ACOUSMATIC REASONING : AN ORGANISED LISTENING WITH IMAGINATION

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ABSTRACT

This paper proposes acousmatic reasoning as a way of organised listening to electroacoustic music. It also examines the inference processes of acousmatic reasoning—overcoded, undercoded, and creative abudctions—as well as syntactically relevant properties (SRPs), properties of sound-images identified by listeners and closely related to the processes of acousmatic reasoning. The paper then sets out an analaytical listening exercise using *The Flywheel Dream* (1994) by Paul Koonce to show how acousmatic reasoning works in electroacoustic music listening.

1. INTRODUCTION TO ACOUSMATIC REASONING

Considering that examining the possibility of making-sense in electroacoustic music listening means observing how listeners use inference, a process of reasoning based on evidence acquired not only by listening, but also by imagining, it is believed that electroacoustic music listening involves a two-sided process: on the one hand, it affords listeners unlimited freedom in exercising their imagination, a topic I have examined elsewhere [13] ; on the other hand, it involves their processes of reason, which delimit, realize or materialize their imagining.

Listeners imagine sound-images while listening to electroacoustic music as it actively employs, as its key feature, everyday sounds whose dis-embodied and dis-placed presentation inspires listeners to engage their memories of sound and sense to imagine that which is missing. As Casey [3] might say (and I paraphrase), listeners imagine more than is heard.

Yet, there is more to the task of listening, for participating in the play of associations is only part of the game; the greater challenge is to follow the way sounds and sound-images (gradually or suddenly) transform and navigate in a theater of semiotic phenomena where the reading of sounds depends upon 'inferential processes' [6]. Furthermore, the drama of changing sound-images is not the listener's only concern; with less and less quotidian connotations cueing listeners to the nature of scene and sound, listeners soon recognize that they are no longer simply playing the game of signifiers. Consequently, electroacoustic music offers listeners the opportunity to listen in two different ways, one that focuses on issues of representation and mimesis and another that focuses on the sounds alone and how they reference their own developing aural orders. [6]

However, the duality only explains part of the complexity of electroacoustic music listening, for with the duality comes an underlying process, emerging out of the ability and interest of listeners concerned with how the two modes interact. The idea that listeners can balance 'concrete and abstract attitudes' [18] and travel back and forth between semiotic and spectromorphological listening depends, first and foremost, upon their ability to negate semiotic references while listening. While this may be a challenging skill to acquire (as conceptual as it is perceptual), once mastered, a field of play between the semiotic and the spectromorphological can open up, offering listeners the opportunity to engage in what I call *acousmatic reasoning*.

1.1. Definition and issues of acousmatic reasoning

I define acousmatic reasoning as *a process of listening to and composing with dis-embodied and dis-placed sound materials based on their spectromorphological and semiotic significations and connotations*. So defined, acousmatic reasoning involves three primary subjects: sounds dis-embodied and dis-placed by technological manipulation, semiotic and spectromorphological listening as opposing modes of listener engagement, and finally, the listener's inference processes.

1.1.1. Dis-embodied and Dis-placed Sounds

Audio recording and technologically manipulated sounds foster the perceptual dis-embodiment and dis-placement of sounds, which can inspire listeners to imaginatively construct sound-images that ground and complete their perceptual experience. [13] Yet, however natural, the imaginative construction of sound-images may not be a practical listening goal. For much like other products of the imagination, sound-images are as easily destroyed as they are constructed, especially in pieces in which the mix and shift of aural cues challenges listeners to hear sound-images as anything more than ephemera. The question then is: how do listeners successfully turn sound into sound-images? And moreover, why do they base their images on some sounds rather than others? I argue that, as primary

processes, semiotic and spectromorphological listening provide insight into the way listeners choose and turn sounds into images.

1.1.2. Semiotic listening: listening for sound

One form of listening used in acousmatic reasoning is semiotic listening. Semiotic listening is *a way of listening to electroacoustic music in which listeners entertain sounds and their potential sound-images based on semiotic significations*.[1]

In semiotic listening, listeners focus not only on moment-to-moment sound-images, but also on how they change, sequence, or collect together to create meaning. Depending on what they find, listeners may then imagine a *sound-image framework* capable of encompassing and explaining the function of one or more sounds, which become, through their reinforcement of it, *components* of the framework. For example, a listener, upon hearing the sound of typing and telephone calls, would conceivably progress from an initial identification of the sound with the human action of typing to its possible use as a *sound-image component* in the *sound-image framework* for office scenes.

In the formation of plausible sound-images, source-identification and context-identification are co-dependent processes, and that, being co-dependent, the source and context identification processes continually impact each other. If listeners hear, for example, a traffic sound added, at low volume, to the office example given above, they either ignore the sound, or most likely, recognize it as outside traffic, heard through an open office window. Having identified the traffic as such, listeners maintain the sound-image of the office by simply modifying their listening framework to now include an open window near a busy street. But if the traffic sounds become louder and louder, gaining foreground prominence, the framework is challenged and even changed as the listener is seemingly taken through the open window and into the street, although when the shift from inside to outside occurs exactly is hardly clear, since the spaces we hear are never so clearly demarcated as the ones we see. In fact, the growing traffic volume could suggest that we are merely walking toward the open window, or more fantastically, that the window is coming closer to us or getting bigger and bigger just before moving us through it into the out-of-doors.[2] As the traffic sound gains more of the listener's attention, listeners fail to assimilate the sound into the image of an office; the added sound can destroy the office framework altogether.

Newly introduced sounds can, no doubt, change a listening framework. However, the identity of an established framework can be challenged not only through new sounds, but also through changes to component sounds already supporting the framework. If, for example, a rhythmic feature were introduced into the typewriter sound of the office scene and became increasingly regular, so much so that it began to sound as if someone were performing music with the typewriter, then the listener would be forced to question the plausibility of the sound as having come from a typewriter, since, conceivably, no one types that way (Although, in theory, one could 'play' a typewriter; however, typists rarely show such ability or concerns short of boasts of speed; more, musical performability is not a common property of typewriters.). At best, it is imaginable that, because of the central role of typewriters in offices in listeners' imagination, listeners might attempt to keep the typewriter in its place by changing it into, perhaps, a musical typewriter; however, doing so would no doubt render the office scene more musical and comical than believable.

The emergence of the office framework in the example above is as much a consequence of the assimilation and inclusion of available sound-image components as it is the downplaying and exclusion of other sounds deemed irrelevant or outside the domain of the office framework. Yet, the task of creating and maintaining plausible frameworks is more daunting (if not entertaining), for added to the difficulties of navigating the inclusion and exclusion of sounds to a framework is the problem of dealing with components that betray their original identities or contextual frames; transformations of sound composed to betray a listener's initial reading are common to the field's more engaging electroacoustic compositions, especially since they actively engage listeners with the veracity of the frameworks they imagine.

1.1.3. Spectromorphological listening: listening to sound

Given the above, how then do sounds come to betray the readings made of them? And what circumstances of sound, development, and transformation lead listeners to incorrectly identify sounds? As discussed, changes to

[1] Semiotics as used in my definition of *Semiotic Listening* should be distinguished from semiotics as used by others. For example, discussing mainly music in the Classical style in his book *Playing with Signs,* Agawu distinguishes between two forms of semiosis: the semiosis identified through the internal structuring of the music and the semiosis identified by the extramusical 'topics\ the music draws upon. By borrowing the concepts of Roman Jakobson, he terms the former as 'introversive semiosis' and the latter as 'extroversive semiosis.' By distinguishing the two different types of semiosis, he proposes to investigate the 'interaction between topical signs and structural signs, a notion that might be described in terms of play' [1]. As such, Agawu's use of semiotics is concerned with the identification of both intrinsic and extrinsic sign systems, whereas my use of semiotics is concerned only with matters of source and context identification, and their signifying processes. Interestingly, however, just as Agawu is interested in the play between topical signs (extroversive semiosis) and structural signs (introversive semiosis), this dissertation is also interested in the interplay between sounds and what they represent or signify; my definition of semiotic listening is a step toward recognizing and investigating this interplay.

[2] One can argue that listeners may not necessarily attempt to combine these two sound-images as one; rather, they may entertain the two as they are. This argument may be true. Nevertheless, it should be noted that the previous sound-image of 'a busy office' has effectively been changed due to the introduction of the traffic sound.

critical sound features (such as the volume of traffic heard in an office scene) can, at their extreme, render a listening framework implausible. As aptly supported by Smalley [18], the decision to reevaluate an established sound-image depends upon engagement with the sound's spectromorphological properties. In fact, the source-identification process relies mostly on spectromorphological properties, which is why a sound-image perceived as no longer tenable inevitably leads a listener back to not just the source-identification process, but to a deeper examination of a sound's spectromorphology. [17]

There are two issues in spectromorphology that need to be discussed in order to relate spectromorphological listening to acousmatic reasoning. First, spectromorphological listening takes reduced listening as an investigative strategy, which means that spectromorphological listening is subject to the same dialectical conditions as found in reduced listening. Listeners engaged with reduced listening and its removal or denial of the representational and semiotic connotations of the sounds they hear face an equivalent sensitization to the spectromorphological properties of sound that allow sounds to signify; in short, focus on sound can actually *encourage a new spectromorphological awareness of how sounds represent*. The second issue is closely related to the first: despite its goal of investigating the abstract dimension of sound, spectromorphological listening reveals, and is affected by, mimetic structures and the sound-image traces they carry and preserve. It is particularly interesting how the aural abstractions of gesture and texture can be identified, however remotely, with sound-images, specifically those of body and place. [7][9][10][11][13][16][18]

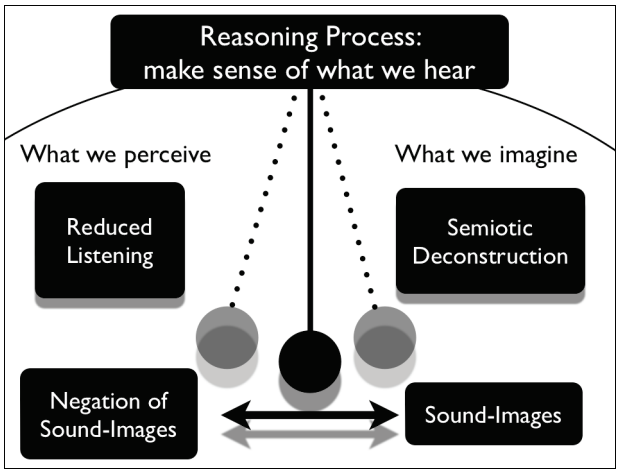

Figure 1. Listening procès in an acousmatic situation

As such, by employing acousmatic reasoning in electroacoustic music, listeners listen to dis-embodied and dis-placed sounds by traversing back and forth, like a pendulum, between the semiotic and the spectromorphological (Figure 1). But how can we examine this act of travel? To answer this question, it is necessary to explore the third subject of acousmatic reasoning, that is, listeners' inference processes.

2. ACOUSMATIC REASONING AT WORK

2.1. Inference processes in acousmatic reasoning

The power of listening modes and frameworks to orient the listening experience may render new sounds or changes in sound as random and trivial—as extraneous to the work and, therefore, *semantic noise.*[3] With time, however, what initially is taken for noise or meaningless distortion can, through emerging order, design, and exposition, come to be heard as noteworthy and even essential to how one understands a piece. Bateson gives an intriguingly similar example of such a process in the perception of anatomy: 'To the aesthetic eye, the form of a crab with one claw bigger than the other is not simply asymmetrical. It first proposes a rule of symmetry and then subtly denies the rule by proposing a more complex combination of rules'. [2]

Notably, recognition of the crab's asymmetry comes only after the viewer's presupposition that the crab is, at some fundamental level, symmetrical (even though the two process appear to occur at the same time). By extension to music, Bateson's example suggests that the evaluation of new sounds or changes to the properties of existing sounds proceeds along a three-stage process: first, that, regardless of the listening situation, listeners bring whatever rules or codes they know to listening (no matter how limited or naïve they may be); second, once a music succeeds in challenging a presupposed system of codes, listeners make new assumptions and broaden or change existing code systems or propose new ones; and then finally, listeners choose the best, most explanatory code system from amongst the plausible systems they have imagined.

This three-step listening process is based on an inferential process called *abduction*, termed by Pierce and further expanded by Eco. Acousmatic reasoning begins with the process of abductive listening and ends with the choices listeners make, however intuitively, consciously or personally. However, listening to music is an ongoing process that continuously offers up new sounds that can (and will) call into question the explanations listeners have made; consequently, the process of acousmatic reasoning needs to be applied continually, using it to accumulate additional input that either furthers previous explanations or undermines them on the way toward the invention of newer, more plausible ones. Listeners use abduction to imagine 'the

[3] With regard to semantic noise compared to engineering (or channel) noise, Hockett notes: 'Ordinary Spanish usage reflects this distinction quite neatly. If A speaks to B and B responds with *no entiendo*, it means "I have not heard your words, because of interfering sound or lack of attention; please transmit the same message again"; if he responds with *no comprendo*, it means "I heard you all right, but what I heard doesn't make sense; please paraphrase or explain." Channel noise, thus, is the responsible factor when that which leaves a transmitter is not that which reaches the receiver; semantic noise is a discrepancy between the codes used by transmitter and receiver.' [12]

Rule' that might explain 'the Case' they are hearing. Once proposed, listeners 'widen (and verify)' the suppositional rule relative to new sounds and the ability of the rule to continue to sufficiently explain what they imagine. [6] Furthermore, Eco differentiates three types of abduction, *overcoded, undercoded,* and *creative abduction*, which correspond neatly to the three types of abductive listening found in acousmatic reasoning.

2.1.1. Overcoded abduction

Eco defines an abduction as *overcoded* when 'the law is given automatically or quasi-automatically'. [6] Assuming that there is some kind of process predisposing them to listen according to one or the other mode, we can say that each mode by itself, can, in essence, function as a kind of 'automatic' rule, in the spirit of Eco's overcoded abduction, specifying the way in which sounds will generally be heard.

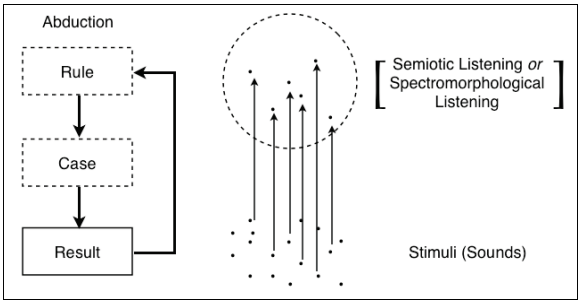

Figure 2. Overcoded abduction

Looking back at the discourse explored here, I have argued that within the practice of acousmatic reasoning, listeners have the choice to listen semiotically or spectromorphologically. However, given that listening according to one or the other mode is a choice, the rule is therefore adopted 'quasi-automatically,' since certain choices or conditions must first be met to incline or direct a listener into one or the other mode. Figure 2 shows the process by which sounds (aural stimuli), perceived according to one or the other mode, are explained by an overcoded abduction; the sufficiency of the abductive reading is determined by the ability of the stimuli to map into the rule's codes.

2.1.2. Undercoded abduction

In acousmatic reasoning, however, listeners suppose much more than any one listening mode might necessarily address. In particular, listeners imagine sound-images that function, however temporarily and tentatively, as rules, explaining the sequence of sounds they hear.

According to Eco, this form of abduction that employs imagination and supposition in the ongoing creation of explanatory rules (in our case, the sound-image as explanatory rule) is *undercoded* because 'the rule must be selected among a series of equiprobable alternatives'. [6] Sound-images must be seen as *undercoded* due to the uncertainty surrounding them, the possibility of multiple explanations that introduce doubt; in spite of the doubts at play, the rules of sound-images, however undercoded, are standardly, albeit provisionally, embraced by listeners given the tenable explanations they momentarily offer.

Figure 3 illustrates how listeners, searching for explanation, choose the most plausible sound-image. In undercoded abduction, conditioned by the lack of pre-established rules, 'certain macroscopic portions of certain texts are provisionally assumed to be pertinent units of a code in formation, even though the combinational rules governing the more basic compositional items of expressions, along with the corresponding content-units, remain unknown' [5].

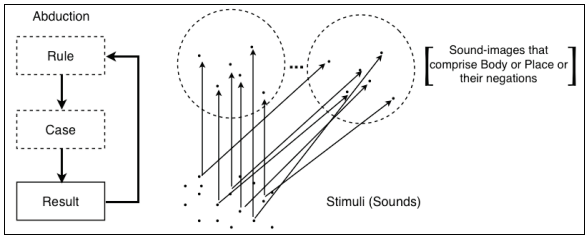

Figure 3. Undercoded abduction

Likewise, compared to the two listening modes that function as a pre-established and quasi-automatic rule in acousmatic reasoning, sound-images in undercoded abduction are based on a listener's provisional assumptions that 'certain macroscopic' properties of sound can be considered as 'pertinent units' of the supposed sound-images; but, as shown in Figure 3, the ability of some sound components to code into multiple sound-images introduces doubt, judgment, and even guessing into the explanatory process. Consequently, listeners, faced with sound-images that are only plausible, *entertain* them until they are seriously challenged, requiring the development of new sound-images—a process easily identified with what Eco calls *creative abduction.*

2.1.3. Creative abduction

In a *creative abduction*, 'the rule acting as an explanation has to be invented *ex novo* [anew or once again]'. [6] Eco further notes: 'In creative abductions one is not sure that the explanation one has selected is a "reasonable" one…. Many cases in which language is used not to confirm but to challenge a given world view or a scientific paradigm, and to decide that certain properties cannot belong any longer to the meaning of a given term require an interpretive cooperation that displays many characteristics of a creative abduction'. [6]

In a similar fashion, listeners who realize that some of the sounds or properties of sound that can no longer be explained by the sound-images they suppose need to

establish new sound-images. As shown in Figure 4, this process can involve not only the introduction of new sounds or new properties of existing sounds, but also the continuation of previous sounds into new contexts.

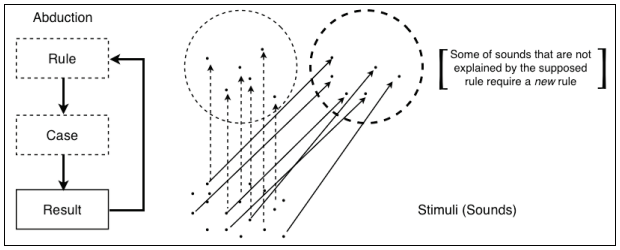

Figure 4. Creative abduction

2.2. Syntactically relevant properties (SRPs) in acousmatic reasoning

The abductive processes in acousmatic reasoning presuppose that sounds in an electroacoustic composition may signify more than one thing, and that, relative to a particular context, listeners choose the most plausible meaning. Using Eco's terms, the possibility of multiple significations in electroacoustic music listening is based on the assumption that listening to an electroacoustic composition is a process that examines 'a polydimensional network[4] of properties, in which some properties are the *interpretants* of others'. [6] Given this, the question then becomes: what properties in acousmatic reasoning are meaningful to listeners?

The answer to this question depends upon a listener's current listening mode; as shown in Figure 5, semiotic listening focuses on sound-image components and their potential sound-image frameworks, while spectromorphological listening focuses on spectral types and morphological shapes.

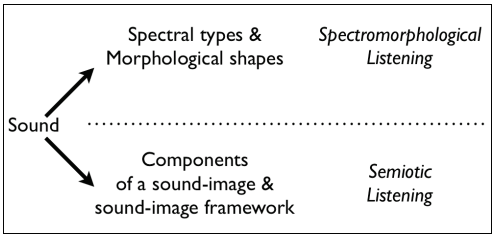

Figure 5. Properties of sound in acousmatic reasoning

Furthermore, not every property that can be categorized in Figure 5 is significant in acousmatic reasoning; some sound properties are more relevant than others, and that these differences affect acousmatic reasoning. The differences among properties of competing relevancy to the perception at hand is fittingly articulated by John V. Kulvicki in his book *On Images: Their Structure and Content*, in which he proposes the concept of Syntactically Relevant Properties (SRPs): 'Let the *syntactically relevant properties* (SRPs) of tokens in a certain system of representation be those properties on which the syntactic identities of the tokens supervene. Changing the syntactic identity of a token requires changing its SRPs, though there can be changes in a token's SRPs that do not affect its syntactic identity. Shape, for example, is an SRP of most alphabets. One can change the shape of a letter without altering its syntactic identity, but if one wants to change a letter's syntactic identity, one must change its shape'. [15]

To look at this from a sound perspective, let us consider an audio example where we hear a voice whose first five formants are gradually shifted; in particular, formants centered at 609Hz, 1000Hz, 2450Hz, 2700Hz, and 3240Hz are shifted to 650Hz, 1100Hz, 2860Hz, 3300Hz, and 4500Hz, respectively. [4] What we hear is a person singing the vowel 'a' whose gender changes from male to female. In terms of SRPs, the SRPs associated with the gender of the voice can be identified as having changed from those of a male to those of a female; however, the SRPs associated with the voice itself has not changed. It is matters of audio detail like this, seemingly hidden, that can have a significant impact on how we hear electroacoustic music. Therefore, any discussion of the listening process based on acousmatic reasoning requires a close examination of SRPs, acknowledging their dependence upon not only the operative listening mode, but, as well, the image or framework to which listeners are, at any given moment, most attentive.

3. LISTENING TO *THE FLYWHEEL DREAM* USING ACOUSMATIC REASONING

3.1. Introduction to *The Flywheel Dream*

The Flywheel Dream by Paul Koonce [14] is replete with everyday sounds whose semiotic and spectromorphological features offer ample opportunities for listeners to engage in acousmatic reasoning. In line with the quaternary framework I have proposed elsewhere [13], the work's sounds often conjure up images associated with the human body or familiar places; more important, however, is the way these sounds undergo various processes of transformation that constantly force into question the identity of sound-images. For listeners, the continuous transformation of sound-images places them in a state of unrelenting tension where their uncertainties about what they are listening to keep them working to determine what each sound is (and just as relevantly, what it is not).

Given this, the focus of this (analytical) listening exercise is on the properties of the piece's sounds and sound-images, in particular, their SRPs. Furthermore, this exercise seeks to identify the functional relationship between SRPs and acousmatic reasoning and the imaginative process by which listeners create, question

[4] Eco terms this network *Model Q*. For a further discussion about Model Q, refer to Eco's *A Theory of Semiotics*. [5]

and ultimately negate sound-images of body and place in their imaginative and acousmatically reasoned movement through the quaternary framework for listening.

3.2. Analytical listening to *The Flywheel Dream*

In this analytical listening, we will look at the use of acousmatic reasoning to position various moments from 00:00 to 01:24. Following this, we will make detailed observations of some key sounds from 01:24 to 02:48, with the purpose of examining the interplay between semiotic and spectromorphological listening and the distinctive shifts that occur between the four poles of the framework—Body, Place, Non-body, and Non-place—during the segment.

3.2.1. Acousmatic reasoning from 00:00 to 01:24

Figure 6 shows the results of the analytical listening exercise I conducted from 00:00 to 01:24. Moving from top to bottom, we see spectromorphological features (SRPs) collected by a sonogram as well as through our spectromorphological listening followed by semiotic features (SRPs) collected through the semiotic listening. Below the semiotic features are the sound-image frameworks, identified by dotted circles, which I inferred through undercoded and creative abduction; the figure is completed at the bottom with the quaternary framework. As shown on the right side of the figure, both spectromorphological and semiotic listening modes are overcoded abduction processes as they progress according to relatively rigid rules connected with and distinguished by the particular form of listening. Sound-image frameworks, however, as shown, are products of undercoded or creative abduction, representing a listener's explanation of sonic events based not on hard facts or rules but on imagination.

Dotted-line arrows connecting one or more semiotic features (SRPs) to a sound-image framework indicate an undercoded abduction where the semiotic features become components of the sound-image framework. An important feature of sound-image frameworks is the question mark '?' beneath the name, which identifies that the imagined framework is in some way fleeting and difficult to verify as it is likely challenged by *missing, conflicting or distorting information*. [13] Question marks combined with exclamation points and arrows, '!→?' or '?←!,' identify sound-image frameworks that shift from being affirmed to negated or vice versa.

Sound-image frameworks can combine or merge to become *super-set* sound-image frameworks, for example, sound-image frameworks like 'Kitchen' and 'Office' becoming sound-image components of another sound-image framework called 'Indoor.' Consider, also, a sound-image framework called 'Musical combo,' as found in Figure 6, which intersects with both 'Indoor' and 'Outdoor,' suggesting that, in this section of the piece, 'Musical combo' could support both 'Indoor' and 'Outdoor' frameworks.

The Quaternary Framework, included beneath the sound-image frameworks, is divided into two levels: Body/Non-body and Place/Non-place. Gray boxes identify poles on the quaternary framework and solid arrows between them indicate shifts from one pole to another. If the shift is contained within a gray box, then the shift takes place within the same context. For example, in Figure 6, BODY → NON-BODY shows that the transition from Body to Non-body—in this case, the shift of 'Child/!→?'—is due to the changes in the SRPs of 'Child,' which should therefore be identified together. Compared to the shift from BODY to NON-BODY, the shift from BODY → NON-BODY to PLACE, which is not in a single box and has an angled arrow shifting focus to a different axis, indicates that BODY → NON-BODY does not become, but is rather subsumed by PLACE.

Section (a) has a quality of relentless locomotion that is supported by both semiotic and spectromorphological readings of the work. This sense of locomotion is caused not only by the spectromorphological features of the collaged sounds, but also by the diversity of materials, which resist being circumscribed by any one sound-image of body or place. The sound-image frameworks in section (a) are potentially somewhere indoors, possibly an office or a kitchen or a domestic place with added environmental noise. However, none of these sound-image frameworks is definitively distinguished by support through sounds, context, or circumstance. Section (a) may offer listeners the opportunity to imagine a sound-image framework connected with place, but there is just *too much conflicting information*, or better, too many plausible yet unconfirmed frameworks that leave listeners little choice but to take what they hear, for the moment, as NON-PLACE, as shown in the Quaternary Framework.

In section (b), listeners get a strong sense of the human body as a result of SRPs associated with the body: the voice of a young child or even baby, and footsteps moving through shallow water. However, these SRPs are *distorted* by expansion in time and the introduction of reverberation; consequently, listeners are led away from 'Child!' toward 'Child?' as the image of the voice becomes less and less natural and the distortions of a reverberant space are added.

Our traversal through the quaternary framework in section (b) begins with Body, due to the strong sense of the human body as we have discussed, but quickly moves to Non-body. To form Non-body in this section, listeners collect together the reverberated and time-expanded voices, joining them together based on their spectromorphological similarities. Place soon subsumes the shift in the quaternary framework from Body to Non-body as a result of the cave framework whose SRPs include not only reverberated voices and footsteps, but also the sound of birds and reverberated water drops. In section (b), thus, the listener's experience, as mapped onto the quaternary framework,

shifts from Body to Non-body, and then finally, to Place.

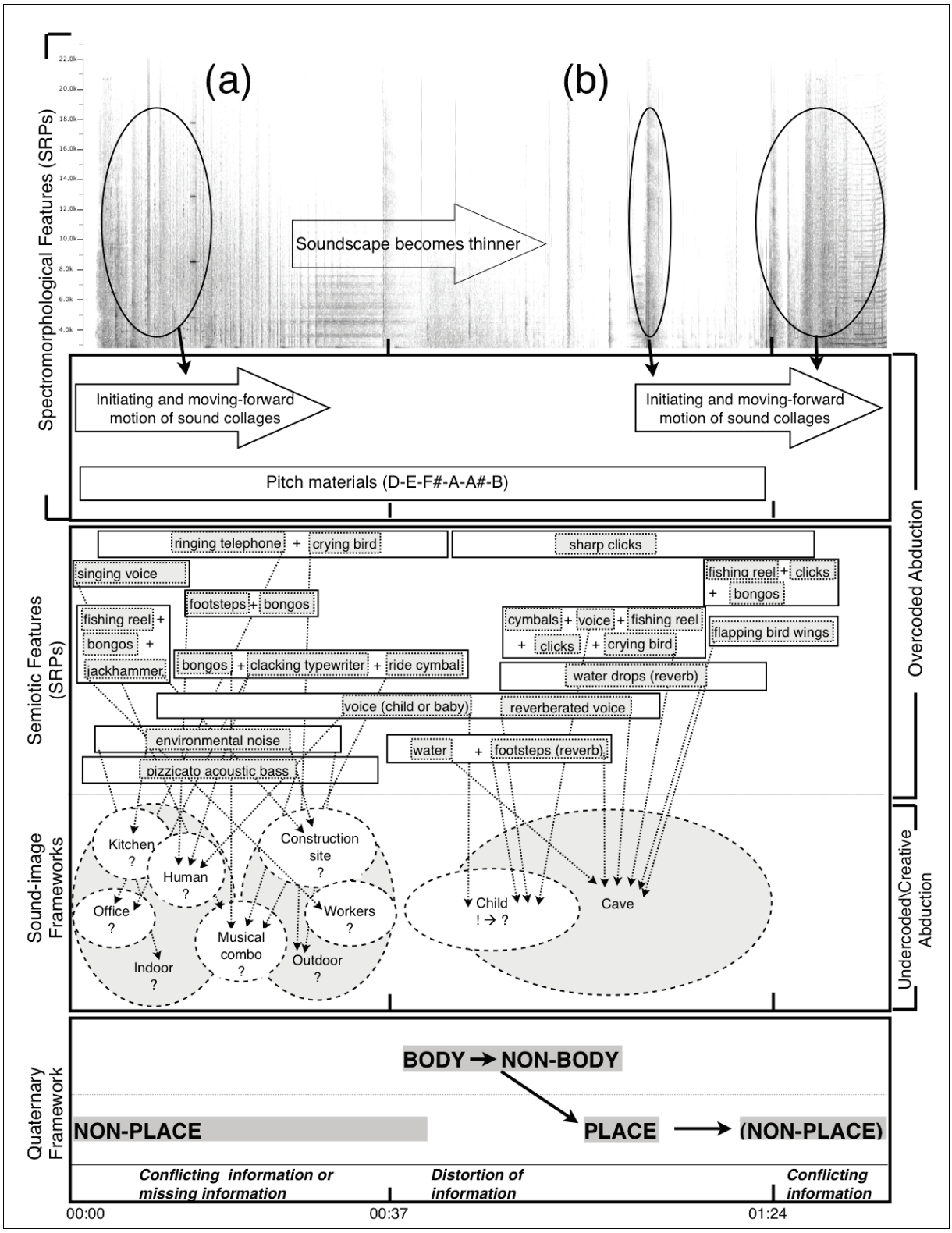

Figure 6. Detailed listening exercise for *The Flywheel Dream* (00 :00 – 01 :24)

Section	Symbols and Codes	Explanation
Spectromorphological Features (SRPs)	(a), (b)	• Subsections
Semiotic Features (SRPs) and Sound-image Frameworks	cymbals	• Sounds in gray, dotted-line rectangles denote preliminarily identified sound-image features and possible sound-image framework components.
	footsteps + bongos	• Sound-image features enclosed in white boxes and linked by "+" denote spectromorphologically linked sounds, regardless of semiotic implications.
		• Dotted lines with an arrow identify the use of sound-image features in sound-image frameworks as a result of undercoded or creatively coded abduction.
		• Sound-images in white, dotted-line circles denote sound-image frameworks formed through undercoded or creatively coded abductions using one or more sound-image features as framework components.
		• Sound-image frameworks with gray backgrounds indicate 'super-set' frameworks; super-set frameworks are formed through the joining together of related frameworks into more generalized frameworks.
	?	• Question marks beneath the name of a sound-image framework identify the framework as questioned, challenged, or potentially negated.
	!→?	• An exclamation point followed by a question mark beneath the name of a sound-image framework identifies the framework to be first affirmed and then questioned, challenged, or even negated.
	?→!	• A question mark followed by an exclamation point beneath the name of a sound-image framework identifies the framework to be initially questioned, challenged, or even negated, but then finally affirmed.
• Quaternary Framework	NON-PLACE	• Quaternary framework poles in gray boxes denote the pole currently in effect; boxes extend over the length of time during which the pole is identified.
	BODY → NON-BODY	• Gray boxes containing processes of negation or affirmation (denoted by arrows) indicate framework shifts operating within the context of a single sound-image framework.
		• Solid arrows denote transition between two or more poles of the framework.
	(NON-PLACE)	• Poles enclosed in parentheses indicate preceding or upcoming poles otherwise not indicated by accompanying information.

Table 1. Explanation of symbols and codes used in Figure 6 and Figure 7

One benefit of the detailed listening is how it illustrates the interaction between spectromorphological and semiotic listening modes. In Figure 6, we can see that, in the semiotic listening section, there are various sounds linked by a plus sign (+) and circumscribed by a rectangle. These notations indicate that the sounds are linked together spectromorphologically, despite the possibility that they may be semiotically unrelated. *The Flywheel Dream* offers listeners copious examples of these unlikely semiotic bedfellows cultivated through spectromorphological congruencies; notable examples include the fishing reel + bongos + jackhammer sounds in the beginning to 00:05, the footsteps + bongos from 00:19 to 00:22, the interplay in rhythm and pitch between the ringing telephone + crying bird sounds from 00:24 to 00:46, and the rhythmic interplay between the bongos + clacking typewriter +ride cymbal from the beginning to 00:40. I have mentioned that, in section (b), the voice loses its identity when it is combined with other sounds. Between 01:07 and 01:12, you can hear a collage of sounds that starts with clicks, followed by (in series) the ride cymbal, fishing reel sounds with a time-expanded voice, water drops, fishing reel sounds with clicks, and a bird call. This is another example of the

juxtaposition of semiotically heterogeneous sounds based on the similarity of their spectromorphological designs. The role of this sound collection is twofold: it functions to not only move away from the cave as a place (a semiotic function), but to also reinitiate the motion observed in section (a) and move into the next section (a spectromorphological function), thus, effectively encouraging listeners to move from Place to Non-place.

3.2.2. Interplay and metamorphosis of SRPs in acousmatic reasoning from 02:10 to 02:50

The analytical exercise explored above using *The Flywheel Dream* shows how acousmatic reasoning works in listening. This paper will now examine, in more detail, the interplay of SRPs (semiotic and spectromorphological properties) in acousmatic reasoning. The segment to be examined is from 01:24 to 02:48, which includes the sound sequence fishing reel → clicks → water drops → ticking bicycle derailleur → ping-pong balls → ticking clock → alarm clock from 02:10 to 02:50.

Shown in Figure 7 are the results of an analytical listening exercise for the segment mentioned above from 02:10 to 02:50. This segment offers another example of the interplay between spectromorphological and semiotic features in the piece, displayed primarily through its rhythm (a spectromorphological feature). The continual metamorphosis of the segment's rhythmic features causes it to momentarily conjoin with different semiotic features and sound-images.

The segment begins with the sound of a reverberated and time-expanded trilling flute, along with the sound of a clicking fishing reel, which, by this point in the piece, should be familiar to listeners. One of the spectromorphological features of the fishing reel is its decelerating rhythm. Based on semiotic listening, one can hear the clear combination of the fishing reel with the clicks, which are then followed (through superimposition) by the sound of water drops, the bicycle derailleur, ping-pong balls, a clock, and finally, an alarm. Listening to the metamorphosis of the fishing reel into the water drops and finally the clock requires, among other things, close attention to the regularity and irregularity of sound events. For example, where the water drops are intermittent, the clock, conversely, stands out through its much faster, regular ticking. The fishing reel, which is regular while changing in speed, decelerates and metamorphoses into the sound of the water drops, gradually adopting their irregular rhythmic identity. At the same time, the water drops, the ticking bicycle derailleur, and quasi-regular bouncing ping-pong balls metamorphose into the regularity of the clock. As shown in the spectromorphological listening diagram, the rhythmic features progress from 'decelerating' to 'irregular' to 'regular,' which coincides with the contributing sounds, from clicking fishing reel to ticking clock to finally alarm (the solid arrows indicate the contribution that spectromorphological rhythmic features make to the sequence and identity of sounds).

In addition, it should be noted that the change of sound-images through changes in their degree of regularity is a feature that combines with other sounds to create new sound-images and shift preexisting ones. The rhythmically irregular sounds identified as water drops combine with the running water to suggest a cave as a place, and the rhythmically regular sounds that eventually become identified as a clock, underscored at the end of the segment by a disrupting alarm, combine with the sound of soft, restful breathing to suggest a bedroom as a place.

The stability of Place is present and evident in this metamorphosing segment. However, the cave place, which is a reprise of the previous cave image, carried over by reverberated water drops and running water, is not as strong a sound-image as when it was first introduced. Compared to the earlier moment, this sound-image lacks the information listeners need to identify it as a cave; even the most important cave SRPs, such as those connected with the water drops, quickly change to suggest a bicycle derailleur or ping-pong game, causing our listening experience to shift from a cave to something that is not a cave ("Cave (Reprise)/! →?'), and, by correspondence within the quaternary framework, from Place to Non-place. Furthermore, the bedroom, while identifiable, appears but for a few seconds, as it is quickly eclipsed by the awakening call of the alarm clock and the collage of noisy sounds that follow; the intrusion of construction sounds and honking cars combine with the return of familiar sounds to re-engage the toy box spilling moment. Thus, sound-images and frameworks connected with Place are as soon challenged as they are imagined, as denoted by "Bedroom!→?'.

3.3. Macro-experience of *The Flywheel Dream* based on acousmatic reasoning

Despite the various easily recognizable sounds that we hear in *The Flywheel Dream,* listening to it semiotically is never easy; the piece resists the listener's semiotic reading of it. While we are able to detect some place-like images in the piece, they are, however, never verified. Interestingly, spectromorphological features—the primary pitch content and morphological shapes—offer listeners a simpler way to 'understand' *The Flywheel Dream*. Sounds carrying these spectromorphological features are the common thread that runs through the piece, knitting together all of the heterogeneous materials that do not otherwise go together. Listening to the piece according to acousmatic reasoning, one can regard the piece as being similar in structure to the mobiles of Alexander Calder in that the spectromorphological features of the piece act as the armature holding together copious and seemingly mobile objects. Furthermore, like a mobile whose moving parts are powered by wind, a motor, or the observer, *The Flywheel Dream* is powered by the

semiotic whimsicality of the sounds as well as the listener's imagination.

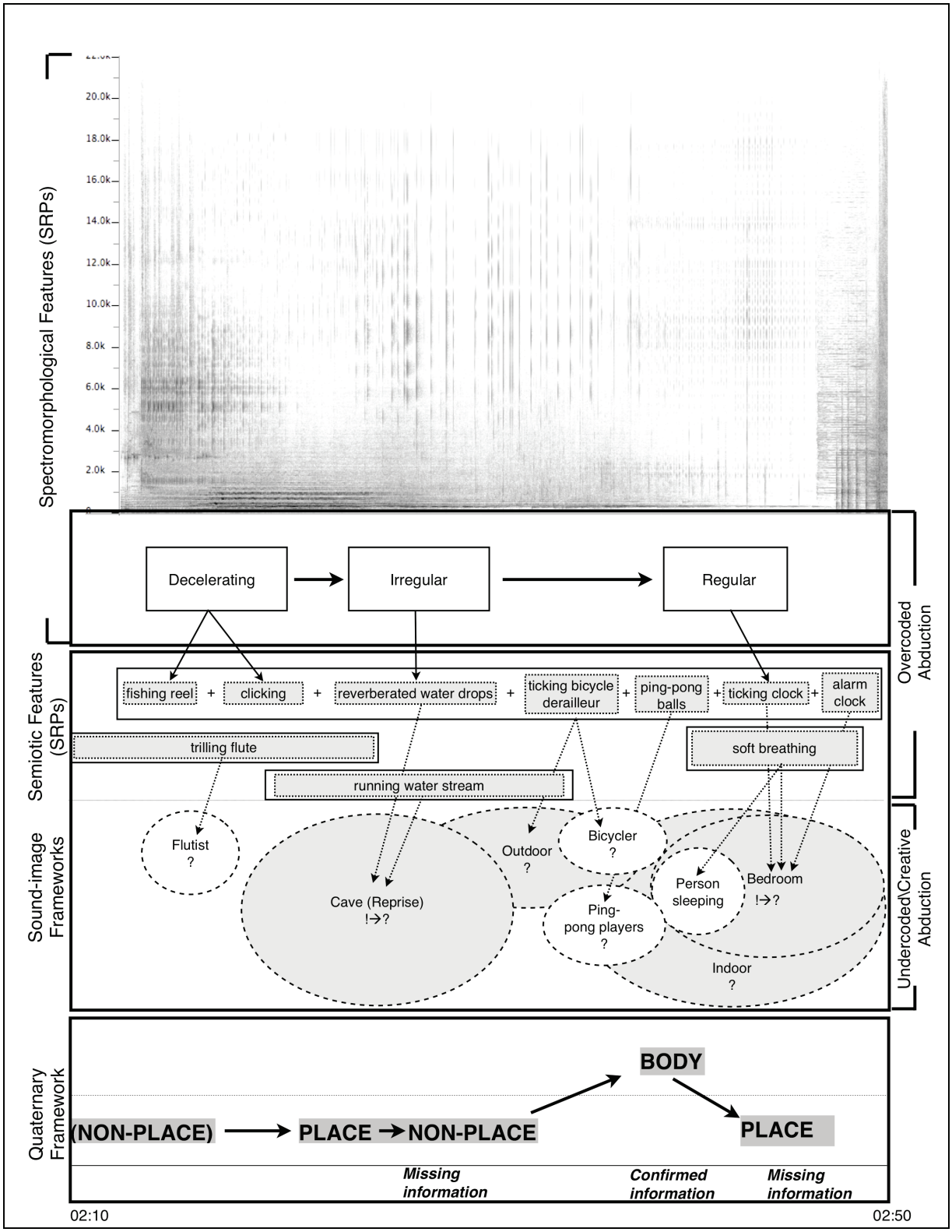

Figure 7. Detailed listening exercise for *The Flywheel Dream* (02 :10 – 02 :50)

4. CONCLUSION

The goal of the proposed acousmatic reasoning, well stated, has been to address how listeners listen to electroacoustic music that is clearly engaged with everyday sounds and their connotations. By definition, other forms of electroacoustic music, not so engaged with everyday sounds, are not addressed. Additionally, acousmatic reasoning is a process not just for listeners, but for composers as well. As composers more and more realize how they are, in fact, their first listener, they need to learn how to be attentive to what they, and others, experience when listening and work to examine how acousmatic reasoning, as a fundamental process behind how they listen, plays a role in their compositional processes.

Listening to electroacoustic music is as much an act of reasoning as of imagining. Good listeners are not only attentive to both modes of listening, but, as well, balance their attention in accord with the pieces they hear. Acousmatic reasoning, as proposed in this paper, shows how listeners proceed to listen.

5. REFERENCES

[1] Agawu, V. K. *Playing with Signs: A Semiotic Interpretation of Classic Music*. Princeton, N.J: Princeton University Press, 1991.

[2] Bateson, G. *Steps to an Ecology of Mind: Collected Essays in Anthropology, Psychiatry, Evolution, and Epistemology*. Northvale, N.J: Aronson, 1987.

[3] Casey, E. S. *Imagining: A Phenomenological Study*. Bloomington: Indiana University Press, 1976.

[4] Dodge, C., Jerse, T. A. *Computer Music: Synthesis, Composition, and Performance*. New York: Schirmer Books, 1997.

[5] Eco, U. *A Theory of Semiotics*. Bloomington: Indiana University Press, 1976.

[6] Eco, U. *Semiotics and the Philosophy of Language*. Bloomington: Indiana University Press, 1984.

[7] Emmerson, S. « The relation of language to materials », *The Language of Electroacoustic Music.* London: Macmillan, 1986.

[8] Emmerson, S. *Living Electronic Music*. Aldershot, UK; Burlington, VT: Ashgate Publishing, 2007.

[9] Godøy, R. I., Haga, E., Jensenius, A. R. « Playing 'air instrument': mimicry of sound-producing gestures by novices and experts », Gestures in Human-Computer Interaction and Simulation: 6th International Gesture Workshop GW, 2006.

[10] Godøy, R. I. « Gestural-sonorous objects: embodied extensions of schaeffer's conceptual apparatus », Organised Sound 11(2), 2006.

[11] Godøy, R. I. « Imagined action, excitation, and resonance », Musical Imagery. Exton, PA: Swets & Zeitlinger Publishers, 2001.

[12] Hockett, C. F. « An approach to the quantification of semantic noise », Philosophy of Science 19(4), 1952.

[13] Kim, S-. J. « Imaginal listening: a quaternary framework for listening to electroacoustic music and phenomena of sound-images », *Organised Sound* 15(1), 2010.

[14] Koonce, P. *The Flywheel Dream* (1994), Walkabout & Back: Electroacoustic Works. New York: Mode, 2000.

[15] Kulvicki, J. V. *On Images: Their Structure and Content*. Oxford; New York: Clarendon, 2006.

[16] Leman, M. *Embodied Music Cognition and Mediation Technology*. Cambridge, Mass: MIT Press, 2008.

[17] Neuhoff, J. G. *Ecological Psychoacoustics*. Amsterdam; Boston: Elsevier Academic Press, 2004.

[18] Smalley, D. « Spectro-morphology and structuring processes », The Language of Electroacoustic Music. New York, NY: Harwood Academic Publishers, 1986.