elevation of suspended light bulbs) before sloping downwards towards the opposite wall. In this manner, spectators are drawn *in to* the space as they re-trace the luminosonic contour through their own movement. As the piece is reconfigured to new presentation spaces, the process of installation involves finding individual qualities of the space[9] – its inherent architectural rhythm, balance and focal points – and accentuating them.

4.1.2.3 Site-specific installations

Site-specific media installations involve the embedding of media architectures within material spaces in a manner characterized by engagement with both physical-architectural features and the particular historical or thematic identities of a site. As such,

[9] For instance, the presentation space at Eastern Bloc Gallery (Montreal, QC) is characterized by two large concrete columns which occupy the gallery space. Consequently, light bulbs were placed around the columns in order to illuminate them from different angles and create various shadows.

site-specific works cannot be easily remounted in an alternative presentation spaces. Likewise, such works are usually not presented in white box galleries, as the presentation space does not posses an independent sense of site.

UVA's *Chorus* and Hans Peter Kuhn's *A Vertical Lightfield* are considered site-specific due to their addressing of the thematic identities of presentation sites, which are integrated as a formal element of the work. In *Chorus,*[10] a thematic interchange is created between the vocal sounds[11] present in the work and the locations' relation to choral singing (Dziekan 2011, 74); In Kuhn's work, the permanent site-specific installation is located in a Singaporean shopping mall and is conceived as a "contradiction to the site," creating an "island of meditation… [in a] temple of consumerism".[12] That is, in both works, the identity of the site becomes "part of the content of the work itself" (Suderberg 2000, 5).

4.1.3 Activation of space and site using light and sound

The construction of site-independent, site-responsive, or site-specific luminosonic architectures activates the surrounding material-architectural space through sound and light. However, despite the historical coupling of pitch and light-colour (Jewanski 2009b, Kienscherf 2009), light and sound media activate architectural spaces in different manners.

[10] A work commissioned by the Opera North for the reopening of the Grande Theatre of Leeds, and subsequently presented in Durham Cathedral (Dziekan 2011, 74-76).
[11] The sounds were composed by a collaborator, UK-based composer Mira Calix (Dziekan 2011, 78).
[12] Personal correspondence.

4.1.3.1 Similarities and differences in the audiovisual "illumination" of architecture

The interaction between audiovisual sound-and-light media and existing architectural spaces can be discussed using the metaphor of illumination. Following Blesser and Salter, "[sound] illuminates a space in the same way that light does… ears as well as eyes can sense illuminated objects… [and] the environment" (2007, 343). Both sonic and visual illumination require action: "just as light sources are required to illuminate visual architecture,… sound sources (sonic events) are required to 'illuminate' aural architecture in order to make it aurally perceptible" (15-16). While sonic "illumination" reveals aural architecture as a "composite of numerous surfaces, objects, and geometries in a complicated environment" (2), it operates differently than visual illumination of architectural features. These differences include the spatial resolution of "illuminated" space, as well as the time scale on which illumination occurs.

The differences between aural and visual illumination of architecture can be illustrated through the following thought experiment. Imagine a luminosonic object located in a corner of a large, windowless, empty room. The object produces a brief flash of light followed by a brief transient sound, and consequently, briefly illuminates visual and aural architectures. The brief visual illumination produces a percept of the light-emitting object, as well as its precise location and distance; the object illuminates the corner in which it is located, and partially illuminates distant architectural features. The overall percept of visual architecture, however, is centered on the object itself. In contrast, the brief sonic illumination reveals a relative, less precise location of the object (Shimojo et al. 2001, 65). Furthermore, the distance between perceiver and source is highlighted through the activation of aural architecture (i.e. reverberation). Thus, the

"illumination" of aural architecture is less localized than its visual counterpart as reflections arrive from all surfaces between object and perceiver: "[the] listener is immersed in the space's aural response, and there is rarely a discernible location for that response" (Blesser and Salter 2007, 16). That is, the spatial resolution of sonic illumination is coarse, resulting in the experience of immersion; a counterpoint to the fine resolution of visual illumination and the resulting experience of precise localization.

Moreover, the visual and aural illumination of material architecture operates on different time scales: "Sound and light waves have dramatically different velocities… sound waves traverse a space with perceptible speed [while] light waves move instantaneously"[13] (16). The visual illumination of architecture afforded by the instantaneous flash of the luminosonic object is finished as soon as it stops producing light. In contrast, the illumination of aural architecture continues after the acoustic impulse, as "the sounds of the past, at least on the timescale of seconds, exist concurrently with the sounds of the present" (16). In terms of perceptual relevance, "[time] is central to sound but mostly irrelevant for vision"; "Turn off a light source, even in a mirrored room, and abruptly the space becomes dark. Turn off a sound source, and the space continues to speak" (16-17).

The differences between visual and aural illumination reinforce contrasting ontological views. The specificity of location and "apparent stability or rigidity of the spatial [realm]" of visual perception (Handel 1993, 163) is inextricably tied to the ocular

[13] Of course, light waves move at the speed of light, not instantaneously. However, the perception of light in closed architectural spaces is of instantaneous illumination. The temporal nature of light can only be experienced over large distances, primarily in outdoor conditions.

dominance of Western culture, the "association of vision with reason"[14] (Howes 2005, 324), and the commonsense notion that "seeing is believing." The apparent stability offered by sight affords the separation of a visual scene into distinct objects, in turn reinforcing the separation between perceiver and the external world. This is in contrast to the ephemeral and temporal experience of listening, in which the mutual dependency of sound and time, source sound and reverberation, as well as audition and tactile vibration reinforces the connection between perceiver and world. In other words, "[listening] is centripetal; it pulls you into the world. Looking is centrifugal; it separates you from the world" (Handel 1993, xi).

This final observation can be illustrated with an additional thought experiment: imagine an empty, windowless, architectural environment occupied by twelve luminosonic objects in relatively equal intervals. The production of a uniform amount of light by all twelve objects results in the saturation of the architectural site with light. With the illumination of all surfaces, the emptiness of the space is reinforced, while the overall percept is mentally separated into individual architectural features or geographical regions. In contrast, saturation of the same space with uniform sound emitted from all twelve luminosonic objects results in a percept that emphasizes immersion and continuity: sound becomes an almost tangible substratum contained by the surrounding architecture, connecting architectural features with the empty spaces between them. In

[14] Beginning in the Enlightenment, and followed by the identification of "the progressive rationalization of society… with the increasing visualization of society and space" (Howes 2005, 324.)

contrast to the conception of visual "perspectival space… [sound gives] visual space [a] plastic quality"[15] (Schulz 1999, 32).

The visual or aural illumination of architectural features and the spaces between them results in different affordances. As described above, illumination using light reveals precise locations. The specificity of revealed location offers potentials of signification that are not afforded by the coarse spatial resolution of sonic illumination. While the affordances of certain architectural constructs – corners, angles, curves (Bachelard 1994, 146) – are initially triggered by visual illumination, the inclusion of sonic material in combination with visual illumination may intensify the overall affect experienced by the spectator.

If visual illumination reveals specific locations, sonic illumination of an architectural site affords movement. First and foremost, sound can afford the perception of movement between luminosonic objects. Consider a section from *Room Dynamics* in which adjacent luminosonic objects are activated by simultaneous light flashes and transient sounds (video example 4.1).[16] The affordance of an audiovisual "trajectory" occurs primarily through sound: as Chion points out, sound's ability to suggest movement (even in combination with static images) may be considered a perceptual "slight-of-hand…: sometimes it succeeds in making us see… a rapid movement that isn't even there" (1994, 11-12). Sounds emitted by a luminosonic object may also afford the movement of the spectator, especially when combined with visual illumination of a specific location. Since the primary function of quotidian luminosonic objects is visual

[15] It is telling that the short-term saturation of a space with light causes discomfort through disorientation, while the short-term saturation of a space with sound causes a bodily discomfort, and eventually, pain.
[16] Video support examples may be viewed in the online web resource www.adambasanta.com/thesis/video.html

illumination, the projection of sound from such objects is often surprising, encouraging spectator movement to closely examine this phenomena. While the visual examination of a luminosonic object may take place from a distance, auditory examination necessitates proximity as distance from a sound source results in lower levels of perceptible sound.

4.1.3.2 Luminosonic ensembles: objects in shapes, objects in space

The use of luminosonic ensembles in installation works challenges the separation of "energetic" and "material" architectural spaces (Sterken 2001, 263). In all works discussed thus far, the energetic architecture (consisting of an ensemble of luminosonic objects) is in constant dialogue with the material architecture within which it is embedded. As luminosonic objects emit sound and light, they redefine both the quantitative (length, height, width) and qualitative (light, dark, mysterious, saturated, dense, sparse) appearance of the material space; in other words, they define the environmental context in which they are presented. In turn, the reconfiguration of environmental context reflects back on to the objects themselves, not only in terms of the physical reflection of sound and light redefining the appearance of an object,[17] but also in terms of qualitative affect, perceptual and semantic meaning.[18] In this perceptual feedback loop, the luminosonic object is constantly redefined by the very environment it is reconfiguring.

Although the process of mutual redefinition is at play in all works using luminosonic objects, this process is rarely at the foreground of perception. The perceptual

[17] For instance, the perception of colour is heavily influenced by environmental context (Varela, Thompson and Rosch 1991, 157-171). Likewise, loudness and spectral weight are highly influenced by the sonic context surrounding individual stimuli.
[18] The ecological approach to perception posits that all afforded meaning is a result of a relationship between stimuli, organism, and environment (Gibson 1966, Windsor 2004).

salience of objects (in particular, dynamically activated light and sound-emitting objects) tends to command our attention and dominate the perceptual field. This perceptual dominance results in reduced awareness to both changes in the architectural environment, and the mutually defining relationship between objects and their surrounding context. The balance of perceptual salience between the object-level and the environmental-level, however, may be influenced by several compositional parameters of the luminosonic ensemble.

Through experiential analysis of both sound installations (Leitner's *Ton Raum TU Berlin*) and audiovisual installations (artificiel's *condemned_bulbs*, Salter's *N_Polytope,*[19] as well as my own work *Room Dynamics*) I observe a relationship between the number and arrangement of active media objects (whether luminosonic, or purely sonic as in the case of loudspeakers in Leitner's work) and the balance of salience between objects and environments. In general, greater numbers of active media objects, greater proximity between objects, and greater regularity in their spatial arrangements all result in reduced salience of changes to the architectural environment.

From a sonic point of view, the larger amount of active speakers reduces the perception of spatial colouration as the balance of direct-to-reflected sound is skewed towards direct sound.[20] From a visual point of view, tightly knit, uniform spatial

[19] Leitner and artificiel's works were analyzed from a spectator's point of view through respective visits to TU Berlin (Berlin, June 2012) and Maison de Culture Frontenac (Montreal, May 2012). The *N_Polytope* project, on which I was a collaborator, was analyzed throughout the work process, in addition to its final presentation (Gijon, Spain, June-July 2012).

[20] I first became aware of this notion following comments by composers Hans Tutschku and Daniel Terrugi while attending the *Sound in Space 2012* electroacoustic music diffusion workshop (Boston, MA). This observation was confirmed when performing an experiential analysis of Leitner's *Ton Raum TU Berlin*. In my experience of the work, which involves acoustic treatment of a hallway in TU Berlin as well as a sound composition for 42 hidden speakers, acute spatial perception was activated only when the installation was dormant: at those moments, I could concentrate on the effect of acoustic treatment on my spatial awareness, as well as the experience of being contained in a small, intimate (acoustically speaking) room which is

ensembles using large numbers of media objects (for instance, the grid-formation in artificiel's *condemned_bulbs*, or the ruled surface supporting 150 LED's and 50 micro-speakers in Salter's *N_Polytope*) strengthen the gestalt of objects-as-connected-points through the phenomena of perceptual completion. The aforementioned compositional determinations of numbers of objects, size, distance, and regularity of arrangement prevent the luminosonic ensemble from pointing outward towards their environment: we experience *shape*, not *space*. In contrast, irregular spatial arrangements (C. Ziegler and Modler's *Neoson*, my own work *Room Dynamics*) and smaller numbers of spatially separated luminosonic objects (*Room Dynamics*) afford awareness of the spaces *between* objects, and allow attention to be drawn away[21] from the objects themselves and towards their effect on the architectural environment.[22]

The balance of perceptual salience between objects and environment can also be modified by the temporal density of light and sound events. In this sense, alternation between low, high, and medium densities of audiovisual events allows the temporal manipulation of the spectator's attention to both object-level and environmental level-events. Paced appropriately, the oscillation of heightened perceptual salience between

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embedded within a much larger environment. The experience of hearing the large foyer of TU Berlin's main building coming through sonic "windows" (the entrances to the acoustically treated hallway) was both perceptually and emotionally powerful. However, when the installation produced sound, my spatial awareness disappeared, replaced instead with the perception of sonic movement – which while defining the size of a "container" space is a percept of a moving object, not of space – or the perception of a saturated sonic space, which draws attention to the materiality of sound itself, not the materiality of the space in which it is embedded.

[21] Although awareness may be drawn away from the object level and towards the environmental level, the object level remains more perceptually salient. The balance between salience of objects and their environment is, however, more balanced.

[22] This has been the case with spatial adaptation of *Room Dynamics* to rooms of various sizes. The presentation in the relatively larger space of Eastern Bloc Gallery (Montreal, QC) resulted in higher degree of audience comments regarding the "reshaping" of architectural space than the subsequent adaptation of the work to a smaller architectural setting at The Bridge PAI Gallery (Charlottesville, VA).

each level can be used as a compositional device, partially sequencing the spectator's perceptual ability to attend to each level.[23]

Both low and high[24] temporal densities of audiovisual events afford greater awareness of the mutual influence between objects and their environment. A low temporal density of slowly evolving sound and light events (video examples 4.2 and 4.3, from *Room Dynamics*) tend to exhaust our attention to the object-level due to an insufficient level of activity, resulting in a shift of awareness towards the environmental level. Similarly, high densities of sound and light events (video example 4.4, from *Room Dynamics*) frustrate our attention to object-level events due to the speed at which they occur, resulting in a heightened perception to changes in the environment. In contrast, medium-level temporal density of sound and light events – i.e. an "appropriate" density of events expected by the spectator – (video example 4.5, from *Room Dynamics*) tends to engage us on the object-level, resulting in limited awareness of environmental change. However, the balance of perceptual salience is additionally influenced by both subjective factors and compositional context: once a spectator becomes aware of the relationship between luminosonic objects and their environment (changes in size, perspective, shadows) they are more likely to attend to this aspect regardless of the ensemble's spatial arrangement or temporal density of events.

Increasing awareness of the mutually redefining relationship between object and environment is significant as it challenges the conceptual separation between objects,

[23] This compositional approach is utilized throughout *Room Dynamics*.
[24] The terms low, high, and medium densities are contextual; they are in relation to our *expectation* of "appropriate" density and speed of events.

space and time,[25] as well as the notion of "objects [and spaces]… being timeless" (Eliasson 2006, 60). Attending to the manner in which "forms are… temporal, constantly changing due to the ongoing negotiations and renegotiations with their surroundings… adds a great amount of [subjective] relativity to any form…and the suggestion that form exists at all as a static, final language becomes obsolete" (Eliasson 2006, 61). The awareness of this relativity may lead to active re-engagement[26] with a work, an object, or a spatial situation. This re-engagement, the "[individualization of Euclidian] dimensions of space [and time]" (66-67) is particularly evident in media installation works that afford interactions between media architectures, material architectures, and the mobile spectator.

4.2 Media architecture and the mobile spectator

In most medium-specific art, the relationship between work and spectator is highly codified, rooted in a history of performance or presentation practice: we sit and listen in a classical concert,[27] sit and watch an experimental film, or visually observe paintings at a gallery. In installation art, the relationship between work and spectator is neither codified nor fixed, but rather, "composed" anew by the artist with each work. Installation art may even be defined by its unique relationship to the spectator as an art

[25] A similar point is made by Simondon's discussion of the interdependence of a technical object and its milieu (Simondon 2007, 206-215)

[26] In Eliasson's discussion of dimensionality, the stability of Euclidian dimensions (height, length and depth) are augmented by a fourth, topological dimension (time), and further complemented by a fifth dimension of relational engagement, which inscribes the former four dimensions with a "softness through negotiation" (Eliasson 2006, 66). This fifth dimension "is only possible when the fourth dimension is present; without a notion of temporality the idea of engagement does not make sense" (66).

[27] The activities of sitting and listening are only part of this codified practice, which includes elements ranging from dress code, to architectural design of concert spaces, as well as the rituals of audience placement and behaviour. For a full deconstruction of the audience's performance practice in classical music see Small 1998.

form that insists on the participatory "literal presence" of a mobile, multi-sensory, "embodied viewer" (Bishop 2005, 6).

The open-ended relationship between spectator and work is especially pertinent to media installations which occupy a material space. In such works, energetic and material architectures are simultaneously occupied by the mobile spectator, who is free to determine their own spatial perspective and durational exposure to the work. The *experience* of media installations is thus dependent on the immersed spectator who, by virtue of their presence, reconfigures or co-produces both material and energetic spaces.

4.2.1 Movement and the co-production of space and time

The relationship between an individual and their surrounding space is never static. Rather, it "is in constant movement [and can] perhaps be called a relationship of co-production… when someone walks down a street she produces the street and is, simultaneously, produced by the street" (Eliasson 2006, 65). That is, the *experience* of space and architecture, whether material or energetic, is always in relation to the spectator: "objective" spatial characteristics of distance and location are "subjectified" in relation to the spectator's body, perspective, spatial position and intentionality. These "subjectified" characteristics essentially change the manner in which the individual navigates in space. In turn, the spectator's body, intentionality, and personal history modulate the affective experience of space and the objects populating it.

The allowance and encouragement of spectator mobility in media installations highlights the inseparable relationship between the experiences of space and time. Movement allows us to "experience space and time simultaneously – space as the sphere

of freedom from physical constraint and time as duration in which tension is followed by ease" (Tuan 1997, 118). The interlinking of space and time via movement is central to the experience of architecture: "The perception of [architectural] space, the appropriation of its form or shape, proceeds via movement, which leads us through a sequence of spaces, through the rhythm of archways, which has us pace out the length and width of their spatial segments and makes us listen to the echo of our footsteps – briefly, it takes shape over time" (Barthelmes 2005, 10). Spatial configurations can thus be envisioned as enabling a "bodily flow of an individual whose decisions as to where to be [construct] the [media] composition" (Labelle 2006, 73). Although energetic space can be analyzed as an objective entity independent of the perceiver, this abstraction bears little resemblance to experience: "space [becomes] a pulsating encounter, created through movement of sounds, modified by movement of the person experiencing the space – movement… as space-shaping temporal process; space as time-space" (Kern).

4.2.2 Spatial design as composition

The spatial design of a media installation is thus a compositional aspect of the work, modifying the co-production of spatio-temporal experience in collaboration with the active, mobile spectator. Through composition of spatial design – the spatial distribution and constitution of luminosonic ensembles – the artist creates a relationship between "built structures of… [sound and light]…and the human body" (Leitner). The mobile spectator's interaction with spatial design of luminosonic ensembles can be analyzed in terms of movement affordances.

I suggest two general categories of spatial design found in media installations using luminosonic objects: *closed* and *open* spatial circuits. A closed spatial circuit uses architectural barriers to restrict possibilities of spectator mobility while affording others. For instance, Gàl and Kori's *Defragmentation/red* utilizes the existing architecture of a water reservoir to create a light-saturated corridor through which spectators navigate. A closed spatial circuit is created via the architectural barrier of a hallway and its movement affordances: spectators walk along a pre-determined path (the hallway), while controlling their own pace and direction (forward and backwards) within the given path. A closed circuit thus establishes a spatio-temporal sequence or quasi-linear[28] narrative; "it is space which has a beginning and an end. Space is here a sequence of spatial sensations" (Leitner).

In contrast, open spatial circuits are characterized by few architectural barriers, allowing the spectator to freely determine pathways within a spatial design. Such open spatial circuits allow *multiple possibilities* of linear narratives through space. One example of open spatial circuits is evident in my work, *Room Dynamics*. In this work, the 12 luminosonic objects[29] are physically dispersed throughout a gallery space in various heights and locations. Spectator mobility is limited solely by the boundaries of the gallery space, as well as the occasional low-hanging light bulb around which a spectator may navigate. Otherwise, the spectator is free to move around or between luminosonic objects and thus greatly determine their own spatio-temporal sequence in collaboration with the built structures provided by the artist.

[28] Closed circuits cannot create completely linear narratives, as both pace and direction of motion is determined by the spectator.
[29] Specifically, "sounding" light bulbs.

Some installations utilize a hybrid of closed and open spatial circuits, often using a grid-like spatial design. For instance, artificiel's *condemned_bulbs* and Chris Ziegler's *Forest 2 - cellular automaton* utilize a grid of luminosonic objects which simultaneously encourages and restricts movement. In both works, the grid affords rectilinear movement pathways: in *condemned_bulbs* each row of light bulbs presents a closed spatial circuit, while in *Forest 2 - cellular automaton* larger distances between luminosonic objects allows diagonal movements.

Regardless of the spatial approach – closed, open, or hybrid – spectator movement is activated in part through the eschewing of a privileged viewing (or listening) position in favour of "multiple perspectives… [which] deny the viewer any one ideal place from which to survey the work" (Bishop 2005, 13). That is, denying a privileged viewing and listening position – "a bird's eye view" from which the entirety of the work can be perceived – provides an impetus for exploratory movement.

4.3 Archi-Textures[30]: Temporal structures in relation to space and body

The experience of media installation works is thus a product of interaction between energetic and material architectural spaces, modulated by the spatio-temporal pathway of the mobile spectator. Luminosonic media architectures, however, often involve time-based compositional-dramaturgical structures which dynamically reconfigure the perception of surrounding material architectures. In other words, one perceives an archi*texture*: the temporal texturing of architectural spatial experience. This notion is foreshadowed in Nicolas Schöffer's writing on kinetic art, as he describes the

[30] The term architexture has been used in various scholarly and artistic contexts. However, my use of the term to illustrate the temporal texture of media architectures is unrelated to its previous history.

dynamic control of light – the "sculptor of space… par excellence" (Zyman 2006, 467) – through the concept of "luminodynamism"[31] (Schöffer 1996, 399). The interaction between dynamic luminosity and the "rhythm of structures" (399) produces a "constructive and dynamic integration of space in plastic work" (or "spatiodynamism", 397-8), which results in the perception of "temporal architecture" or "chronodynamism" (399-400).

The integration of temporal media structures in installations faces several obstacles which arise as a function of the presentation context. Most traditional presentation practices in medium-specific temporal arts (namely, dance, theatre, film and music)[32] benefit from a static audience who's attention is focused on "appropriate" sensory events (notes, rhythms, texts, gestures, images) within limited geographical regions (i.e. the stage, the screen) and fixed temporal frames (i.e. start of the show until the end of the show). The above restrictions allow the use of sanctioned media materials as *vocabulary* through which large-scale temporal-dramaturgical structures can be constructed. The use of temporal structures in media installations is thus problematic, as such work often involves multi-sensorial events which are dispersed through space, experienced within a spectator-determined temporal frame[33] by a mobile spectator.

The creation of temporal structures in media installation works can benefit from contemplation of traditional compositional strategies. However, an adaptation of existing

[31] Although Schöffer describes the use of both light and sound media as means of creating chronodynamic structures, he offers no sonic equivalent to the term "luminodynamic," ostensibly due to the inherent dynamism of the sonic medium.

[32] I am increasingly uncomfortable with the notion of the classical visual arts – painting and sculpture – as non-temporal forms of art. In my own experience, navigating through a gallery of classical or contemporary painting and sculpture is a deeply temporal activity, co-produced through my own spatio-temporal pathway in the gallery space.

[33] The temporal frame involves the length of time spent in the installation space, as well as the points at which the spectator enters and exits the space. A traditional concert presentation restricts the spectator's ability to modify the temporal frame while an installation context enhances it.

compositional models to the specific realities of the installation context is necessary, as such models no longer operate in the same manner within their new presentation setting. For instance, sound artist Robin Minard observes that "[musical] parameters such as register, timbre and rhythm take on new meanings as work is guided by the influence of sound elements on spatial perception rather than on the listener's interpretation of a musical narrative or a particular musical syntax" (Minard 1999, 75). Indeed, what use is it to compose a 90-minute, three-part sonata structure using luminosonic objects in an installation context when most visitors will enter the work at an "inappropriate" point and may only spend ten minutes in the installation space? In the following sections, I will articulate three effective approaches for the composition of temporal in media installations using luminosonic objects.

4.3.1 Co-produced temporal structures

Co-produced temporal structures operate through the geographical placement of relatively static (or slowly evolving) media materials within the installation space. These spatial structures are experienced sequentially, mixed and balanced dynamically, through the spectator's exploratory movement in the installation space. In this sense, co-produced temporal structures exhibit the interrelation of space and time described in section 4.2.1, as temporal structures are activated exclusively through movement. In the absence of spectator movement, these structures can no longer be described as temporal: they are not enacted in time.

An example of co-produced temporal structures can be found in Young and Zazeela's *Dream House*, which consists of a light-saturated room in which spatially

dispersed loudspeakers produce various sinusoidal frequencies. Walking into the room, the spectator becomes aware of multiple psychoacoustic phenomena (binaural beat patterns as well as constructive and destructive phase interference) changing relative to their position;[34] as soon as one stands still, the sound aggregate becomes static. That is, the evolution of the sound aggregate (created via frequency and spatial relations of multiple sinusoidal waves) is animated in time through motion: a temporalization of space (Labelle 2006, 162).

Co-produced temporal structures adapt musical-compositional strategies by relegating time from its status of "dominating linear band" (Schulz 1999, 32) and elevating space as the primary compositional strata. While "conventional musical concepts most often deal with narrative forms… communicated through a musical syntax which unfolds in time and conceived as a function of the traditional concert hall," media installations utilizing a co-produced temporal structure "no longer [communicate] through a temporal narrative progression… [but] instead [unfold] in space through… our perceptual investigations of [spatial] surroundings"[35] (Minard 1999, 81). Commenting on the use of co-produced temporal structures in Minard's sound installations, Schulz observes that "[if] we can speak of [traditional] composition at all, then [Minard's spatial approach to compositional structures] is only a kind of generator for a process that in essence resists completion" (Schulz 1999, 32).

Co-produced temporal structures are often coupled with open spatial circuits, which afford the spectator great control over both temporal frame and chosen spatial

[34] In my experience of *Dream House*, even a slight tilting of the head will produce perceptible changes to the overall sound aggregate.
[35] Robin Minard received his primary training in music composition prior to his commencement of a practice in sound installations (Minard 1999, 134).

pathway. Several examples combining co-produced temporal structures and open spatial circuits are found in Robin Minard's sound installations, most notably *Music for Passageways.*[36] This work involves a quadraphonic composition playing through 32 speakers, each of which is embedded in tube shaped pipes of various dimensions and resonant tunings. As the spectator moves through the open space between resonant tubes, a negotiation of temporal structure is enacted.

Minard describes two compositional strategies with which to create co-produced temporal structures, termed the "conditioning" or "articulation" of space (Minard 1999, 75-79). A "conditioning of space… implies the creation of a static or uniform spatial state… [which] does not exclude slow evolutions in spatial characteristics" (75). A conditioned space produces a homogenous media-architectural "'colouring' of the space" (75-79), and a relatively uniform co-produced temporal structure, as movement does not correlate to significant sonic change.[37] In contrast, an "articulation of space… implies a spatialization of sound… the spatial localization of sound elements" (79). Within an open spatial circuit, an articulation of space creates "gradations in colouring effects… different 'regions' of colour or luminosity[38] instead of one uniform spatial colouring…, [the perception of] different musical elements localized at different points in space" (Minard 1996, 19).

[36] Although Minard does not use luminosonic objects, his work usually involves a visual representation of sonic production using objects (usually, loudspeakers). In this particular installation, Minard uses resonant tubes as audiovisual objects, manifesting both aurally and visually. Bernhard Leitner's sound installation *Tuba Architecture*, in which free-hanging metallic panels are resonated using loudspeakers, is relevant in a similar way.

[37] Except, of course, for sound localization, which would change relative to the spatial positioning.

[38] Minard consistently uses light and colour as metaphors to describe the ability of sound spectra to shape the perception of space. He further theorizes manners in which "the accentuation of different [sonic] registers [can create] the effect of 'heavy and somber' or 'light and clear'" (Minard 1999, 77).

In addition to creating co-produced temporal structures, the combination of open spatial circuits and "articulated" media space can act as a catalyst of exploratory movement by the spectator. That is, in "creating static [media] space in installations… which call forth different combinations of sounds depending on the listener's position in the room… [the artist may provoke] an active exploration of the sound space" (Gàl 2005, 71). In this sense, the "articulation of space" (Minard 1999, 79) can create the very conditions necessary for co-produced temporal structures (in other words, spectator movement).

The "articulation of space" (Minard 1999, 79) in installations using closed spatial circuits offers a somewhat deterministic variation of co-produced temporal structures. For instance, in Minard's *Stationen*, a multi-channel sound environment occupying a bell tower, the verticality of the material architecture is highlighted through "a vertically-organized sound colour…, an overtone-based chord" arranged from low to high in vertical space (98). As the spectator ascends the bell tower, they attend to the rising sonorities occupying the space. In this manner, a determinate sequential structure (B always occurs after A or C) may be combined with indeterminate pacing to generate a high degree of control over perceptual sequences in co-produced temporal structures.[39]

[39] Other examples include Minard's *Intermezzo* (using sound media) and Gàl's *Defragmentation/red* (using both sound and light), both of which use the closed spatial circuit of a hallway. Similarly, Nauman's *Green Light Corridor* utilizes a combination of hallway architecture and various levels of light saturation. Finally, James Turrell's *Arhirit* uses a more flexible closed spatial circuit through the sequencing of several light-saturated ganzfeld rooms, which are ordered in relation to the manner in which the "after-colour of one gallery space [lingers] on the retina to make its complement in the following room even stronger" (Bishop 2005, 87).

4.3.2 Independent spatio-temporal structures

Independent spatio-temporal structures are closely related to traditional musical and dramaturgical linear structures in which individual materials (for instance, a melody, chord, or sound) are conceived sequentially, repeated, varied and contrasted to create a developmental compositional trajectory. Independent spatio-temporal structures are perceptible from a static location and do not necessitate spectator movement. Furthermore, independent spatio-temporal structures tend to exhibit larger, perceptually salient temporal arcs than co-produced spatio-temporal structures.

Despite the close relation to traditional linear compositional approaches, the use of independent spatio-temporal structures in an installation context shares several features with temporal structures that are co-produced. Although independent spatio-temporal structures can be perceived from a static vantage point, their inclusion within an artistic context in which spectator movement is encouraged[40] results in a collaboration between two levels of temporal events: (1) the temporal development of luminosonic materials and (2) the temporal sequencing of the mobile spectator as they explore the installation space. In this sense, the experience of independent spatio-temporal structures is still co-produced through "collaboration" between artist and spectator, though the balance of co-production is skewed towards the artist.

A further similarity between independent and co-produced spatio-temporal structures involves the interrelationship of experiential space and time: in both cases, temporal structures are created *at least in part* through spatial positioning. But while co-

[40] Spectator movement is encouraged in installation art as this activity has become a prevalent aspect of many installation works. Likewise, spectator movement is encouraged through the use of compositional strategies discussed previously, such as open circuit spatial design and the denying of a privileged viewing position.

produced temporal structures rely solely on the mobile spectator's spatial positioning to generate temporal development, independent spatio-temporal structures exhibit a balanced relationship between space and time. In such structures, time-based compositional materials are mapped onto space, allowing spatial relations to become a new compositional stratum in which relationships between materials may be expressed. However, the relegation of time in favour of space which defines co-produced compositional strategies (see section 4.3.1) does not occur.

Independent spatio-temporal strategies are used to create developmental structures using luminosonic materials. Audiovisual behaviours of a specific luminosonic object may be modulated in time: light morphology, "intensity, concentration [and] dispersion," rhythm and movement have been identified as viable possibilities for the expression of developmental structures in early works of kinetic light art (Popper 2006, 427-447). All of the above parameters – morphology, intensity, concentration, dispersion, rhythm, and movement – may be extended to sound behavior in luminosonic objects. Audiovisual behaviour of a luminosonic object may thus be modified using the aforementioned compositional vocabulary, repeated, embellished through variation, or contrasted. As these relationships evolve in time, spectators may identify larger developmental structures: for instance, a movement from high sono-luminescent intensity to lower levels of intensity.

The emphasis of spatial experience in the installation context allows spatial positioning to create, reinforce, or modify existing developmental structures through a consideration of luminosonic object assemblages as instrumental ensembles. As such, the activation of a solitary luminosonic object is perceived as a solo; the activation of two

such objects, a duet; the activation of a group of objects, a section or aggregate. It follows that the activation of a single light-and-sound event by one luminosonic object, followed by an exact repetition of the event by a different luminosonic object, is thus not perceived as a direct repetition: the spatial location of the event has varied, and thus, the two events are perceived as closely related, yet nonetheless different, events.

The spatial application of the musical term "counterpoint" offers a powerful device with which to create large-scale spatio-temporal structures in installation works. The effectiveness of spatial counterpoint stems from the organic synthesis of the strengths of each medium: the musical comparison of temporally-related materials based on similarity is combined with installation art's consideration of experiential aspects of space.

The use of spatial counterpoint as a compositional device in media installation works is elaborated on in Xenakis' commentaries and dramaturgical sketches of *Polytope de Montreal*. In this work, 1,200 light-emitting objects, mounted on various architectural ruled surfaces, are divided into "vertical and horizontal cross-sections," differentiated in layered levels using mathematical systems such as the "theory of Groups" (Xenakis 2008, 213). Spatial positioning enables both the demarcation of different light gestalt units[41] as well as their temporal development *through* space: light-gestalts "collide….evolve" (202), perform "rhythmic invasion" (213), become "stationary, or mobile, slowed down or accelerated, revolving, contracted, or dilated" (257). Temporal development of spatially differentiated light gestalts may be further guided by "logical operators of conjunction, disjunction, or of complementary action" (258).

[41] These gestalt units are often described using organic and mathematical metaphors: "stochastic river," (Xenakis 2008, 210) "constellations" (257) "lines and planes" (133), "surfaces, volumes… galaxies" (270).

Analyzing Xenakis' writings alongside the partial video documentation the second indoor polytope, the *Polytope de Cluny*, it is possible to glean two devices with which to construct spatial counterpoint: namely, *spatial transposition* and *spatial modulation* of luminosonic gestalts within audiovisual architectural environments. Spatial transposition involves a spatial displacement of an audiovisual gestalt. Akin to the transposition of musical notes, the internal relations of the luminosonic gestalt (size, behaviour, tempo, audiovisual relations) remain in tact; it is only the positioning in space (the pitch-space of the stave, the surrounding architectural space) that changes. In contrast, spatial modulation involves variation of the original luminosonic gestalt: a "responding" gesture, such as a spatial inversion (along one or several axes) of a given light and sound trajectory. The principles of spatial transposition and modulation are used extensively in *Room Dynamics* to develop contrapuntal structures in space, articulating spatially distinct luminosonic entities and governing their temporal development (video example 4.6).[42]

The principles of spatial transposition and modulation elevate spatial counterpoint as a central compositional technique for ensembles of luminosonic objects. The notion of spatial counterpoint, however, need not be limited to the use of individual luminosonic objects. Rather, it may be extended to the composition and development of luminosonic-object-aggregates: the motivic use of spatial units within a luminosonic ensemble. Simple spatial units, for example, the "lines" of adjacently activated luminosonic objects emerging from the luminosonic ensemble in *Room Dynamics* (video example 4.7), can be used as effective motivic units due to their recognizability. The temporal development of

[42] The principal of spatial transposition is also used extensively to allow algorithmic variation between "states" of the work. That is, otherwise identical audiovisual events are transposed with each iteration of a given movement, always activating the space in a unique manner.

such motivic units can, in turn, be governed by principles of spatial transposition and modulation. Simple, geometrical luminosonic aggregates are commonly used in works using grid-formations within open spatial circuits, as this spatial design allows the creation of various simple shapes (straight or curved lines, squares, circles etc.).

Simultaneous activation of luminosonic objects can also occur without the inscription of a discernable shape (such as a line or circle) in space. The activation of non-adjacent luminosonic object aggregates may be likened to the construction of an audiovisual "chord" in space. Just as the vertical axis of pitch-relations provides measure of intervallic distance between simultaneous pitches, the three-dimensional space of an audiovisual architecture can afford a sense of distance-relation between simultaneously activated luminosonic objects. This distance relation, however, is purely spatial, and thus much poorer than pitch relations in terms of resolution and perceptual salience.[43] Furthermore, distance relations between luminosonic objects lack a sense of hierarchical relations which define pitched relations in a musical chord. In this sense, the extension of the musical metaphor of the "chord" to the spatial realm is significantly limited: care in the composition of each spatial chord as well as a limit on the total number of chords used is necessary in order to avoid a reduction of progressions of spatial chords to meaningless perceptual "noise".

When articulated carefully, however, spatial chords offer some, albeit limited, compositional opportunities. Spatial chords may be transposed in space or spatially modulated: rotated, inverted, stretched or contracted using the metaphor of spatially

[43] The perceptual salience of spatial position is further reduced when luminosonic objects are dispersed throughout the installation space, depriving the spectator of a privileged vantage point from which to view all objects simultaneously.

"closed" or "open voicing".[44] Nevertheless, it is unlikely that spatial transposition or modulation will be perceived as related to the original chord manifestation, due to the limitations discussed above. A more effective means with which to modulate spatial chords involves variation in the articulation of each constituent "note". For instance, in a chord consisting of three luminosonic objects, two objects may exhibit a percussive audiovisual morphology, while the third object exhibits a rhythmic undulation or "tremolo". The use of spatial chords in Chris Ziegler and Paul Modler's *Neoson* (video example 4.8), for example, is especially effective due to the use of very few numbers of spatial chords, in which each luminosonic object is articulated in various manners. In contrast, an excerpt from my own *Room Dynamics* showcases that while the use of spatially modulating audiovisual chords as hierarchically related compositional materials is nearly impossible, they may be effectively used to illuminate various regions of the installation space (video example 4.9).

Finally, independent spatio-temporal structures may involve the use of dynamic transformations of light and sound intensity, which in turn modify the overall spatial perception of the surrounding architecture. Such transformations may occur through the quick successions of light and sound intensities, which are often perceived as audiovisual trajectories. In a selected excerpt from *Room Dynamics* (video example 4.10), quick successions of light and sound intensities transform the appearance, size and character of

[44] Voicing refers to the intervallic distance between musical notes in a given chord. Consider the intervals used to construct a major chord: the root, major 3rd, and perfect 5th. These intervals may be enacted in a close voicing (root, major 3rd, perfect 5th, all within the same octave) or open voicing (root, perfect 5th, major 3rd transposed up one octave). While the hierarchical function of chord inversions is lost in translation to the spatial realm, the notion of closed and open "spatial voicing" can be effective in the installation context: for instance, the difference between a chord using three adjacent luminosonic objects and a chord utilizing two adjacent luminosonic objects coupled with a third, distant luminosonic object can be discerned perceptually, and thus used to a limited degree in the development of temporal progressions of spatial chords.

navigable space.[45] Furthermore, particularly salient trajectories may be used as motivic elements (video example 4.11, an excerpt from *Room Dynamics*, as well as video example 4.12 from C. Ziegler's *Forest 2 - cellular automaton*), developed or varied through changes in the speed, duration, spatial pathway, and audiovisual manifestation. In this manner, larger developmental movement from slower, shorter trajectories to longer, denser trajectories may be created.

Spatial transformation can also be achieved using slowly evolving, smooth dynamic changes of light and sound intensities. Consider, for example, an excerpt from Chris Ziegler and Paul Modler's *Neoson* (video excerpt 4.13): the dynamic spatial transformation (achieved through overlapping light and sound intensity "ramps") both highlights the architectural divisions of the space (through increased reflectivity in semi-closed chambers) while creating continuity between adjacent chambers. A less directional approach to spatial transformation may be seen in an excerpt from *Room Dynamics* (video example 4.14), as slowly evolving light and sound intensities re-shape the architectural space and the objects within it. Although principals of spatial transposition and modulation may be applied to spatial transformations, these variations may not be perceptually salient enough to create discernable developmental structures.

4.3.3 Large-scale compositional structures

Although a particular (co-produced or independent) spatio-temporal structure may comprise the large-scale formal structure of a given installation,[46] these strategies can be

[45] As the excerpt continues, an inverse mapping of sound intensity to light intensity (i.e. an audiovisual spatial hocket), leads to trajectories of darkness throughout the space.
[46] For instance, Kuhn's *A Vertical Lightfield* formal structure consists of a singular audiovisual situation which does not vary in time.

combined with one another in order to create dynamic, large-scale temporal forms. Each cohesive compositional strategy[47] may be conceived as an installation "state." Despite the similarity to musical movements – self-contained, distinct structural units which comprise one part of a musical composition – the use of installation "states" differ in several respects. Musical movements or sections usually appear only once within the fixed temporal framework of a given work, and their sequence is usually fixed.[48] In contrast, installation "states" may be revisited numerous times in various sequential orders throughout a continually running installation. While some installations utilize fixed time lines through the use of a continuously repeating through-composed loop of installation "states," numerous works utilize algorithmic principles to vary both the manifestation and sequential order of installation "states".

Variation between subsequent re-manifestations of a specific installation "state" may be simply achieved by applying algorithmic principles to the spatial transposition of audiovisual events throughout a luminosonic ensemble: that is, a fixed light and sound behaviour exhibited by a specific luminosonic object will be spatially transposed to a different luminosonic object, remaining otherwise unchanged. Again, using the musically-inspired concept of spatial counterpoint, algorithmic spatial transposition results in distinct spatial activation of both the luminosonic ensemble and the surrounding material architecture. This technique is used extensively in *Room Dynamics* to achieve unique manifestations of each installation "state." Of course, algorithmic principals may

[47] For instance, a continual spatial transformation, accompanied by developing sound textures. Another example may involve a developmental, independent spatio-temporal strategy, such as the elaboration of increasingly complex rhythmic motifs, manifested at first by one luminosonic object and slowly spreading to the entire ensemble.

[48] I am excluding several notable works by Stockhausen, Cage and Boulez which operate using modular forms and may be performed in several different movement orders.

be applied to other compositional parameters, such as the density of audiovisual pulses (video example 4.15, excerpt from *Room Dynamics*), in order to create a unique manifestation of identical compositional gestures. Additionally, variation within an installation "state" can be achieved through interactive or responsive systems. For instance, both Chris Ziegler's *Forest 2 - cellular automaton* and UVA's *Array* track spectator movements, using the resulting data to modify certain compositional parameters, thus allowing installation "states" to manifest uniquely based on the behaviour of spectators (Personal correspondence; UVA).

Regardless of the use of algorithmic principles within each "state," two general approaches are used to determine sequential order of installations states. The most basic formal structure involves the creation of a fixed order of movements that repeat indefinitely: in other words, a loop, usually exhibiting some form of developmental structure.[49] This form of fixed large-scale formal structure is used in both Salter's *N_Polytope* and artificiel's *condemned_bulbs*. In artificiel's work, however, the length of the compositional loop (approximately 45 minutes) is likely to be longer than the average duration experienced by a spectator;[50] subsequently, the formal structure may not necessarily be *perceived* as a loop by most visitors.

[49] This is not the case in Gál's *RGB*, in which each of "nine different light and sound choreographies… [defines the] perceptual space for three to five minutes" (Gál 2005, 40). In this work, there is no developmental structure bridging one "perceptual space" to the next, and can thus be considered an audiovisual variation of Stockhausen's "moment form", in which "self contained entities, capable of standing on their own [are still] in some nonlinear sense belonging to the context of the composition" (Kramer 1988, 207).

[50] Detailing his practice of composing music for installations, Gál reflects on his use of fixed musical structure of about 45 minutes: "It's an experiential value… longer would be boring or redundant… in many cases the offered sound situations are much too long, including my own… [as] the average time [for a visitor's presence in an installation is probably] five to seven minutes… [However, it's] certainly no mistake to shape places so that people want to remain there, so that they want and get more from and installation" (Gál 2005, 68).

The creation of large-scale formal structures may also involve variation in sequential order of installation "states." The order of installation states can be governed entirely by aleatoric principles such as uniform randomness. Nevertheless, the cyclical ordering of installation "states" may contain algorithmic properties while corresponding to large-scale developmental motifs throughout a movement cycle. In my own work, *Room Dynamics*, a modular form exhibiting a developmental structure (a movement from highly individual luminosonic object behaviours towards coordinated group behaviours) is achieved through algorithmic processes: the 18 possible installation states are considered for a rule-based selection process,[51] resulting in a formal arc-structure of various lengths and various constituent movements. Each generative formal structure nonetheless corresponds to the large-scale developmental motif mentioned above.

Combined with algorithmic variation of the manifestation of each installation "state," this approach may lead to the creation of developmental structures which activate the installation space, audiovisual architecture, and the spectator's movement in continuously novel, yet compositionally related configurations. Whether the spectator is able to perceive such large-scale developmental structures is uncertain: it is probable that most visitors only perceive fragments of this overarching form due to limited time in the installation space, while others experience a mosaic-form of subsequent installation states which are not perceived as connected sections of a larger developmental arc.[52]

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[51] A hybrid application of 1st order markov chains alongside an integrated self-monitoring system which excludes future possibilities based on their past frequency and time of occurrence. For instance, state A may transition to states B, C or D but never E. Since state D has been recently manifested, it is excluded from the transition table, with state A and B remaining the only transition possibilities.

[52] In *Room Dynamics*, the perception of mosaic-form is dependent on the type of interpolation (or connection point) between subsequent installation states. In some cases, states are seamlessly interconnected in terms of material and development (video example 4.16 showcases development from individual behaviours to group behaviours over 4 interconnected states) and may afford the perception of larges-scale developmental structures. However, in other cases, installation states are self-contained and

Regardless, the aforementioned approach may encourage spectators to remain within an ever-evolving composition for longer time-periods,[53] and through this extended durational experience of the work, increase the possibility of perceiving larger formal structures.

separated by silence, which affords the perception of mosaic-form (video example 4.17 showcases several subsequent self-contained states).

[53] In *Room Dynamics*, direct repetition is impossible in exposure to the work shorter than 2 ½ hours: the lack of direct repetition does not, of course, exclude the repetition and variation of certain compositional motifs.

Chapter 5: Concluding remarks

Throughout this thesis, I examined various compositional strategies employed in media installations using luminosonic objects. In this concluding chapter, I will summarize my findings and reflect on several implications which extend from my research into the fields of audiovisual installations and contemporary music composition.

In Chapter 1, I provide a brief overview of the scholarly and artistic context within which my research takes place. Following, I articulated two interrelated research questions focusing on (1) the use of luminosonic objects as audiovisual materials, and (2) the ways in which such materials can articulate formal structures in the installation context. My first research question involves an inquiry onto the compositional dynamics of light and sound: an examination of the various ways in which light and sound media can be combined to function as integrated compositional materials. This examination takes place using a musical approach to the construction of sound-and-light materials through the extension of musical orchestration to the audiovisual realm. The second research question extends the notion of luminosonic compositional dynamics to the spatio-temporal realms, investigating ways in which audiovisual materials can create temporal structures within the installation context. With this question, musical notions of large-scale forms or temporal structures are applied to the installation context, in which generally, the articulation of form relies on spatial, rather than time-based, techniques (Schulz 1999, 32; Minard 1999, 73-75; Barthelmes 2005, 10-11; Gál 2005 ,71; Licht 2007, 16-17).

As my research lies at the intersection of audiovisual media studies, music composition, and installation art, I utilized an interdisciplinary methodology which combines first-person qualitative experiential analysis, theoretical accounts of audiovisual production and media installations, and creative practice in the field of audiovisual installations. Throughout the application of my methodology, musical language was used as an analytical tool with which to unpack aspects of light and sound installations. The identification and resolution of potential tensions – caused at-times by conflicting accounts found in theory, analysis, and practice of audiovisual installation, and at other times by the application of musical concepts to the installation context – was used as a means to develop original, hybrid knowledge in the field.

Following, chapter 2 consists of a review of several scholarly and artistic contributions relevant to my research topic. This review includes a summary of notable integrations of light and sound in artistic work, current research on cross-modal perception in the neurosciences, analytical accounts of audiovisual compositional dynamics, and scholarly writing on the use of space in media installations. The interlinking of literary contributions from the worlds of media installation art (Leitner, Minard 1996, Minard 1999, Kuhn 2000, Daniels and Naumann 2009), music composition (Chion 1994, Xenakis 2008, Coulter 2009, Kienscherf 2009), and neuroscientific research (Welch and Warren 1980, Shimojo and Shams 2001) foreshadowed the interaction between musical-compositional practices, installation art, and perceptual-experiential investigations which grounds my approach through the thesis.

In chapter 3, I investigate ways in which luminosonic objects can be utilized as audiovisual materials. I began by exploring the potential associations raised by luminosonic objects from a visual art-centric perspective, focusing on ways in which quotidian light-emitting objects can afford referential meaning within the gallery context. Following, I examine ways in which luminosonic objects can be constituted in terms of the compositional dynamics of light and sound: the ways in which temporally-developing light and sound media can be composed in relation to one another in order to create composite or integrated audiovisual materials. Using the musical concept of orchestration as a metaphor, I developed a typology of audiovisual dynamics through analysis of selected installations and creative experimentation. The eight typologies discussed in this chapter were visually represented in a three-dimensional state-space of audiovisual relations correlating compositional parameters (harmonic and temporal relations) with perceptual results (cross-modal bonding). This three-dimensional representation affords a sense of hierarchical relations between different audiovisual typologies. I concluded by suggesting several ways in which audiovisual typologies and their three-dimensional representation may be used as tools for the analysis and creation of works using luminosonic objects.

My delineation of a *range* of audiovisual compositional dynamics allows a detailed understanding of the compositional potential of luminosonic objects. This understanding is indebted to the extension of musical concepts to the audiovisual realm. First and foremost, the extension of musical orchestration to the audiovisual realm allows simultaneous concentration on individual articulations of each media while accounting for

the cumulative effect of the "audiovisually orchestrated" result. This simultaneous focus results in a detailed analytical examination and subsequent understanding of audiovisual materials. Furthermore, my inquiry of compositional dynamics follows a general strategy found in musical scholarship, in which typological analysis[1] is used to form a vocabulary of potential materials, followed by the creation of new works using this acquired knowledge.[2] To summarize briefly, musical concepts and methods translated relatively seamlessly to the study of audiovisual materials in the context of audiovisual installations.

Subsequently, chapter 4 examines ways in which luminosonic objects can be used to create spatio-temporal compositional structures in audiovisual installations. I began this inquiry by accounting for the complex interactions between sound and light media architectures and the material architectural environment in which they embedded. Following, I elaborated on the interactions between dynamic media architectures and the mobile spectator. This examination revealed the need to adapt traditional musical approaches of large-scale formal constructions to the installation context, as the active, mobile spectator continuously co-produces their experience of compositional structures through both movement and freedom to determine the durational temporal frame.

Despite the difficulties raised by the inclusion of the mobile spectator, two strategies with which large-scale, formal compositional structures can be applied within the installation context were suggested. Co-produced spatio-temporal structures produce temporal evolution of media architectures through the combination of spectator

[1] Musical analysis may be score-based or perceptual. The latter type of analysis has been applied in this thesis.
[2] Other examples of applied typological analysis in contemporary music scholarship include Roy 1998, Coulter 2009, Basanta and Eigenfeldt 2010, to name a few.

movement and the spatial dispersion of luminosonic objects. In contrast, independent spatio-temporal structures exhibit time-based compositional structures which are nonetheless modulated through the spectator's choice of movement pathways and duration of temporal frame. Both strategies were examined in relation to the movement affordances of closed and open spatial circuits, as well as the use of specific compositional devices such as spatial counterpoint, transposition and modulation, spatial chords, trajectories, and transformations. Moreover, I described several ways in which large-scale developmental structures can be created within the installation context through the use of fixed through-composed loops or various applications of algorithmic principles.

Beyond the specific contributions of audiovisual typologies and spatio-temporal compositional strategies, I believe my inquiry results in several larger implications to the artistic and scholarly fields of audiovisual installations and contemporary music composition.

My research suggests new possibilities in the field of audiovisual installations, which are afforded through the application of musical-compositional perspective to the installation context. In particular, the adaptation of the musical concept of orchestration to the notion of audiovisual compositional dynamics allows a detailed and rigorous method with which to create and develop audiovisual materials. This approach affords a greater degree of awareness[3] of both subtle and extreme compositional possibilities using audiovisual media. Furthermore, the systematic approach for the creation of audiovisual

[3] In my own experience, the immediate aesthetic pleasure accompanying the use of isomorphic audiovisual relations results in a less rigorous and systematic process of design of audiovisual material. It seems that increased awareness of possibilities of audiovisual dynamics requires an abstracted notion of audiovisual typologies, which is provided by the spatial model of audiovisual typologies in chapter 3.

materials affords the exploration of hierarchical potentials of audiovisual typologies in various forms of audiovisual production.

In a more general sense, the musical emphasis on the articulation of temporal compositional structures within the installation context offers a challenging perspective to practice in audiovisual installations. The pursuit of methods with which to articulate formal, developmental spatio-temporal structures in the installation context represents a significant contribution to both scholarship and practice in media installations.[4] Theoretical and practical accounts of such spatio-temporal structures must account for the complex interactions between composed temporal structures, their spatial operation, and the co-production of temporal experience through the indeterminate actions of the mobile spectator. The temporal strategies offered in chapter 4 represent an initial attempt to elucidate these aspects from both theoretical and practical points of view. Further development of these ideas would enrich the field of audiovisual installations, and perhaps more importantly, the spectator's spatio-temporal experience of media installations.

The application of musical concepts to the field of installation art and the resolving of subsequent tensions resulting from this cross-disciplinary borrowing offers (initially unintended) ramifications to the practice of contemporary music composition. The examination of compositional strategies in media installations affords the re-reading

[4] This is especially relevant in the context of recent publications which characterize the field of sound art installations in opposition to music's dramatic arcs (for instance, Licht 2007, 13-14). While a full critique of this argument, although necessary, is beyond the scope of this thesis, it is obvious that not all music exhibits dramatic arcs, just as not all sound installations operate "with the aims of non-time-based plastic arts" (14).

of the concert event as a *highly defined type of installation*, in which performers and audience alike perform strictly defined roles within highly controlled physical, geographical, and temporal frames. From a traditional musical perspective, the features of the concert (and the performances of its participants) are unquestionable and normative, defining the very boundaries of the musical medium. However, viewed as a type of installation, the features of a musical concert are just that: compositional relationships which may be used, reconfigured, or rejected by the artist. This awareness allows the expansion of compositional parameters used in the concert-music, specifically, (1) the extension of compositional materials beyond the sonic medium and (2) the extension of compositional decisions to the presentation practice of each particular concert.

Given the success with which the musical concept of orchestration has been applied to the creation of novel audiovisual materials, the notion of audiovisual compositional dynamics may be applied to compositional materials in concert works. With several recent studies confirming the influence of visual perception of performance gestures on the overall experience of a musical work (Vines et al. 2006, Schutz and Lipscomb 2007, Godøy and Leman 2010), the notion of compositional dynamics can be applied to gesture-sound relations.[5] The combination of instrumental sound and non-sounding performance gestures as integrated audiovisual materials comprises the primary

[5] This notion has, of course, been explored by several artists, including collaboration by John Cage and Merce Cunningham, compositions by Fluxus members, Mauricio Kagel, Georges Aperghis, and others. In most of these cases, however, combinations of sound and gesture are not conceived as developmental motives throughout the composition.

compositional concern in my recent chamber composition *sound unsound*.[6] Moreover, the development of nuanced compositional structures utilizing sounding and non-sounding components in concert works can similarly be extended to the tactile (through the use of vibration) and olfactory domains, as well as the realm of thermoception.

Finally, the examination of temporal strategies in the installation context offers new potentials for the creation of instrumental compositions outside the concert hall. In specific, devices such as spatial counterpoint[7] and general concepts such as the co-production of spatio-temporal structures can provide new tools with which to engage compositionally in the context of site-specific concert-installations. Particularly, the combination of closed spatial circuits and an "articulation of space" (Minard 1999, 79) using instrumental performers seems to offer a promising technique for spatial compositions in site-specific concert-installations. Along with the compositional potentials of non-traditional parameters such as choice of site and time of presentation[8] (both concepts inherent to installation practice), the contemplation of musical performance from the perspective of installation art provides new models with which to *compose* presentation practices of particular works. Such an approach to the presentation of musical works seeks to provide new musical experiences which are not only novel in

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[6] An acoustic composition for flute, clarinet, violin, cello, piano, and performing conductor, exploring various combinations of sounding and non-sounding actions. The work was premiered by Ensemble Allogène at the Chapelle Historique du Bon-Pasteur, Montréal, QC, on December 14, 2012. Video documentation of this work may be viewed at www.adambasanta.com/thesis/soundunsound.html

[7] This concept has been utilized by Henry Brant in his oeuvre of acoustic spatial compositions. Likewise, these devices are utilized in Stockhausen's *Carré.* These works, however, are still presented in the concert hall.

[8] While site and time-specific compositions are found in non-Western cultures (for instance, the Carnatic tradition), as well as early Western musical traditions (Adrian Willaert and Thomas Tallis' renaissance era works are notable examples), they are rarely found in contemporary Western music. R. Murray Schafer's *Music for a Wilderness Lake* is a notable example to the contrary.

terms of their intra-musical material, but also in terms of their relation to various publics. In this sense, the extension of concepts from installation art to the musical realm can challenge the institutionalization of the concert, the notion of the composition-as-object,[9] and the socio-political relations between composer (as producer) and audience (as passive receivers).

[9] An elaboration of these topics is found in Small 1998.

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