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Typological Analysis of Gesture Interaction in Acousmatic Music

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Abstract

The authors propose the undertaking of a typological analysis of gesture interaction in canonical works of acousmatic music in order to advance understanding of the contributing factors to the creation of “successful” gesture interaction within the genre. A perceptual, listener-based, methodology of analysis is discussed, and results of said analysis are presented in three levels of typological databases: the micro, meso and macro levels. Finally, suggestions are presented regarding the future implementation of said results in generative and interactive music computational systems.

1. Introduction

While the past 60 years have witnessed a variety of aesthetic approaches in the composition of acousmatic¹ music, it is at the same time clear that the continual production of works in this genre has led to a natural consolidation of certain compositional-aesthetic practices². In order to better understand contemporary acousmatic music, as well as suggest possible directions and revisions for the future of the genre, an examination of dominant, consolidated compositional-aesthetic features is in order.

Arguably, one of the perceptually salient and compositionally important features of acousmatic music is the complex gestural interaction between various sound units. In order to advance our understanding of this feature, we have undertaken a typological examination of gesture interaction in canonical works of acousmatic music. Through this typological examination of existing models of gestural interactions, we hope to shed some light on the factors and variables that constitute “successful” gestural interaction, as well as the ways in which these interactions develop from a compositional standpoint.

2. Research objectives

Our primary objective is the assembly of a typological database of existing, successful models of gestural interactions, compiled through the extraction of existing typologies from several celebrated works of acousmatic music. Once assembled, these typological models may be useful in their suggestion of structural relationships – an acousmatic grammar, so to speak.

¹ In this paper, the term *acousmatic* does not refer to a particular listening condition – acousmatic listening – but rather to the resulting body of work emerging from *musique concrète*, and the subsequent genre of contemporary music referred to as acousmatic music.

² Some speculative reasons for this aesthetic consolidation include the emergence of international festivals and distribution, common tools or methodologies, an emerging online community, as well as the world-wide dissemination of certain theoretical frameworks (reduced listening and spectromorphology, for example).

These structural relationships could in turn prove useful within various research avenues concerning acousmatic music, including composition and pedagogy (Blackburn 2009), and the musicology of acousmatic music (both in terms of analysis of specific works, following as Roy 1998 or Thoreson 2009, or comparative studies, following Young 2004). Within our own on-going research, we envision these structural relationships to be used within systems for the creation of real-time electroacoustic music, whether as part of a musical interaction (through an instrument or control interface) with computational systems (Young and Bown 2009) or as part of a real-time multi-agent generative music system (Eigenfeldt 2009).

3. Selection of works

Three works were selected for analysis and subsequent extraction of gesture interaction typologies, namely: Francis Dhomont's *Novars*, Denis Smalley's *Wind Chimes*, and Jonty Harrison's *...et ainsi de suite...*

The three works in question were selected for several reasons. First, all three are considered canonical works within the acousmatic genre, models of what is widely considered "successful" gestural interaction. Furthermore, these works were created, at least in part, using digital means and contemporary processing techniques. The prevalence of these types of processing techniques (for instance, a brassage time-stretching algorithm) in current production practices ensures that our analysis of these works is informed by knowledge of the respective methodologies of production, as well as ensuring the relevance of our results in regards to current praxis in the field.

As well, these three pieces represent different, though related, traditions in acousmatic music: the extended musique concrète francophone tradition represented by Dhomont's *Novars*, as well the outshoot from that tradition, the so-called British acousmatic style represented by Smalley's *Wind Chimes*, while Harrison's *...et ainsi de suite...* occupies a middle ground between the two³.

Finally, and related to our aim of extracting typologies of gestural interaction, these works are generally of an abstract aesthetic in terms of their choice and treatment of sound material, and thus do not incorporate particular extra-musical narratives. This abstract aesthetic lends itself particularly well to the sort of functional and structural analysis suggested by typological reduction, while an application of this form of analysis would be largely inappropriate to, for instance, a soundscape work.

4. Analysis Methodology

Each of the selected pieces was subjected to an aural analysis, enacted from a perceptual standpoint and informed by our experience as individual listeners. However, it is clear that our prior knowledge of compositional and processing techniques were influencing factors in the identification of gestures, their interaction strategies, and their eventual typological reduction.

Throughout the aural analysis, graphic sketches were created and utilized for the identification of gestures as well as the separation of gestures into constituent parts – once again, based on the listener's perspective. Through repeated listening, efforts were made to note variations of individual sound parameters in each sound unit (for instance, grain density in a granular texture). Additionally, repeated listening allowed the noting of interaction strategies between individual gestures. Finally, the raw data resulting from the processes of separation, classification, noting of sound parameters and observation of interaction strategies were analyzed in order to extract typological models of gestural interaction. While this process of typological extraction involves a reduction of specific, particular

³ The UK born-and-raised Harrison has himself suggested a francophone, musique concrète inspiration for *...et ainsi de suite...* in his program notes.

gestural interactions into broader structural and functional relationships, corresponding to a wider class or typology of gestural interaction, this approach seemed fitting to our aims and the aesthetics of the works chosen for analysis.

It is worth noting that although the resulting typological databases emerged from the analysis of individual works, the emphasis is placed on comparative – rather than individual – analysis, with the final goal of cataloguing shared typologies of gestural interactions. Furthermore, this emphasis was a guiding factor in the analysis process of each of the individual works. In this manner, our analysis can be seen as a form of *modeling by observation*, which will in turn allow us to address questions regarding the factors and variables comprising “successful” gesture interactions in acousmatic music.

5. Definitions: Gesture as a contextual variable

Since our research is centered around the identification of gestures and their modes of interaction, it is important to arrive at a working definition for our basic unit of analysis: the gesture.

For the purposes of our research, a gesture will be defined as a perceptual sound unit, broadly following gestalt rules. That is, a gesture is listener and context dependent; it is, in a sense, in the ear of the beholder. For example, a single gesture may be comprised of a collection of smaller perceptual units, which we will term *gesture elements*. However, given the right compositional context, the identification of multiple gesture elements may be superseded by a consideration of gesture elements as constituent parts of a global gesture. Though the reasons for grouping of gesture elements into a global gesture are beyond the scope and aims of this paper, we speculate that in general this process is guided by rules of gestalt perception as well as the ecological understanding of classes of sound as they operate in everyday listening (for a detailed discussion, see Gaver 1993).

Examples of the contextual nature of a perceived gesture are as follows: an attack-decay archetype *may* be heard as an individual gesture. However, an attack-decay archetype *may also* be heard as a gesture element within a global gesture; for instance, within an accelerando gesture of subsequent attacks. Another example may be heard when an attack-decay archetype’s decay portion is elongated by a separate texture. In this example, both the attack-decay archetype and the texture function as perceptually discernable gesture elements within a unified global gesture.

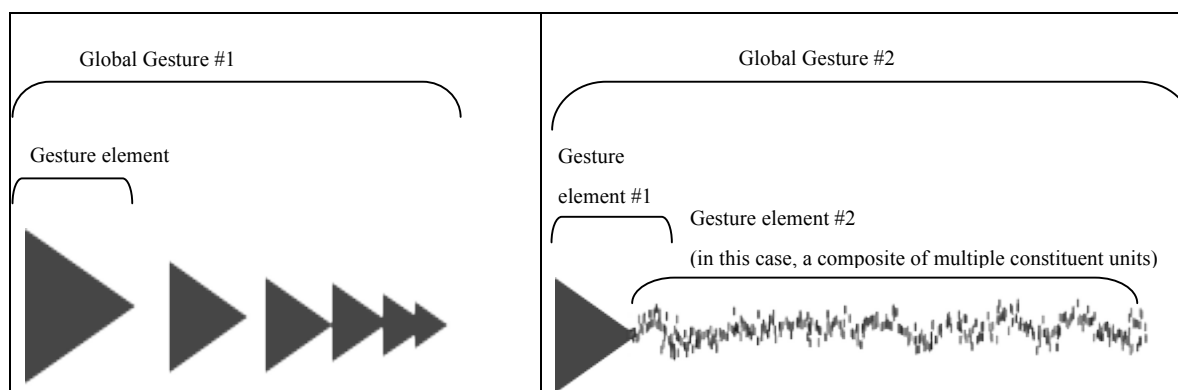


Diagram 1a and 1b: Illustrations of relationship between gesture elements and global gestures.

While this definition will undoubtedly seem problematic to advocates of machine-based analysis, we feel that it is through the embracing of the subjective, perceived nature of a gesture (rather than depending solely on its measurable acoustic features) that a study of gesture relationships which respects the musical context in which gestures appear may be undertaken.

6. Results of analysis

In general, our findings can be categorized in three different, yet related typological databases, with each database corresponding to a hierarchical compositional level: the micro, meso and macro levels.

The first database is concerned with *causal typologies*, or morphological strings (Smalley 1986), in turn corresponding to the micro compositional level. This database contains information on how sequential gesture elements form larger perceptual gestural units.

The second typological database is that of *co-existing gestures*, corresponding to the meso-level. This database contains information on the ways in which perceptually separate but temporally overlapping gestures interact with one another.

The third and final database concentrates on the *temporal evolution* of the two former databases, and thus corresponds to the macro compositional level.

Of course, there is considerable overlap between the different levels, as this categorization is both general and after-the-fact. However, we find this classification to be useful for the organization of the following results, specifically in relation to possible applications in design architectures for generative music creation systems.

6.1 Results: Micro-level

Most results concerning the micro-level causal relationships may be summarized in the following tables. Each table is concerned with the causal possibilities emerging from, or preceding, a particular sound. Note that typologies appear in all three pieces, though they are by no means exhaustive. The examples are labeled with the composers first and last initials (FD = Dhomont's *Novars*, JH = Harrison's *...et ainsi de suite...*, DS = Smalley's *Wind Chimes*).

6.1.1 Causal typologies

Table 1, below, contains causal relationships emerging from the attack-decay archetype, the most frequently occurring causal unit observed in our analysis. Generally, the attack-decay archetype led to striated sounds (such as a drone, chord, texture or sub-bass rumble), a directional gesture (a gesture with an emerging onset, which undergoes some directional movement - directional pitch or spatial motion are examples of this), or a temporal accumulation or de-accumulation of some kind (this may manifest as an *accelerando/ritardando*, or as accumulation/de-accumulation of texture). Other cases included causing a morphological, yet still recognizable, variation of the initial sound (for instance, reversing the sound or some form of spectromorphological shaping), or the causation of a mirrored relationship (for instance, call and response) in which the original sound becomes in dialogue with itself. Finally, the attack-decay archetype was often observed to be used as a catalyst for structural change within the work, usually through causing a movement to a different contextual sound identity or by concluding a phrase or section, leading to silence or a silencing of simultaneously occurring sounds.

Attack-decay archetype →	<i>Consequent state / sound unit</i>	Examples
	Drone	FD 00:19, 0:42 JH 02:50, 17:47 DS 00:00, 06:46
	Chord	FD 00:56, 06:20, 18:37 JH 4:50

		DS 00:08, 04:42
	Texture	FD 00:00, 01:32 JH 04:19, 14:20, 18:15 DS 00:10, 00:38, 01:05, 01:24, 04:16
	Sub-bass rumble	FD 00:01, 02:08, 05:57, JH 17:38 DS 00:25, 00:45, 08:35
	Directional gesture	FD 06:35, 13:20 JH 05:27, 05:36, 10:15, 12:25, 13:17 DS 03:34, 05:16, 09:26
	Accumulation/de-accumulation	FD 02:49, 03:49 JH 00:57, 13:47, 16:16 DS 00:17, 03:24, 07:10, 12:07
	Morphological variation	FD 04:07, 11:18 JH 00:08, 04:32, 04:42 DS 05:32, 07:45, 11:20
	Mirrored gestures	FD 03:50, 05:00, 09:55 JH 00:08, 00:47, 07:40 DS 03:12, 07:10
	Change to different contextual sound identity	FD 03:49, 14:11 JH 05:37, 09:09 DS 05:19, 05:38, 07:10
	Silence or silencing of other elements	FD 02:08, 06:55 JH 01:42, 04:55 DS 00:26, 02:52, 05:19

Table 1: micro-level typologies emerging from an attack-decay archetype.

Given the prominence and frequent use of the attack-decay archetype in the works analyzed, table 2 outlines causal relationships that would result in an attack-decay archetype. These often included gestures with an emergent onset, whether directional gestures – as defined previously – or non-directional swell gestures, defined primarily by their amplitude shape rather than any spectral or spatial teleology. Attack-decay archetypes were also often caused by the conclusion of accumulating or de-accumulating gestures, such as an accelerando or textural accumulation. Occasionally, attack-decay archetypes were causally related to preceding transient sounds, often as part of a quick flurry or a mirroring relationship. Finally, attack-decay archetypes were often used as the catalyst for a phrase; that is, they were preceded by silence.

<i>Preceding state / sound unit</i> →	Attack-decay archetype	Examples
Directional Gesture		FD 02:48, 13:08, 13:39, 13:55 JH 00:50, 05:37, 06:05, 10:28, 16:11 DS 03:34, 04:34, 05:17, 05:44, 08:03
Non-directional swell gesture		FD 01:18, 13:08, 14:12 JH 09:42, 10:33, 14:10 DS 04:49
Accumulation / de-accumulation		FD 03:20, 03:35, 08:10 JH 00:38, 00:58, 10:38 DS 00:21, 02:25, 02:47
Attack-decay archetype (mirroring relationship)		FD 03:57 JH 00:08, 00:36, 13:00 DS 02:05, 03:13
Silence		FD 00:00, 00:18, 05:57 JH 00:08, 00:48 DS 00:00, 04:49

Table 2: micro-level typologies resulting in an attack-decay archetype.

Directional gestures and non-directional swell gestures were commonly used as a continuation of a morphological string. Often emerging from an attack-decay archetype, they were frequently used as a pivot-sound which may lead to various sound or gesture types. The causal possibilities emerging from these sound types are listed in table 3, below.

Directional or non-directional swell gesture →	<i>Consequent state / sound unit</i>	Examples
	Attack-decay archetype	FD 12:16, 13:08, 13:45, 14:12 JH 09:42, 10:33, 14:10 DS 04:49, 05:17, 07:37, 11:32
	Accumulation / de-accumulation	FD 07:11, 07:17, 08:20 JH 10:37, 12:05, 15:40, 16:50 DS 04:49, 07:45, 07:54, 11:02, 12:06
	Striated sounds (drone / texture)	FD 01:24, 02:28, 18:47 JH 1:45, 03:16, 11:00, 14:17 DS 08:05, 13:47
	Complex morphological string	FD 04:09, 04:20, 04:44, 07:50 JH 06:46, 15:38 DS 04:49, 13:28
	Mirrored gestures	FD 04:40, 05:15

		JH 02:20, 06:35, 15:20 DS 08:45, 13:00
	Change to different contextual sound identity	FD 07:15, 09:47 JH 01:48, 11:00 DS 03:33, 05:19
	Silence / partial silence	FD 03:10, 04:09, 07:15, 08:35, 08:57 JH 02:39, 04:18, 12:05 DS 14:00, 14:20

Table 3: micro-level typologies emerging from a directional or swell gesture.

While the use of the accelerando rhythmic motif as a structural catalyst is detailed in Young 2004, we found that these examples were part of a broader causal category, which included ritardando, as well as changes of density within a gesture. However, the occurrence of these types of causal relationships were not nearly as frequently occurring as those discussed above. The examples of causal relationships emerging from an accumulating or de-accumulating gesture are detailed below.

Accumulation / de-accumulation →	Consequent state / sound unit	Examples
	Transient	FD 02:07, 03:23 JH 0:09, 00:53 DS 00:21, 02:50
	Stria	FD 03:39, 06:18, 06:30, 07:17 JH 00:19, 02:50, 07:45, 08:02 DS 07:20, 07:55, 10:10
	Texture	FD 05:10, 07:42 JH 00:19, 00:52, 05:28 DS 11:52, 12:20
	Mirroring	FD 04:35, 05:00 JH 0:34, 00:22 DS 02:40, 07:05, 10:45
	Change to different contextual sound identity	FD 05:25, 07:17 JH 00:39, 01:00 DS 00:26, 02:49, 05:32

Table 4: micro-level typologies resulting from an accumulation or de-accumulation within a gesture.

While striated elements were not found to be frequent catalysts for other sound types, several compositional developments of a striated element were observed. The most common involved an evolution of the striated element, generally in terms of an accumulation or de-accumulation of some sonic aspect. Occasionally, striated elements provided a starting point for directional gestures, but

most often they were observed to fade to the background, leading to a silence and conclusion of the phrase, section or work.

Striated element → (drone, chord, texture)	Consequent state / sound unit	Examples
	Accumulation / de-accumulation (of density, # of pitches, spectra, etc.)	FD 01:32, 03:05, 08:00 JH 03:19, 05:00, 10:20, 18:10 DS 00:40, 01:15, 06:47, 07:05, 09:45
	Directional gesture	FD 01:20, 02:49 JH 02:03, 02:28, 07:31 DS 03:58, 04:35, 04:59, 8:05
	Silence	FD 01:13, 03:40 JH 00:12, 11:24 DS 06:35, 14:50

Table 5: micro-level typologies emerging from a striated sound.

6.1.2 Mirroring relationships

All of the above sound types contain the possibility of developing musically into a mirroring relationship of some kind, a term briefly introduced above. The term “mirroring” is adapted in this context from Young and Bown (2009, discussing musical interactions with a computational system), and refers to a relationship between a source and result in which the “source is reflected in the result” (216). Several examples of mirroring include repetition, motivic development, and call and response – all of which may manifest using one sound type which develops a dialogue with itself, or different sound types which are in dialogue with one another.

In general, our analysis has suggested two major possibilities of musical development of a mirroring relationship. The first involves subtle development in the form of dialogue: for example, a movement from direct repetition to call and response. The second development of a mirroring relationship involves the accumulation of mirroring gestures into a texture, usually as a catalyst to a new compositional section with a distinctive character.

Mirroring relationship →	Consequent state / sound unit	Examples
	Dialogue	FD 00:12, 03:49, 06:38 JH 00:09, 00:35, 02:30 DS 01:18, 05:09
	Texture	FD 05:10, 07:45 JH 01:09, 05:20 DS 01:25, 02:54

Table 6: the development of mirroring relationships.

6.1.3 Implementation

Finally, the above tables may be combined to create a web architecture outlining the micro-level causal possibilities of a potential phrase (arrows indicate causal relationship). In this diagram, elements in blue represent actual sound types, while elements in green represent development

strategies of given sounds⁴. This type of architecture may be seen as a prototype for implementation in a generative or computer-assisted composition system, or as a means of imbuing fundamentals of gesture structure for the purposes of musical interaction with computational systems.

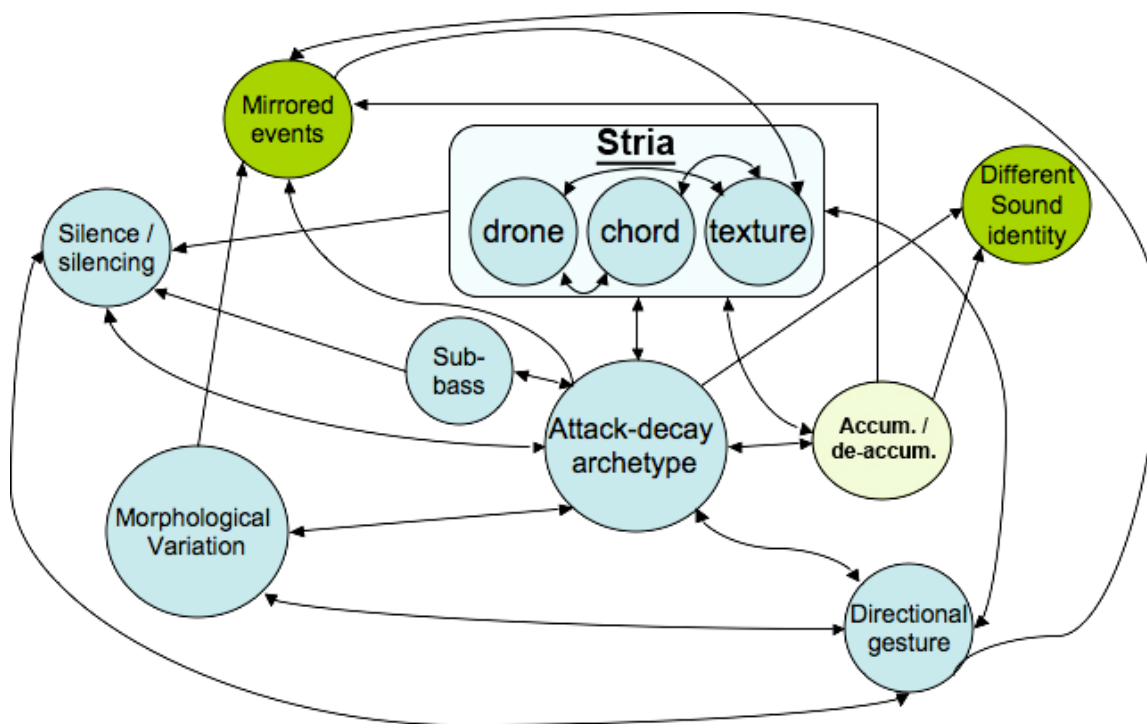


Diagram 1: suggested architecture for the creation of morphological strings.

6.2 Results: meso-level

The results of our analysis of the meso-level – that is, our analysis of interactions between gestures that are perceptually separate but temporally overlapping – reveal two significant models of gesture interaction. The main model will be referred to as the *foreground vs. background* model, while the second model – a subcategory of the foreground vs. background model, which exhibits enough unique characteristics and frequent compositional use – will be referred to as the *negotiating gestures* model.

6.2.1 Foreground vs. Background model

The following discussion will outline meso-level typologies by analyzing individual aspects of a given gesture: its layer type, make-up or composition, interaction or behaviour type, and goal or development strategy. Through this segmentation, we attempt to outline general typologies within which any given gesture could be classified. The results are summarized graphically in diagram 2.

⁴ The exception being the possibility of accumulation or de-accumulation, which could function as either a sound type (in the case of an *accelerando*) or a development strategy (in the case of an accumulation of density in a texture).

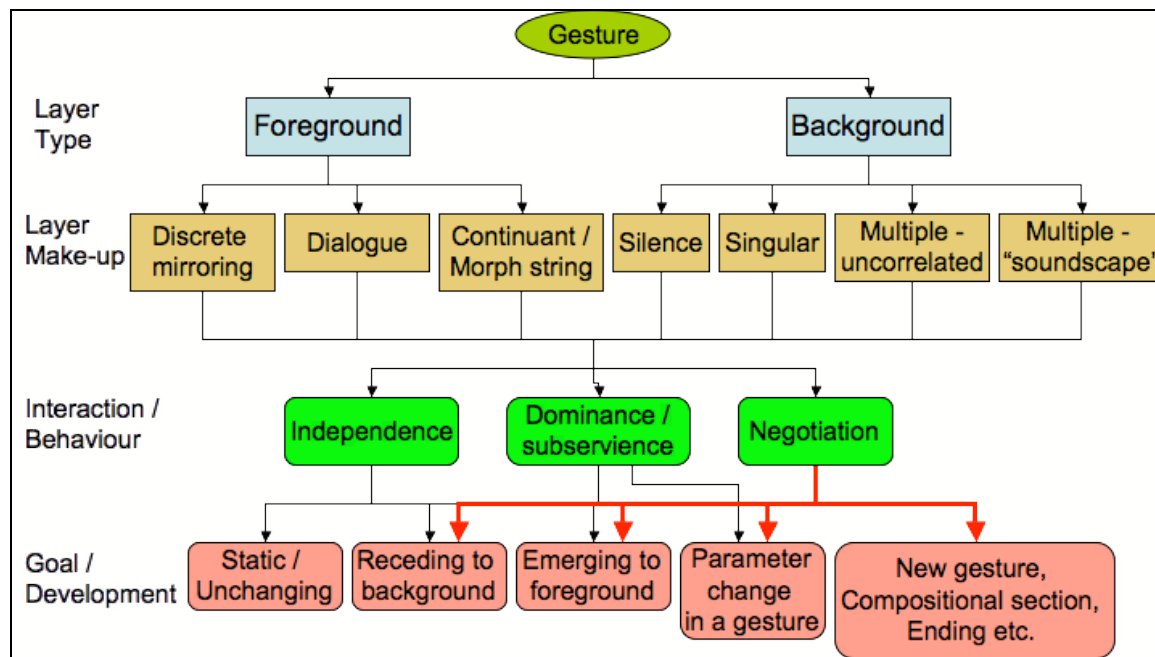


Diagram 2: graphic lay-out of meso-level typologies.

Layer type: In general, a gesture may be categorized as belonging to one of two layer types: the foreground or the background. Although this is a distinction between two extremes, which contain a continuum of intermediate possibilities, it is fair to say that this distinction would be the likely result of a comparison between any two individual gestures.

Layer make-up: Regardless of the layer type classification of the given gesture, the layer to which it belongs to must consist of a certain make-up or composition.

We observed that the construction of foreground layers exhibit one of the following compositional strategies: (1) *discrete mirroring* (that is, mirroring relationship based on a single sound type), (2) *dialogue* (that is, a mirroring relationship between two or more distinct sound types), or (3) a developing, potentially complex phrase, such as a *morphological string*.

On the other hand, the possible construction of the background layer will exhibit one of the following compositional structuring principles: the background layer may be (1) *absent or silent*, constituted of a (2) *singular element* (ie. a single drone), or (3) *multiple uncorrelated elements* (ie. a texture and an uncorrelated drone, in that they exhibit independent and potentially competing behaviors). Alternately, the background layer may consist of (4) *multiple correlated elements* (also referred to as the *multiple “soundscape”* typology, in which multiple elements occupy distinct niches and behave symbiotically, creating the impression of a unified, singular layer)⁵.

Behaviour or interaction type: Regardless of the compositing elements of the layer in which the gesture may be classified, the individual gesture or the entire layer must behave or interact with other co-existing gestures and layers in a certain manner. We suggest three types of behaviour or interaction types: (1) *independence* (in which a gesture behaves independently from other gestures or layers), or (2) *dominance/subservience* (that is, the gesture or its spectromorphology is either causal or subservient). The final behavior type, (3) *negotiation*, which will be expanded on in section 6.2.2, may

⁵ Examples of this can be heard clearly in sections of Harrison’s *...et ainsi de suite...* (6:20, for example), as well as the latter half of Smalley’s *Wind Chimes* (for instance, at 9:00).

be briefly summarized as a mutual, potentially equal interaction type which always leads to a compositional goal.

Goal or development strategy: Each of the three behaviour or interaction types suggested can be thought to have a certain goal; a teleology, or a manner in which it may develop from a compositional standpoint. These goals or development typologies are general and are often shared between different interaction types.

In the case of an independent or dominant/subservient behaviour typologies, there may be an (1) *absence of development* (i.e. the temporary goal is stasis), or the gesture may (2) *recede further into the background* or (3) *emerge further into the foreground* in relation to other layers and gestures.

An additional possibility for development of either the independent or dominant/subservient behaviour types may involve a *variation of a sound parameter*. This could manifest either as a variation of a sound parameter of the given gesture itself or a parameter of a gesture with which it is interacting (i.e. the changing of the grain size parameter of a subservient background texture as a result of a dominant foreground event).

Negotiation, which will be discussed in detail in section 6.2.2, may share some of the above goals or development strategies, but it is the only behaviour type whose goal may include a new gesture, compositional section, or any other major compositional change.

6.2.2 Negotiating gestures

As previously mentioned, the negotiating gestures behaviour typology, while a subcategory of the *foreground vs. background* gesture interaction model, exhibits enough unique characteristics and compositional potential to warrant a closer examination and be considered a second model of gestural interaction on the meso-level.

The term *negotiation* is again adapted from Young and Bown (2009), who refer to it as a bidirectional relationship between agents which strive towards a common goal. While in our case we refer to a relationship between gestures (instead of agents), thinking of individual gestures in terms of their agency and teleology is commonplace in compositional practice; it is how internal motion is established within a musical work. Therefore, we can adapt the term negotiation to suggest a bidirectional relationship between individual gestures, which mediates or leads to a common sonic or compositional goal.

We have observed four types of negotiation between gestures, which can be divided into two major categories, as seen in diagram 3.

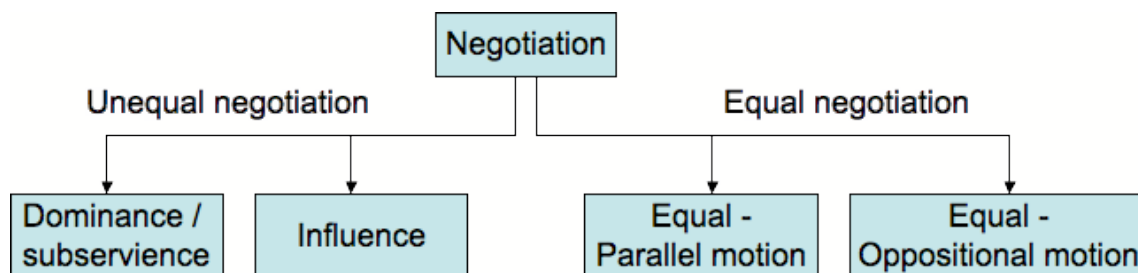


Diagram 3: the four types of gesture negotiation.

The first, unequal negotiation, contains the *dominance / subservience* negotiation typology – where one gesture dominates another towards a goal – and the *influence* typology, which is considered a milder form of dominance. In both these typologies, the negotiation is somewhat one-sided, with one gesture leading towards the common goal, although the subservient gesture still “participates” in the move. These typologies are commonly used in transitions between sections when a single foreground

gesture is negotiating with one or several relative background gestures (examples can be heard in ...*et ainsi de suite*... between 3:49 and 4:19).

The second category of negotiation, equal negotiation, contains two typologies: *equal - parallel motion*, and *equal - oppositional motion*. In both typologies, the participating gestures exhibit an equality in terms of the strength of their movement towards the new goal and their influence on one another.

When equal negotiation with parallel motion occurs, gestures exhibit mutual influence on one another while exhibiting some form of analogous sonic development. A common example of this typology can be heard as foreground and background layers “fade out” simultaneously (such as in *Wind Chimes*, between 6:10 and 6:25), leading to the end of a section or work, or when different gestures modify their spectral content in a parallel direction: an upwards glissando, for example, leading listeners focus to a new spectral niche. It is this type of negotiation that is most similar to the musical term *heterophony*, as exhibited in gamelan music when tempi fluctuation lead to the reiteration of the gong, or the equality of gestures that seem to lead into a new compositional section which can be found in the early music of Pierre Boulez.

On the other hand, when equal negotiation with oppositional movement occurs, participating gestures exhibit mutual and equal negotiation towards a goal, but exhibit oppositional motion of sonic development. For example, one gesture may begin to accelerate while the other de-accelerates, synching up to an attack-decay archetype or leading to a single drone (such as in *Wind Chimes*, between 7:10 and 7:30). Another example, perhaps unique to acousmatic music, involves the progressive bifurcation of a spectral node into a canopy and sub-bass rumble. In both cases, each gesture’s development is equal in its degree of agency leading towards the mutual goal, while the sonic means of arriving at these goals is oppositional.

6.3 Results: macro-level

The macro-level typological database, which considers the temporal evolution of both the micro and meso levels, is predictably the most complex to analyze. However, our research has led to some preliminary results on this front, suggesting possibilities for macro-level typologies, as well as confirming the relevance of micro and meso level analysis to the understanding of macro-level structures. Although it is clear that future work in this area is necessary, we will illustrate our preliminary results through a case-study examination of the first section of Dhomont’s *Novars*.

6.3.1 Case study: first section of Novars

The first section of *Novars* (0:00 to 3:45) revolves around the announcement, repetition and motivic development of the first phrase of the work (0:00 to 0:17). Beginning with the micro-level typological analysis, this phrase may be represented graphically and analyzed as seen in diagram 4, with elements in red representing causal sound units in the foreground, elements in blue representing subservient sound units in the background, and striped-gray elements representing mirrored sound units in the med-ground, which are potentially causal or subservient.

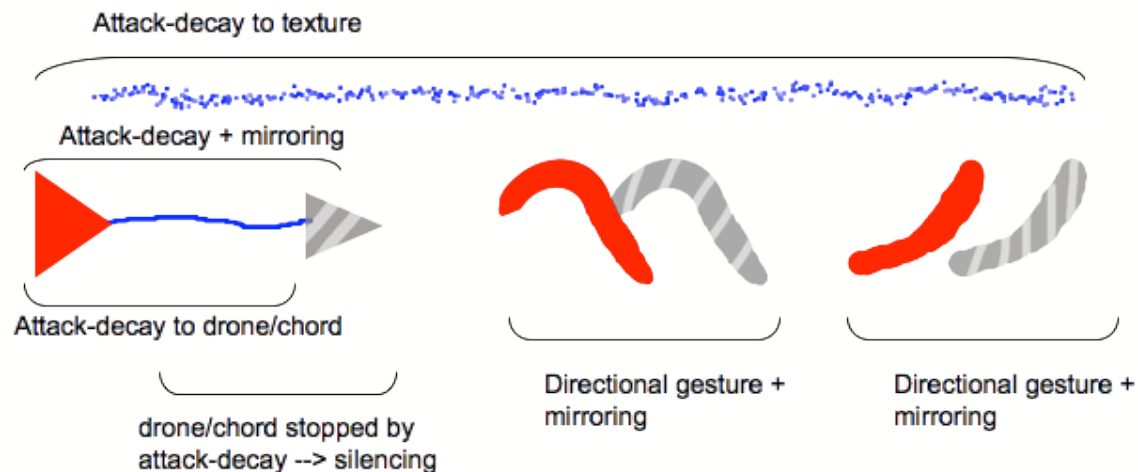


Diagram 4: graphic representation and micro-level typological analysis of first phrase of *Novars* (0:00-0:17).

This phrase also contains a meso-level typology, a parameter change in the consistent texture (namely, a thinning of the texture's spectra as well as a reduction in loudness) due to a dominant/subservient relationship between co-existing gestures: specifically, the dominant mirrored-version of the opening attack-decay archetype and the subservient texture. This meso-level typology is shown in diagram 5 below.

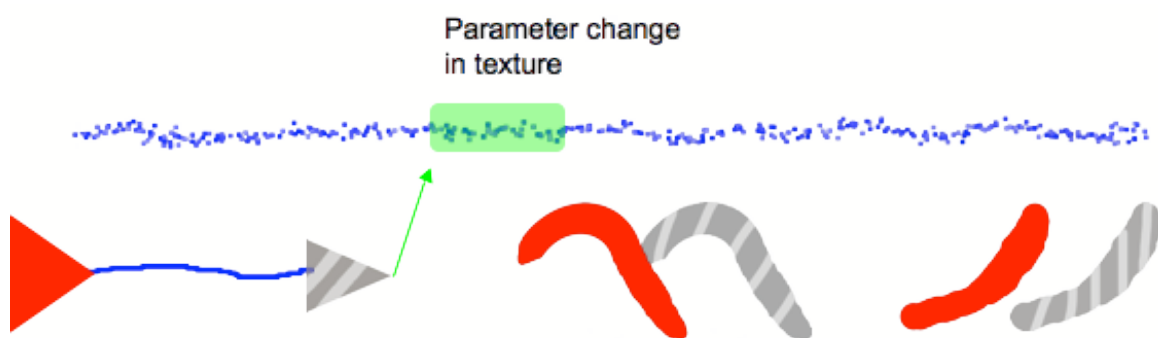


Diagram 5: graphic representation and meso-level typological analysis of first phrase of *Novars* (0:00-0:17).

The combination of the micro and meso level analyses outlined above may be regarded as a formula for each iteration of the phrase re-visited by Dhomont throughout the first section of *Novars*, accounting for most sonic occurrences in the first section⁶. The temporal evolution of this formula of micro and meso level typologies can be tracked in the following macro-level analysis, represented graphically in diagram 6.

In terms of the temporal evolution of the micro-level typologies, although the causal typologies introduced in the first phrase do not vary throughout the first section (for instance, the attack-decay archetype always causes a drone/chord), a gradual increase in the complexity of each sound unit used can be observed. Several examples include the increase in complexity of pitched elements (evolving from one drone to a dyad, and eventually three and four part chords), as well as the increase of complexity in terms of the processing of the attack-decay archetypes (increasing use of texturization using amplitude modulation, as well as sharp, "unnatural" transpositions of spectral regions).

⁶ The phrase is revisited 6 times, and portions of the phrase – functioning as a deceptive cadence – appear several times.

Furthermore, although the texture varies in grain shape, grain transposition range and grain density in response to causal elements, these variations increase in frequency and range as the section progresses. Therefore, we can summarize that a gradual increase in complexity in the micro-level occurs over time, and that each iteration of the original phrase is subjected to this increase of complexity⁷.

In terms of temporal evolution of the meso-level typologies, we have observed a change in the relationships between foreground and background layers. While at the beginning of the section, the texture is clearly a *background layer* (within a *multiple-uncorrelated* layer make-up) interacting within a *subservient* relationship with foreground elements (such as the attack-decay archetypes), it increases in independence by 2:30, slowly inching its way to the foreground; it occupies a larger spectral niche and increases in loudness, and stops exhibiting the subservient behaviour type. The causal elements, in turn, begin to recede into the med-ground as the texture begins to dominate the sonic foreground.

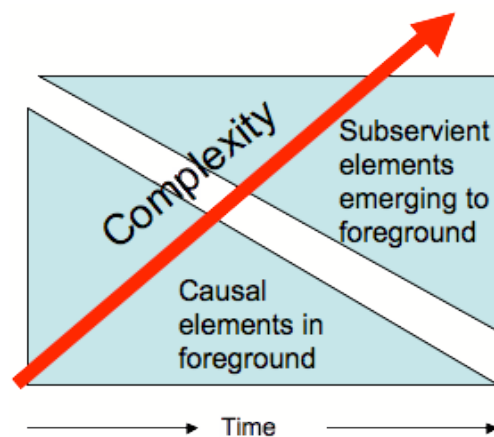


Diagram 6: graphic representation of macro-level development in the first section of *Novars* (0:00 to 3:45)

Although admittedly simplistic, the above diagram can be considered a macro-level typological model, tracing the temporal evolution of both the micro and meso levels. Furthermore, the structural reduction implicit in this typological approach – note the lack of description of specific materials or micro-level typologies – may be applied within the context of a new creation or generative system. Despite the fact that in this new context, different micro and meso level typologies as well as different sound materials may be used, the structural and compositional cohesion of the above model will remain.

7. Future work and implementation

In terms of future work, we envision the continuation of our research on two fronts: continued analysis and generative implementation.

On the analysis front, while we feel that the micro and meso level typological analysis has yielded detailed and useful results, analysis of the macro level has been preliminary and begs further inquiry. Application of this analysis to the other works chosen would serve to enlarge the typological database as well as evaluate its usefulness as a general tool applied to different compositional aesthetics. An additional area of interest would include a study of the relationships between adjacent macro-level typologies; for instance, the mapping of macro-level relationships between the first and second sections of Dhomont's *Novars*.

⁷ The additions of deceptive cadences, discussed previously, also add to the increase in complexity as predictability decreases.

However, beyond continued analysis, we feel that our research would benefit from testing using an experimental methodology; namely, generative music creation. Through the incorporation of the results of our analysis within an architecture for generative music creation and the subsequent appraisal of the musical results, we may evaluate the strengths and weaknesses of our study and refine aspects of it which are found lacking.

Furthermore, an application of our analysis within a generative music system allows a transition in focus from *modeling by observation* to *modeling by experimentation*. While the initial reliance of our typological databases on canonical works of acousmatic music served to ground our results in “successful” examples of gesture interaction strategies, new typological models, their rates of occurrence as well as their modes of development may be controlled by user input, resulting in the creation of new works. In particular, the implementation of micro and meso level typological databases within the context of interaction (using gestural controllers) with a generative computational system – using metadata tagging of sounds and self organizing maps for classification of timbral similarity (Eigenfeldt and Pasquier 2010) – seems a feasible first step in this direction.

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