HATTEN’S THEORY OF MUSICAL GESTURE

AN APPLIED LOGICO-DEDUCTIVE ANALYSIS OF MOZART’S FLUTE QUARTET IN D, K.285

by

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This study investigates the possibility of applying Hatten's theory of musical gesture to a formal system of musical analysis. Using historical antecedents and established musicological practice as a guide, a range of musical parameters in a motive length span of music are incorporated into a single gesture. This gesture forms the basic semantic unit upon which an analytical tableau structure is built, and a syntax is developed to allow derivations of new gestures; a large scale structure displaying fractal-like self-similarity is then proposed. The completed system is applied to the analysis of the ‘Adagio’ of Mozart’s Flute Quartet K.285 to test whether it can consistently be implemented and whether it produces falsifiable results while maintaining predictive power. It is found that these requirements are indeed met and that a set of inference rules can be derived suggesting that the proposed system has ample scope for further development.
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KEY TERMS:

MUSICAL ANALYSIS; MUSICAL GESTURE; MOZART; HATTEN;
ANALYTICAL TABLEAUX; MUSICAL MEANING; MUSICAL PARAMETERS; FORMAL SYSTEM; AURAL SONOLOGY; GRAPHICAL NOTATION; FRACTAL GEOMETRY; LOGIC
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Chapter 1
Introduction

1.1 Preface

"The result of our human outlook is the interweaving of apparent order with apparent accident. The order appears as necessity suffused with accident, the accident appears as accident suffused with necessity. The necessity is, in a sense, static, but it is the static form of functional process. The process is what it is by reason of its form, and the form exists as the essence of process." (Whitehead 1936:186)

When we listen to a piece of music, even one which we have not heard before, it can often be observed that it ‘sounds right’ or ‘makes sense’. Is there a way to codify this sense of correctness that accompanies listening, or is it a purely subjective phenomenon with no discernable pattern?

The problem of meaning and logic in music is a vexed one with fairly entrenched views on either side of the debate. The nature of this dissertation forces me to enter the debate, but although I will broach the topic I cannot hope to settle the matter in such a short space. Nevertheless, I believe that a robust defence of the case for logic and meaning in music is essential for the present topic. This is especially true given that simply providing a formally descriptive system of the musical surface could be accused of being a trivial and irrelevant undertaking without showing a connection to phenomenal understanding of music.

I will not try here to prove any particular system as an absolute answer to all questions, but rather show that it is possible to construct a system with which we can test various ideas about what is logical in music.

1.2 General Introduction

The broad aim of this dissertation is to apply Hatten’s theory of musical gestures, as expounded in his book *Interpreting Musical Gestures, Topics and Tropes* (2004), to a logico-deductive analysis of the second movement of Mozart’s Flute Quartet in D Major KV 285 using existing analytical tools as models.
1.3 Hypothesis and Objectives

Following from Diana Raffman’s (1988:690-691) claim that music has a syntax i.e. ‘...a rule driven system of discrete and repeatable elements type-identifiable exclusively by physical shape’ I will attempt to prove the hypothesis that:

*It is possible to use the concept of gesture as an elemental unit in a logical system for musical analysis.*

The hypothesis will be taken as proven if and only if I can:

1) Develop a formal analytical system to analyse music using gestures as basic elements (See Appendix A).

2) Show that we can make both predictive and falsifiable (i.e. able to be proven false) claims about musical gestures using such a system.

**Table 1. Conditions for accepting the hypothesis**

In the course of the dissertation I will address four specific secondary objectives pertaining to such a treatment of music:

1) Show that it is reasonable to assume that music has meaning of any kind, and more specifically a meaning which can be abstracted from the apparent musical surface.

2) Show that some problems in musical analysis may be solved by assuming that music has meaning, or that meaning is a useful assumption for the analyst to make.

3) Investigate Hatten’s interpretation of how gestures capture and communicate musical meaning, in relation to and in conjunction with ideas put forth by other authors.

4) Show that it is possible to adapt existing musical and logical analytical tools to gestural analysis.

**Table 2. The secondary objectives**
1.4 Logic and Meaning in Music

In his article entitled ‘Mind: The Gap’ from the book Selected Theories of Music Expression (1996:73-96) Fiske argues that musical notes do not have any meaning apart from ‘music noise’ (ibid.:84). This view is not uncommon and echoes the opinions of authors such as Davies (1994), citing Hermerén and Kivy; and Mithen (2005:18), who says: ‘Middle C is middle C and nothing else: it has no referent; it is not a symbol’. An in-depth discussion of the historical aspect of this argument, including Stravinsky’s famous statement to this effect, can be found in Deryck Cooke’s book The Language of Music (1959).

Fiske (1996:85) uses this assertion to argue that music exerts no compulsion upon the composer to do one thing rather than another. He concludes therefore that ‘...logical forms have nothing to do with musical composition and thus nothing to do with music cognition.’ (ibid.:85) Somewhat later in the passage he uses the terms ‘alogical’ and ‘invalid’ (ibid.:86) to show that music has such a non-logical nature.

This line of reasoning is highly problematic because of the nature of logic itself. It should, firstly, be noted that logic is not to be confused with the formal system of first order symbolic logic; they are related but not identical. If Fiske’s intention is to show that music is not first order logic he is indeed justified, but that is a very narrow conclusion, given that first order logic is but one instance of a far larger class of formal logics. An interesting discussion on the origin of this conception of the meaning of the term ‘logic’ can be found in José Ferreirós’ article ‘The Road to Modern Logic-An Interpretation’ (2001:441-484). Fiske’s apparent acceptance of natural language as logical, as opposed to music’s alogicality (1996:83-84), seems to argue against this interpretation though.

If, however, logic is taken to mean ‘...the compulsion of a thing...’, according to one definition in The Concise Oxford Dictionary (Allen:1990), as Fiske indeed seems to do (1996:85), it is difficult to see how anything can be classified as alogical: A random set of events is externally compelled to not follow any order and, conversely, a non-random set of events is internally compelled to follow an order by definition. So, whether music is random or non-random it must be logical, and since everything must be either random or non-random it does not appear that the term alogical has any merit to begin with. Fiske in fact makes it
clear (1996: 83) that he does not believe music to be random, or in fact illogical, but specifically alogical.

What Fiske suggests is that an argument of the form “If X, then Y; X; Therefore Y” cannot be applied to music, arguing that there is nothing to compel a composer to follow such a form (ibid.: 85). This is of course correct, but does not speak to the logicality of the music since there is no logical compulsion to believe “If X then Y” either: Any particular causal arrangement is contingent on the beliefs it represents. The correct compulsion is to believe “If (If X then Y) and X then Y”, which is a form a composer is compelled to follow in music as much as in any other sphere. What Fiske seems to be arguing is that even though the music can be interpreted logically, the fact that it is not renders it alogical. The argument thus appears to be circular: He is saying that music is alogical because it is not interpreted logically.

To see why this is problematic, imagine a piece of music written in such a way as to deliberately follow each musical event X with a musical event Y. In this case we have artificially stipulated that these events are musical and we can further stipulate that they be interpreted as such, at the same time we have stipulated that the music follows a particular logical sequence. If we discover this logical sequence ex post facto do we have to stop considering the music as music in order to consider it as logical? Surely we have here an instance of something which is both musical and logical at the same time. For Fiske to be correct the conception of music must be a wholly separate and exclusive conception from the conception of logic.

Let us take another piece of music where the composer for each instance of a particular musical event (e.g. the note ‘A’) follows that event with another musical event (e.g. the note ‘B’). Again we stipulate that the music be intended and interpreted as music. However this time the final instance of ‘A’ is followed by something other than ‘B’ (e.g. the note ‘C’). Now suppose that the composer intended this relation (“If ‘A’ then ‘B’”) to exist and the listener consciously or sub-consciously comes to expect an ‘A’ to be followed by a ‘B’ and then reacts with shock when the apparently illogical ‘C’ is heard. (a version of C.S. Pierce and John Dewey’s argument, see Spearshott and Cumming 2009).

How should one categorise this reaction? Is the listener responding to the ‘C’ as a musical event or a logical event? Would the listener have been shocked if s/he had not been
expecting ‘C’ and is that expectation not derived from the purported logical sequence suggested by the composer? Clearly the musical affect is intimately related in this case to the logical effect. An argument along similar lines is invoked by Robert Yanal (2006:262-263), albeit with a slightly different aim.

Thus far my defence of the logicality of music appears to have led us to a strong form of Leonard B. Meyer’s expectation theory as he developed it most notably in Explaining Music (Meyer 1973). For Meyer, the meaning of an event is related to the expectation aroused by it (Spearshott and Cumming 2009) but he did not extend his ideas explicitly to the logicality of music, thus conflating meaning and logic. Fiske in fact deals with an argument of similar form in the chapter “Meyer’s theory of music expectancy” from another article in the same book (Fiske 1996: 106-120) and his refutations are quite effective, but they revolve around a cultural definition of meaning in relation to information theory (Fiske 1996: 113-114), a definition which I do not adopt.

The notion of meaning that I do adopt is closer to Ludwig Wittgenstein’s version of the same argument (Pojman 2003:1150-1151). According to him, meaning is a game played by two participants who try to guess one another’s intention in communicating and ascribe intention to apparent patterns (which includes musical patterns as well as speech patterns). Drawing on the above example, the composer of our hypothetical music may have meant to draw the listener’s attention to the particular section by inserting an illogical ‘C’ rather than the expected ‘B’. The listener may correctly or incorrectly deduce that this oddity indicates that the composer is trying to tell him/her something, maybe that the piece is coming to an end. Importantly, the listener need not be correct and the ‘C’ may have simply been an error by the performer but the listener nevertheless ascribed meaning to the event. Meaning can therefore be described as the ascription of intention to pattern, or to express it in terms of semiology: Meaning resides in the connotation of a symbol. Another formulation would be: Intension is present if and only if intention is ascribed. According to Barthes “denotation is not the first meaning, but pretends to be so; under this illusion, it is ultimately no more than the last of the connotations” (Barthes 1974). Denotation then is that special case of intension where intention is ascribed to the use of a symbol rather than to the symbol as an abstract entity, i.e. what an author means by using a word, rather than what the word means (see Chandler 2008).
While a disciplined approach may result in a hearing of a succession of musical events as being thoroughly unrelated and any perceived musical pattern as being completely unintentional and devoid of any connotation, it is hard to see how this mode of listening can be the usual or even a common occurrence. Human beings, after all, are pattern generating machines, famously attributing patterns and causality to random or unrelated sequences of events, and wrongly attributing randomness to sequences of events with no perceivable pattern. This phenomenon was termed ‘apophenia’ by K. Conrad in 1958 (Brugger 2001) but it was known well before, as can be seen by how often the post hoc ergo propter hoc fallacy has been invoked in argument through the ages. Indeed, a growing body of research indicates that this kind of pattern finding phenomenon is critical to human decision making, through the action of the dopamine system, and therefore a central feature of the human psyche (e.g. Lehrer 2010).

The fact that pattern is so readily ascribed even when no consistent pattern is present suggests that not sensing patterns is something which can be, through great effort, acquired as a skill rather than being a normal mode of understanding. Similarly human beings readily and consistently ascribe intention to things and patterns of events even when they are fully aware that no intention is possible. Insofar as understanding music is a normal mode of understanding then, it would quite naturally involve ascription of meaning through assumed intentionality of perceived patterns.

The second part of Fiske’s argument revolves around the contention that the alogicality of music stems from the fact that it refers to nothing outside of itself “...music noise is about other music noise.” (author’s italics, Fiske 1996:83-84) The problem here is that, strictly speaking, logical symbols are also about nothing other than other logical symbols. When we translate a statement such as “there is a cat in the tree” into the language of symbolic logic it becomes a simple symbol: let us use ‘A’. Now this symbol cannot be said to symbolise “there is a cat in a tree”; if it were to symbolise anything at all it can only be a statement. Crucially, that statement must not be any particular statement, in fact the statement is just ‘A’, it is a statement of a statement. Of course ‘A’ continues to refer to the feline in the mind of the person doing the logic, but it ceases to be of consequence in the operation of logic and does not have any further bearing in that
mode of thought. The information is lost and irrelevant from a purely logical perspective.

Perhaps Wittgenstein again captures the idea best with proposition 2.0233 from his *Tractatus Logico-Philosophicus*: “If two objects have the same logical form, apart from their external properties, the only distinction between them is that they are different.” (Wittgenstein 2003: 1153). The notion is also supported by Ayer in the preface to his *Language, Truth and Logic*: “…the a priori propositions of logic…cannot be confuted [because] they do not make any assertions about the empirical world, but simply record our determination to use symbols in a certain fashion.” [my italics] (Ayer 2003:1226). If we were to accept Fiske’s position on music then, we would be forced into the position of having to accept that logic itself is alogical, which is absurd.

Conversely it may be argued that music is alogical precisely because it refers to something. Herein lies some grain of truth: musical events, as we have seen, are not the same thing as logical symbols in that they refer to other musical events and hence are not logical events. This position strikes me as an extremely strong one though, because it leaves us in the position of also calling language alogical, a position which Fiske does not take up. In fact the statement used by Fiske “If X then Y” does not express what the linguistic relationship, which looks and sounds exactly the same does. In logic, it only expresses a relationship between the truth states of X and Y, a relationship which (contrary to the linguistic conditional) is true whenever X is false. Unless one is prepared to argue for a strict mutually exclusive relationship between connotation and denotation, I cannot see this argument as having any validity.

In other words, logic is a special case of meaning where nothing is denoted and language is the special case where anything can be denoted (while being tightly bound to cultural influences). Music then can be defined as a form of communication where denotation is self-referential (i.e. a musical idea denotes only itself). This recursive character is very important and will be discussed further in later chapters. This working definition has three further important features: 1) It makes no mention of sound, the musical conception being defined as a purely mental construct which may or may not be audibly reified; 2) It allows for multiple simultaneous interpretations of the same symbol, resolving the dichotomy between logical thought and musical thought; and 3) It
allows elemental ideas to mean anything (i.e. they do not restrict connotation).

Having shown that music cannot be alogical, by *reductio ad absurdum*, it is necessary that it is logical. Furthermore, since logic can be formalised it is reasonable to suppose that music, being logical, can also be formalised. But if logic is taken to be the compulsion of a thing, as per our earlier definition, what is it in music that is compelled? What should be the elements of musical syllogism? Clearly there must be some ascribed quality which we are logically compelled to believe when we believe something about some other ascribed qualities.

The candidates for the role of this ascribed quality in music are manifold. If one were to simply treat each musical idea as a logical statement and then proceed to read the music as if it were a logical argument of some sort it would most likely end up reading as nothing more than a succession of unrelated statements, a little like trying to understand Shakespeare by finding the ratio between the instances of the letter ‘e’ and the letter ‘d’ in the text. If, however we use a pattern of notes (by analogy to a word being a pattern of letters) we can abstract a range of standardised patterns which will constitute the required quality and which can consistently be applied to all forms of music and yet have some claim to being meaningful in the sense of revealing or having ascribed to it an intention to communicate. This is the basic conceptualisation of a gesture.

Gestures are indeed often ascribed to music not only through dance and a conductor’s movements, but also by trained and untrained listeners asked to ‘draw’ music, as demonstrated by Tan and Kelly (2004:196) and by philosophers of music dating back at least as far as Hanslick’s ‘Tönend bewegte Formen’ according to Kühl (2009).

This last concept, one of music as a shaped pattern, is adopted by Hatten in his *Interpreting Musical Gestures, Topics and Tropes* (2004). A gesture, then, is the act of one set of musical events (i.e. events with no outside denotation) being considered in relation to another set of musical events.
Chapter 2

Musical gesture, as defined by Hatten

2.1 Introduction

Even though the term gesture has started to become quite widely used in the musical literature of late, there is still no generally accepted consensus definition for it. One author who has devoted considerable effort to the gestural interpretation of music is Robert Hatten, who in his Interpreting Musical Gestures, Topics and Tropes (2004:93-96) gives us a very broad and comprehensive definition consisting of twelve points which I will use as a foundation for understanding precisely what gestures may be.

The definition may be divided into three parts dealing respectively with the issues of discovery, the nature of, and the meaning of gestures. The points, in a reduced and paraphrased form, are given in table 3 below. It is important to note however that the goal is not simply to discuss Hatten’s gestures, but to develop them into a form that is useable in the course of proving the hypothesis.

2.2 Issues of Discovery

In this section Hatten establishes gestures as an abstraction from musical phenomenon in general, including the sound produced, the score from which they are produced and the actions performed by producing it. Presumably one could, without harming Hatten’s central thesis, add in other elements of the musical phenomenon, such as the theatre of the performance itself, including the expectations of the listeners and the attitude of the ticket salesperson, as Small does in Musicking (1998); this is an important concept which will be further developed in Chapter 3.3. In any event, once the act of abstraction has taken place information loss has occurred, meaning that we cannot recover the original object of analysis from the list of gestures produced by the analysis. In this respect gestures are like any analytical tool, from notation itself through Riemann’s functional harmonic symbols to Schenkerian graphs, and as such we must answer some fundamental questions raised about analysis before proceeding.
1. Gestures are not the actions used to generate sound; rather, they are the meaningful shaping of sounds.
2. Gestures communicate on a separate level of meaning from the notated score; their meaning cannot be found in the notation.
3. ‘Gestures may be inferred from the musical notation...’ By reading the notation sensitively we may infer which gesture was intended by a composer.
4. A listener can infer the intended gesture with access to only the sounds produced by a performer.
5. This point is basically a restatement of points 2, 3 and 4: ‘Gestures may be comprised of any of the elements of music, although they are not reducible to them...’

6. Two defining characteristics are given here: gestures are units of the ‘perceptual present’, which may be thought of as around two seconds [this rule is a contingent one, which may be related to the limits of short term memory; as such it should be regarded as an indication of the order of magnitude, rather than a stopwatch timing-ed. see Hatten 2004:101]; and gestures are built around ‘nuclear points of emphasis’.
7. Gestures provide continuity, even when there is none in the musical sound.
8. ‘Gestures may be hierarchically organised, in that larger gestures can be comprised of smaller ones’.

9. Gestures are motivic in nature and may serve thematic functions.
10. ‘Gestures may encompass, and help express, rhetorical action...’ and so relate to extra-musical movement or even verbal dialogue, without being linguistic in themselves.
11. Gestures may point to, or refer to other gestures in order to draw attention to a significant part of the music.
12. Gestures ‘...reveal the intentions and modalities of emotion and action...’

Table 3. Hatten’s twelve points
In an article called ‘The paradox of musical analysis’ (1999) Mark DeBellis outlines the first problem: If analysis is more meaningful or insightful than the original subject, is that additional meaning not attributable to the analysis itself and a product of the analyst’s mind rather than that of the musician? My answer to this is in the affirmative, the analyst is indeed superimposing his interpretation, as represented by the abstraction of gestures and must do so because of the different role that this kind of analysis plays to the normal, notational variety (i.e. we are not analysing anything that can normally be notated or abstracted directly from normal notation). When a piece of music is notated, the aim of the composer is first and foremost to stipulate the physical character of the music (i.e. the specific sounds s/he wishes to use) but the thing which s/he ultimately wishes to express are the gestures produced by the sounds. This creates a problem, because stipulating the gestures precisely as logical objects would leave us with no specific details about the actual work we are performing (see Chapter 1.4) while stipulating the work precisely does not inform us of the gestures to be used (i.e. it would be a direct copy of the directly apparent qualities of the work). The solution is to notate the ‘sound’ as accurately as possible while leaving the interpretation up to the knowledge and stylistic skills of the performer. The act of analysis is therefore an integral part of every step of the musical process from the composer to the performer to the listener, and the task of the analyst is to select an abstraction s/he can reasonably expect each of those participants to have formed themselves. It is fair to say, therefore, that the notation and product of performance (sounds) are symbolic of the music itself as represented by gestures.

But how then can we justify using one interpretation instead of another? This is basically the question raised by Kofi Agawu in ‘The Challenge of Semiotics’ (2000:138-160). Agawu effectively nullifies the notion of correct interpretation by pointing out that the number of ‘taxonomic-empirical’ rules which may be applied to a given musical extract are, in fact, infinite and because of this we cannot justify using any one rule, or indeed any set of rules as a basis. Here I must concede the point: A listener may use the quality of his breakfast to decide which gesture the performer was expressing, a performer can fluff a note and in so doing alter the meaning of an entire movement, while a composer may simply have glossed over a section without thinking of any particular interpretation, or his handwriting may have been misread by a
careless editor. It is for this reason that the analyst must assume a set of gestures, justified by the score or performance, of course, and start his or her analysis from that point. Gestures are therefore axiomatic parts of the analysis which may nevertheless be loosely derivable.

If these strictures are admitted, though, we are faced with the further problem identified by Nicholas Cook in ‘Analysing Performance and Performing Analysis’ (2000:239-261): If musical analysis is to have any function at all, it must in some sense be prescriptive, or suggest one performance over another. Does this mean that an analyst can tell a composer what to write, or select good performance over bad ones by checking for compliance with his or her decisions? Can an analyst tell a listener what should be heard when the music is heard ‘correctly’? Certainly, given the above objections, such a prescriptive approach cannot be justified. What role remains for the analyst then?

My answer to this is to suggest analysis as a study of the decisions involved in music making and perception. Put another way, if the composer decides which gestures to symbolise with notation, the performer decides which set of gestures to implement and the listener decides the gestures which are heard, the analyst can analyse the way that gestures interact with one another, whether they are used in the same way by different role players or whether interpretations follow any discoverable rule, all without fear of infringing on the domains of the other role players. This is similar to the way that a philosopher will deal with logic, saying, ‘Apples are fruit and fruit are tasty, therefore apples are tasty’ does not inform us of anything more than the statement is saying. It does not compel a speaker to make this particular inference or even to agree with its components, but by studying statements of this form we can come to know the syllogism, a particularly useful piece of information about the nature of knowledge itself. According to Frege: “To discover truths is the task of all sciences; it falls to logic to discern the laws of being true” (in Ferreirós 2001:450). The task of gestural analysis is then not to discover gestures, but to discover the laws of being a gesture.

Thus the notated score is a symbolic representation of the gestures of music and the specific gestures used are treated as axioms for the study of gestures and their interrelationship.
2.3 The Nature of Analytical Gestures

In this section Hatten makes several points, each of which stipulates key requirements for creating a system for analysing with gestures. The first of these points is the statement that gestures are found ‘in the perceptual present’. When analysing music there are many possible starting points which may be used: we can start at the level of wave forms, as does Alexander Truslit in ‘Gestaltung und Bewegung in der Musik’ of 1938 (in Repp 1993:48-72, see Fig. 2); at the level of notes themselves, as does any analysis which is based primarily on notation; at the level of motifs, half phrases, phrases, sentences, sections, movements, whole works, bodies of works or indeed the entire musical enterprise itself. By stipulating ‘the perceptual present’ and qualifying that with the statement ‘typically within two seconds’, Hatten simply guides us as to what should be our starting point, indicating gestures, as objects on the scale of motifs. Since we are not analysing motives themselves but their function as gestures I will designate this analysis a \textit{functional motivic analysis}. The ‘perceptual present’ is useful because of the psychological concept of procedural or short-term memory; since we know that this kind of memory can, in a typical individual, hold fairly accurately around five to nine items for this space of time (Miller in Weiten 1995:263-264). We can refine our definition further by saying: \textit{The functional motivic analysis of the musical parameters an individual attends to in the perceptual present.}

The problem of how to differentiate the function of gestures then arises. Because the number of gestures which can be imagined is infinite, surely if an analyst attempts to identify each gesture individually s/he would arrive very quickly at an immense number of different types. Indeed the total number would most likely be a larger order of infinity if the distinction between gestures had an infinitely fine grain (to see how, refer to Cantor in Hawking 2005:971-1039). While investigating this typology may be of considerable interest were we to undertake a purely gestural analysis, it is wholly destructive to any attempt to perform a functional analysis using gestures, since we are investigating the interaction between like and unlike gestures. In other words, we need a method to pare down the plethora of possible gesture types to a very small usable number. Here Hatten provides a useful clue to the solution by mentioning ‘nuclear points of emphasis’. But if we know that there are points of emphasis, how can we identify
them? The problem is that if we identify this emphatic moment with any given parameter (such as pitch, volume, rhythm, timbre etc.) we cannot reliably tell beforehand whether it will be the highest note or the lowest, the loudest or softest, which provides that emphasis, so this leaves us no better off than when we started. If, however, we identify the nuclear point separately, that is, not by rigorous examination but by intuitive investigation into each separate parameter, it is possible to indicate the relative location of the nuclear point within the gesture. Some gestures will have an emphasis near the beginning of the gesture, and some more toward the end, while yet others may have a central point of emphasis or be expressly without any significant nucleation (when a singer word-paints the word 'stillness' for example). I propose therefore that a very small set of functions are differentiated for the current application, and that they are differentiated by the position of this emphatic moment, being either forward, with the emphasis toward the end; backward, emphasis toward the start; or neutral, with no emphasis or emphasis toward the middle. The definition of gestural analysis then grows to: The functional motivic analysis of the musical parameters an individual attends to in the perceptual present, differentiated by the location of emphasis amongst them.

At this point in the discussion it is necessary to deviate somewhat from the course set out thus far by introducing another list of characteristics outlined by Hatten. This list is given verbatim but not in the original order in table 4 (2004:124). This new list can be divided into two parts, each dealing with a separate feature, the first part of which is largely a revision of some of the issues raised earlier. The process Hatten outlines can be interpreted as follows: Discrete musical parameters coalesce to form analogue gestures which are in turn fixed into well-defined shapes and which may then, in turn, be analysed. This gives an outline of a syntax for the analytical process which I will propose in the next chapter. But what then of the semantics, the way that these discrete gestures are related to one another? The issue is dealt with in the next set of quotations shown in table 5 (ibid. :124).

Using this new information we further extend our definition. Gestural analysis is: The formal and functional motivic analysis of the musical parameters an individual attends to in the perceptual present, differentiated by the location of emphasis amongst them.
<table>
<thead>
<tr>
<th>Hatten’s Comment</th>
<th>Original Designation</th>
<th>Discussion and Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘Contextually constrained and enriched, both stylistically and strategically’</td>
<td>f.</td>
<td>We derive the gestures from the musical and social parameters relating to the specific work under investigation.</td>
</tr>
<tr>
<td>‘Analog, as opposed to digital or discrete’</td>
<td>a.</td>
<td>The entire gamut of parameters is potentially under investigation, rather than a well defined subset.</td>
</tr>
<tr>
<td>‘Hence, continuous in a productive sense of continuity (i.e. not necessarily continuous sound, but continuity of shape, curve, motion across silence, etc.)’</td>
<td>b.</td>
<td>Meaning that any digital (or discrete) input gets converted into the analogue (or continuous) output of gestures.</td>
</tr>
<tr>
<td>‘Beyond precise notation or exact reproducibility’</td>
<td>h.</td>
<td>Information is lost in the transition from musical parameters to musical gestures.</td>
</tr>
<tr>
<td>‘Typically foregrounded’</td>
<td>g.</td>
<td>When we listen to music, we are not hearing musical parameters, but the gestures formed by them.</td>
</tr>
<tr>
<td>‘Possessing articulate shape’</td>
<td>c.</td>
<td>Here the gestures themselves are made digital, i.e. they are conceived of as discrete (See Dewey 1936:172, point 5).</td>
</tr>
</tbody>
</table>

Table 4. Hatten, on the nature of gestures
<table>
<thead>
<tr>
<th>Hatten's comment</th>
<th>Original Designation</th>
<th>Discussion and Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘Amenable to type-token relationships via cognitive categorisation or even conceptualisation, and thus’…</td>
<td>i.</td>
<td>Statements i and j suggest that Hatten believes that formalising gestures may be possible.</td>
</tr>
<tr>
<td>‘Potentially systematic to the extent of being organized oppositionally by type, as in gestural “languages” or ritual movements’</td>
<td>j.</td>
<td></td>
</tr>
<tr>
<td>‘Possessing hierarchical potential’</td>
<td>d.</td>
<td>Hatten uses this term in a Schenkerian sense (see page 126-127), so that different levels of analysis each produce gestures and different levels of gestures are related to one another in some way. Successive, repeated abstraction can be carried out.</td>
</tr>
<tr>
<td>‘Possessing a significant envelope (pre- and postmovement can substantially affect the quality of the sounding gesture)’</td>
<td>e.</td>
<td>Gestures cannot be interpreted in isolation, but are related to neighbouring gestures.</td>
</tr>
</tbody>
</table>

*Table 5. How gestures relate to one another*
2.4 The Meaning of Gestures

In this section I will briefly elaborate on my, and Hatten’s, assumption that music has meaning. It is important to note that it is not required that this justification is accepted as, again, I do not hope to resolve the vexed problem of musical meaning in such a short space. I merely aim here to justify the prior assumption of musical meaning in relation to gestures, which is an important one for the present project. The views expressed here should not be directly attributed to Hatten (see the meaning section in table 3). Instead they represent a development from those views in light of the discussion in chapter 1.4.

If music is taken to mean something through the vehicle of gestures, how do gestures mean? Are they physical analogues or is the physical motion associated with the word an analogue of a cognitive process?

Some authors, such as Davies (2001:23-44) and Langer (as discussed by Osbourne 1979:16) employ an approach to answering this similar to Darwin’s physiognomy, outlined in ‘The Expression of Emotion in Man and Animals’ (1998: 94-95), the idea being that since human beings attribute shapes to music and also attribute meaning or expression to shapes it is reasonable to assume that meaning is attached to musical ‘shapes’ or gestures. Alternatively, a strong interpretation may be adopted, whereby meaning is assigned directly to gestures in the manner of words in an approach similar to one followed (though not in terms of gestures) by Cooke in The Language of Music (Cooke 1959). Hatten follows a hybrid approach in Interpreting Musical Gestures, Topics and Tropes (2004), one where gestures convey meaning first by being a mental analogue of a physical action, and then by that analogue having an outside meaning, an idea possibly first found in Coker (1972:139).

I will, for the purposes of this dissertation, slightly adjust Hatten’s reductionist position and instead give precedence to the relational content which informs the physical gesture. In other words, the physical gesture is iconic of a purely mental phenomenon. Support for this approach is found in the fact that the concept of gesture is not confined to the musicological discourse, but extends to a wide range of different fields. Corballis and Gentilucci (2006:949-960) argue that language itself developed from manual (i.e. hand) gestures, in what appears to be a large and growing field in the study of language.
Psychologists such as Susan Goldin-Meadows at the University of Chicago are meanwhile studying the connection between gestures and arithmetic ability (Anonymous 2009:77). In the musical field gestures have been linked to geometrical concepts, through the analogy of a climber (Tymoczko in Rehmeyer:2008), to mathematical functions (Mazzola and Andreatta 2007:23-46), to dance (Scrutton 1997:340) and to physical forces and processes (Larson 2006:61-74). This far from exhaustive list suggests to me that gestures are in fact a way of thinking, a kind of ‘thought-space’ where different concepts can freely intermingle, a concept similar to what Brower refers to as ‘cross-domain mapping’ (2008:51-106) in relation to the idea of ‘image schemas’ which can be related to gestures (ibid. 60 and 96). Even though music does not function as language there is still a very strong correspondence between the two modalities of thinking in a ‘gestural’ or ‘image schematic’ thought space.

My own interpretation, then, is that gestures are context neutral. They can denote forms of thought and may be treated as linguistic, physical, mathematical, logical, musical or any type of idea depending on how they themselves denote. So that a gesture which denotes itself is a musical gesture, and a gesture which denotes nothing is a logical gesture. At the same time, gestures qua gestures always have a musical type of denotation in that it denotes itself as the signified. At the same time, a gesture can have an extra-musical connotation, a second order connotation of what the signifier intends to signify by being intentionally gestural in a particular way. So having established the motion as gestural in that it denotes a movement of a certain type, the movement itself as opposed to another movement can separately and severally denote something outside of itself.

But how does a single gesture denote both itself and something else? Consider an analogy with language to clarify the relationship: A person sees an inscription ‘FISH’ which s/he knows in the English speaking culture is intended to denote a certain type of creature. That denotation has several connotations, including the types of creature themselves, a foodstuff, an odour or the religion associated with the word when the word is taken to also denote an English translation of the Greek word ‘Ichthus’, which itself denotes a phrase. Each time the connotation/denotation dichotomy is resolved through ascribed intention: “What was intended by the use of a given sign from the list of connotations of that sign” and “What was intended by the
use of a given sign as opposed another sign with similar connotations”.

Thus a purely musical gesture which has itself as its first denotation in what the gesture refers to, can also, at the same time, denote something external as its last denotation in what the actual form of the gesture is (compare to Barthes 1974 as discussed in chapter 1.4). Seen this way, gestures become an embodiment of Frege’s solution to the paradox of analysis discussed earlier in this chapter: a gesture has a musical “Sinn”, but can have an extra-musical “Bedeutung” (see Salmon:1993).

It is this extra-musical musical second order denotation through the vehicle of gesture which allows us to freely speak of musical meaning. Gestures can, in this interpretation, transcend the boundaries between the different modes of thought and allow us to develop a systemic and standardised way of thinking about not only music, but also the relationship between music and language (or other modes of thought) without blurring the boundaries between them. What I, as a musician, find particularly intriguing about this concept is that it seems to me ideally suited to the musical mode of discourse. In other words, gestures may represent a way for music to fruitfully and formally engage with other disciplines in a way analogous to mathematics, language and logic.

2.5 Gestural Analysis

We are now in a position to finalise the definition of gestures in a form which can be applied in the analysis to follow. Gestural analysis is: The formal and functional motivic analysis of musical meaning as defined by musical parameters an individual attends to in the perceptual present, differentiated by the location emphasis amongst them.

The analytical system which I will present in the following chapters should then be interpreted as that special case of gestural analysis where gestures which have a musical first order denotation (i.e. they denote their own shape) but do not denote anything in the second order. That is: the musical gestures as they are employed logically disregarding any outside meaning.
Chapter 3

Methodology

3.1 Syntax and Semantics

We have seen that musical ideas denote nothing but other musical ideas, and that the combination of musical ideas denotes a gesture. A musical gesture is then the case when that gesture denotes only itself. But two musical gestures treated in opposition to one another denote a gesture again. That means that a formal system of gestures has a recursive quality which is directly analogous to the recursive quality seen in musical denotation itself.

This characteristic has some very important implications, some of which will be dealt with at the end of this chapter. For now though, the important implication is that the syntax of the system is the same as the semantics, i.e. the syntax is the relation between things and the semantics is the relation between those things, which are of the same type. It is as if instead of saying “If A then B”, one were to say “If AND then OR”. Nevertheless, I will maintain the traditional separation of syntax and semantics, dealing first with types of symbols used and how they are arrived at and then with how they interact.

3.1.1 Syntax

It is perhaps not surprising that the first systematic use of the concept of force or energy in musical analysis, in the work of Hindemith (1941, see Fig. 1), should appear not too long after the immense popularising of the idea of energy brought about by Einstein. The basic concept is that we can define each part of the apparent musical surface according to its intensity or energy, both melodically and harmonically, instead of defining them according to their functional relation to a central tone, or tonic (as in Riemann analysis) or by simply mapping the flow of one or more parameters (as Truslit does with his waveform analyses, 1938; 1993, see Fig. 2). The result is a tension graph as can be seen in figure 3 below. This process was also employed and developed by Persichetti in Twentieth Century Harmony (1962), adding the concepts of melodic line, texture tension, mass register and root
direction to those used by Hindemith (see Fig. 4). More recently John D. White (1994) has used the idea as part of his Comprehensive Musical Analysis (Fig. 5). White also provides a list of musical parameters which can conceivably be so analysed, shown in Table 6.

| Rhythm                  | - Details of rhythm at the motivic level.  
|                         | - Harmonic rhythm                              
|                         | - Density                                      
|                         | - Relationship of rhythm to text               
| Melody                  | - Melodic intervals                            
|                         | - Conjunct versus disjunct motion              
|                         | - Tessitura                                    
|                         | - Range                                        
|                         | - Pitch profile                                
|                         | - Cadences                                     
|                         | - Density                                      
|                         | - Relationship of text to melody               
| Harmony                 | - Details of harmony                            
|                         | - Consonance and Dissonance                    
|                         | - Cadences                                     
|                         | - Contrapuntal or polyphonic techniques        
|                         | - Relationship of text to harmony              
| Sound                   | - Details of orchestration or instrumentation.  
|                         | - Texture                                      
|                         | - Dynamics                                     
|                         | - Relationship of voices                       
|                         | - Relationship of text to sound                

Table 6. White's list of parameters (1994:25)

For use in tension analysis the text of many of these parameters simply needs to be altered to read: 'Change in X' where X is a parameter. Clearly this list is not complete, and indeed cannot be made complete since the list of possible parameters is potentially infinite, as was shown above (for my list of what I consider to be
key parameters see Appendix B). In addition to this, it is not conceivable that any listener can heed all, or even a substantial subset of even this limited list in one hearing. The analyst must therefore choose a set of parameters at a given moment which a listener is most likely to be attending to, which should not be an overly difficult task given that, for the sake of clarity, most composers would not attempt to have large differentials across a vast set of parameters, if only because this would make understanding a work virtually impossible. (I am ignoring of course the many mostly 20th century composers who did and do precisely that for effect or as a stylistic feature and I would argue that they are the exceptions which prove the rule).

The above examples use a continuous figure to represent the flow of tension, whereas what is required is a set of individual gestures. Hindemith again provides us with a useful example of how this may be done (Fig.6, ibid. 184). Hindemith uses the concept of degree progression as the defining feature of such units whereas I will be using Hatten’s definition of gestures as discussed in the previous chapter. The other difference that I would impose on this way of dividing the musical surface would be to apply Lerdahl and Jackendoff’s injunction against overlapping units (1977:118), because this makes analysis much simpler, meaning that two overlapping units (or groups in Lerdahl and Jackendoff’s terminology) are treated as sequential. Lars Thoressen uses a symbolic representation of such gestural units in his analytical technique, called ‘Aural Sonology’ (2007), although he limits his analysis to melodic and textural complexity, allowing him to use a much richer symbolism (see Fig. 7) than would be possible here (I will use only three symbols because I only wish to investigate the formal relationship between different classes of gestures rather than the transformation of gestures themselves).

It is important to note at this point that any method of deriving gestures in this fashion is somewhat ad hoc. This is because ultimately gestures are defined by how they are perceived, and specifically where the marked element is perceived to be in the perceptual present according to Hatten’s scheme. The derivation of gestures must be somewhat abductive as a result, a situation similar to that of mathematics, where the statement 1+1=2 cannot be proven mathematically even though it is true analytically. 1+1=2 is true by derivation from definition, but that definition cannot itself be mathematically derived. In the same way we can
use gestures analytically even though they cannot be analytically arrived at: we simply assume a certain gesture to be true on the basis of a ‘best guess’, in the same way as a physicist assigns a number to a physical entity, and proceed deductively from that point onwards.

3.1.2 Semantics

Having seen how gestural analysis based on discrete symbolic representations of tension flow may be achieved, we can move on to the issue of treating these symbols syntactically. The main source of inspiration for this function is again Lerdahl and Jackendoff’s analytical method (see Fig. 8, as discussed in the article Toward a Formal Theory of Tonal Music 1977:111-171). The main thrust of their method is the establishment of a set of well-formedness rules (this should be understood as an attempt to establish a syntax) for interpreting the hierarchical organisation of metrical points (or beats) in the music. The notation depicts a “right branch” (\(\bowtie\))...[as something which] denotes the subordination of an event to the preceding event within that region at that level ; a “left branch” (\(\triangleright\))...[as something which] denotes the subordination of an event to the following event within that region at that level’ (this is very similar to the semantic features discussed above, ibid.: 129). This kind of analysis does not aim to present a logical structure and does not, at the level of the tree structure itself, have the ability to provide predictions for the further development of the tree; that is: for each left branch there must be a corresponding right branch - but this does not tell us exactly where each branch would be; for this information we can only refer back to the source music. Furthermore, and for roughly the same reason, it is not falsifiable; that is: We cannot disprove the fact that any particular branch is either left or right by investigating earlier branches. The Lerdahl and Jackendoff method is therefore not a strictly logico-deductive analytical system.

There is, however, a logical system which shares many features with the above system and yet has the desired characteristics of predictiveness and falsifiability. This method is called ‘Analytical Tableau’, and it is a common technique for dealing with modal logic, or logics dealing with relations such as X believes that Y, or X thinks that Y, or X is possibly Y. Examples of this can be seen in figures 9 and 10. The only real difference
between this procedure and Lerdahl and Jackendoff’s is that each
node is now a logical symbol, or semantic unit, and the tree
represents the relation between the nodes themselves, rather than
the concepts symbolised at each. In the present application this
means simply that each node will hold a gesture, and the structure
will encode the relationships which hold between those gestures.

One further addition to the standard analytical tableau will be
required before we can proceed. Hatten stipulates that gestures
have both ‘hierarchical potential’ and a ‘significant envelope’
(p.126), which are related to Rosch’s dimensions of horizontality
and verticality (1978). Rosch’s horizontal boundary being how the
two categories are situated with respect to one another, while the
vertical dimension is the intrinsic differentiation. This means that
each set of gestures is related to one another not only in the way
that they relate to one another qua gestures - so that, for example,
a forward gesture with another forward gesture produces a
combinatorial forward gesture (this is Rosch’s basic level) - but
also in that one gesture can be subordinated to the following one,
producing a forward moving ‘meta-gesture’. ‘Subordination’ here
is Lerdahl and Jackendoff’s terminology and the same term is
employed in a similar fashion by Rosch. ‘Meta-gesture’ is my own
term, but one which corresponds to Rosch’s super-ordinal level.
The system I will expound in the following section will therefore
treat any two gestures as combining in both of these manners to
produce a third ‘resultant’ gesture which then interacts with the
following gesture, as indentified beforehand by our semiotic
analysis. An added dimension is therefore required over the two
in a standard tableaux and this will be done by distinguishing
horizontal relations from vertical ones (see Fig. 11).
Figure 1. Hindemith's system of ordering verticalities (harmonies) according to their tension, or energy, rather than their function.
Figure 2. Truslit's experiment, published in 1938 (in Repp 1993:48-72), involving one participant drawing a curve and writing a musical passage which is thought to correspond to it (Urbewegung [original motion]). The second participant then attempts to reconstruct the original curve by listening to the music (Festgestellte Beweg [established motion]). Because both participants were familiar with the procedure and theory in this experiment (p.58) it is not possible to exclude meta-musical symbolisation but it is nevertheless instructive to note that this kind of gestural communication is possible.
Figure 3. Hindemith's categorisation system for harmonic analysis (1941:158) can be seen in the line called 'Harmonic Fluctuation'. The graphic representation of it is the 'Actual Design of Harmonic Tension'.
Although register placement of the entire tonal mass does affect the direction of sound,

'Although register placement of the entire tonal mass does affect the direction of sound, harmony with a strong downward pull can resist a register climb.'

Figure 4. A very similar process to that seen in Figure 2 is followed here, except that the parameters graphically notated now include the melodic line, texture tension, bass line, implied roots, mass register and root direction (Persichetti 1962:183).
Figure 5. White's graphical notation (1994:262) is much more digital in style than either Hindemith’s or Persichetti’s. Looking at the line ‘A. Dynamics of texture’ one can fairly easily separate the flow into two forward gestures followed by a reversal and then three more advances.
Figure 6. Hindemith defines units in the music according to degree progression (1941:184). Notice that the length of these units is around the two-second ‘perceptual present’ mark also associated with motives. Again, the two-seconds should not be regarded as a stopwatch timing guide, but as an indication of order of magnitude.
Figure 7. Thoressen uses symbolic representations of gestural units to analyse 'formbuilding transformation' (2007). While this system does not formalise a gestural theory, it does offer an example of using symbolic musical gestures and their relationship to one another systematically.
Figure 8. Lerdahl and Jackendoff’s ‘Grouping, metrical and time-span analyses’ of Schumann’s “Wehmut” from Liederkreis. The sub-ordination tree structure is prominently displayed at the top.
Figure 9. An analytical tableau with symbolic units at each node, from Letz and Stenz (2006:83). The uppercase letters represent predicates and the lowercase letters the variables. This is similar to Lerdahl and Jackendoff’s predication of a left or right branch (\(\wedge\) or \(\vee\)) to a particular set of notes.

Figure 10. Another example of an analytical tableau. ‘The election’ (Nute and Erk 1996:17) using Donald Nute’s defeasible logic. The arrows indicate different relationship (namely strict, defeasible and defeaters). The nodes may be either satisfied or failed (as opposed to the true or false connotations of first order logic).
3.2 The Analytical Algorithm

Step 1: The musical extract is divided into large-scale structure such as movements, sections and phrases.

Step 2: The tempo is established. Since the gestures are temporally defined, i.e. they are roughly two seconds in length according to Hatten's rule of thumb, this must be completed before we can continue to isolate each gesture.

Step 3: The broader harmonic structure is also analysed beforehand since it may cut across gestures which occur simultaneously and so is not properly analysed at the gestural level.

Step 4: A portion is selected and further divided into separate independent lines and each line is divided into gestures according to Hatten's 'two second' rule of thumb.

Step 5: Each gesture is analysed according to a set of indicative parameters, i.e. those prominent and likely to be noticed for that section. This is also related to parameters which have been indicative in earlier gesture.

Step 6: The gestures, having been ascribed a value of either forward/advancing (/), backward/retreating (\), or stable/holding (^), are listed for each line in turn.

Step 7: The first two gestures of the first order or consecutive gestures are placed next to each other ([A] and [B] in Fig. 11) and above them is placed the gesture produced by their combination ([C] in Fig. 11) according to the truth table shown in table 7.

Step 8: The meta-gestures, defined by the relationship between each gesture and the next at the level of musical parameters (i.e. each gesture is considered as a musical idea rather than a logical idea), are analysed and listed above ([D] in Fig. 11).

Step 9: The meta-gesture ([D]) and the combination gesture ([C]) are again combined, using the same truth table as given in table 7. This forms the next, resultant gesture to the side ([E] in Fig. 11).

Step 10: The next first order gesture is appended to the side of this resultant gesture and the process continues from step 7.

Step 11: After all the gestures for a particular section have been used in this manner, ending in a final resultant gesture, the final gesture can be used in combination with the resultant gesture of
other lines in the same section, with resultant gestures of other sections or with further consecutive gestures to form a new resultant.

**Step 12:** This final resultant can now be used together with the resultant for the next part carrying on the same process at the next hierarchical level.

<table>
<thead>
<tr>
<th>Gesture 1</th>
<th>Gesture 2</th>
<th>Combinatorial or resultant gesture</th>
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</thead>
<tbody>
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<td>/</td>
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</table>

*Table 7. The truth table which will be applied in the analysis. It is important to note that, since the present method is a form of modal logic these values are not truth values (Stanford Encyclopedia of Philosophy 2009).*
Figure 11. An axiom schema for the gestural analysis system in the form of an analytical tableau. [A] and [B] represents consecutive gestures, [C] is their combination, while [D] is the meta-gesture and [E] is the resultant. The final resultant gesture is underlined for clarity. The super-structure is decided by the perceived structural units of the music being analysed. A well formed formula (wff) in this system is 1) a single gesture, insofar as it represents the resultant of a resolved pair, where a resolved pair consists of the base gestures with their combination considered with the meta-gesture to form a resultant; 2) a resolved pair of gestures or 3) two simultaneous gestures resolving onto a resultant.
3.3 Final Methodological Remarks

What may be observed here is the fractal like self-similarity of this structural system as displayed in figure 11 (see also Fig. 55), meaning that it looks roughly the same regardless of the scale it is viewed at (Mandelbrot 1982). This means that whether we use small-scale (like wave-forms) or large-scale (like sociographic features) as fundamental units, the analysis will look approximately the same.

An important feature of fractals is that they are bounded at some point; usually a fractal is a single object when viewed from the macro level. This feature is a function of the recursive nature of the derivation of these structures, starting from a simple idea, such as a triangle in the case of the Koch curve, which submitted to a simple operation infinitely many times. The fractal generated in this analysis is somewhat unique though, in that it starts from a simple idea (the gesture attributed to Hatten’s ‘perceptual present’) which is infinitely expanded outwards, rather than inwards, i.e. fractals are apparently infinitely divisible, while gesture tableaux are apparently infinitely extensible. This is why Small’s idea (1998) of the meaning of music expanding into the cultural sphere averred to at the start of Chapter 2 was such a crucial one: it suggests that the sphere of thought can expand outwards this way to an arbitrarily large scale. The formal system of gestures, then, is in fact a formal philosophy of mind, with a web of denotation at different levels of the fractal, a theory depicted in figure 12.

It is in this then that gestural analysis is differentiated from analysis aimed at an a posteriori investigation of an acoustic phenomenon. Broadly speaking, musical analysis is highly systematic in analysing the score. A plethora of very potent tools can be brought to bear on a score to form axioms of music or statements of musical fact, such as note names, function name or a Schenkerian Urtext. It is often assumed that because of the nature of musical denotation we must stop there, we cannot proceed further because then we would be analysing some other form of thought. What the present technique offers is a way to systematise that which denotes musical ideas as they relate to one another, without forcing the musical axioms to denote anything other than themselves and be thus transformed. In fact, at any level, any gesture can be interpreted as multiple kinds of ideas simultaneously or converted from one kind to another simply by changing the type of denotation.
$\Rightarrow$ - Denotation function
M - Musical idea
G - Gesture
L - Logical idea
P - Pictorial idea or physical gesture (denotes a mental or physical object or physical gesture)
Li - Linguistic idea (with a culturally prescribed definition)
Ma - Mathematical idea (with the number concept)

Figure 12. A gestural philosophy of mind. The two musical ideas at the initiation point become logical ideas when they are combined to form the combinatorial logical idea. The same process happens when the meta-gesture is combined with the combinatorial gesture.

In this view, the elemental ideas are initially logical and are transformed into musical ideas when considered in combination, a notion indirectly supported by Hanslick when he says: “The forms which construct themselves out of tones are not empty but filled: they are not mere contours of a vacuum but mind giving shape to itself from within” (1986:30) and then refers to the “bonds and affinities” of “musical elements” being without “…concept as its criterion or tertium comparationis” (ibid. :31, author’s italics), a notion which identifies it as a logical idea (i.e. without denotation). The combination in turn becomes a gesture when combined with the meta-gesture.
Chapter 4

Analysis

4.1.1 Introduction

This chapter will present a sample analysis of a piece of music which will demonstrate the formal system in use. In order to do this the information on the score needs to be translated into the syntax of the system (/, \ and ^). As with first order logic this translation is an intuitive process with certain rules of thumb applied. In logic this translation is not a formal process and it may be argued that it is also not formalisable.

The assignment of variables in this way is a subject of intense study in music, and a wide array of very potent tools can be brought to bear on the problem. However, even with this facility, variables are not deductively proven, but rather inductively intuited. Once they are assigned however, they should be treated as axiomatic.

The methodology deployed for the purpose may be disputed on several grounds, not least in the method of breaking the music into significant units of the perceptual present. While these reservations must be taken into account, the purpose of this dissertation is to show how such elemental units can be used in formal analysis as opposed to showing how they can be systematically derived. As such, a principle of simplicity and clarity is adopted which may produce musical results that could seem counterintuitive, depending on precisely how one would reify a gesture in performance.

While the problem is acknowledged, it in no way impacts on the validity of the method, since the goal is not to standardise the derivation of axioms, but merely to show how this could be done. The axioms are entirely a priori for the purposes of this analysis, despite my attempts to show how one may go about justifying them a posteriori.

That being said, every attempt has been made to represent a possible reading that a performer may make. This may be compared to the decisions that the author of the present study did in fact make in performance as given in Appendix C. It should be noted that the reading here is not intended to reflect that performance and should be regarded as a wholly separate interpretation.
4.1.2 A Note on the Selection of Music for Analysis

The music analysed here (the second movement of Mozart’s Flute Quartet in D major KV 285) was chosen largely to satisfy the departmental regulation stipulating the need for a connection between the final recital and dissertation of the candidate (i.e. myself). There is however an additional reason why Mozart’s music may be particularly susceptible to this kind of gestural analysis and must therefore be taken into consideration when the success or failure of the investigation project is determined. It is my belief that Mozart’s music, including his purely instrumental music, can be understood as a product of his operatic sensibility, and that his style therefore has an innate physicality in its nature which when combined with the clarity of the textures he employs makes it an ideal candidate for this kind of analysis. Whether this motive impulse is as strong in other composers, or some other element of Mozart’s style lends itself particularly to gestures is important to understanding the role of gestures in music generally, but will remain an open question for the purposes of this dissertation.

4.2 Overview

4.2.1 Major Subdivisions

In Mozart’s Flute Quartet KV 285 the major subdivisions are the three movements. Because the second movement ends on an interrupted cadence and moves *attacca* into the final movement, these two can also be grouped together. The second movement has what can be described as a modified ternary structure (where A’ indicates a modified A):

\[
\begin{array}{ccc}
I & A & A' \\
II & B & \\
III & A (Coda) & \\
\end{array}
\]

or a proto sonata form structure:

\[
\begin{array}{ccc}
I & A & B & A' & C \\
II & D & E & \\
III & A'' & B' & (Coda) & \\
\end{array}
\]

For the sake of clarity I will assume the second option so that the first phrase will be called **A**, and the second **B** and so forth in the following analysis (See Fig. 13).
4.2.2 Tempo

The tempo indication is *Adagio* which, according to the practice of the time (Fallow: 2009), can be assumed to be in the range of 50-70 crotchet beats per minute. We can further suppose that, because of the strong melody/accompaniment division, the dominant paradigm is that of song. Furthermore the lightness of the texture and dynamic level suggests that it is not very dark in mood; perhaps a good description would be ‘nostalgic’. These factors therefore suggest a tempo in the upper end of the Adagio range, or approximately 60bpm, which will be my working assumption.

4.3 Section I, Phrase A

4.3.1 Harmony

The harmonic progression is fairly simple, in keeping with the song-like nature of the music [b: I-V6-V-I] the only major non-harmonic note being the E# appoggiatura at bar 2.1.2.2 and the corresponding one at 4.2.

4.3.2 Lines

The accompaniment lines (violin, viola and cello) are fairly clearly delineated in synchrony with the bar-lines because of their motion. These lines could arguably be subdivided with the violin having gestures on each beat while the viola has gestures the same length as the bar and the cello has gestures each two bars long. For the sake of clarity and space, however, I will treat the accompaniment as a single gesture encompassing the whole bar.

The melody is more difficult to subdivide because two interpretations are possible. The first possible solution is to segment it as with the accompaniment into two sections of two gestures corresponding to the bars. Alternatively it is possible to interpret it as two sets of three gestures each two beats long (see Fig. 16). There does not seem to be an obvious rationale to decide between the two as the first interpretation is fairly obvious in accordance with the bar-lines and the accompanying figures while the second is supported by the motion of the melody and the fact that the first crotchet B at 1.2 would be more naturally performed with a semi-staccato to match the articulation of the other parts. This interpretation would group the first two beats together to the exclusion of the third.
4.3.3 Derivation

Although the derivation of the gestural symbols is key to this process, it does not strictly fall within the ambit of the present study. I will however include such a breakdown of the first half of this part as Appendix B for the sake of completeness and by way of example for analyses which follow. It may be noticed that while gestures are defined by the position of a nuclear point of emphasis, the sub-gestural parameters cannot be so defined (or they would be gestures themselves). The inference from parameter to gesture may be impossible to make deterministically since gestures are also defined as perceptual objects, i.e. they are only what they are perceived to be, and since we cannot accurately determine what an individual actually perceives we cannot purely deductively infer the nature of gestures. Nevertheless it is possible to compile an inventory making an informed judgement on the presumed information available to that individual.

4.3.4 Structural Diagram

After placing the gestures into the structural diagram (see Fig. 18) the meta-gestures can be similarly derived, with the same caveats as discussed above. Here it may be observed that while the combinatorial gesture - as represented on the vertical axis - is the result of the previous resultant (where there is one), the next gesture, the meta-gesture is always derived from the gestures themselves (i.e. one gesture and the next). It can also be seen that although sequent gestures have meta-gestures, simultaneous ones do not; this omission is conscious, because gestures are defined temporally and the meta-gesture of the horizontal relation seems to me to be captured, albeit indirectly, by the vertical relation.
Figure 13. The second movement ‘Adagio’ of WA Mozart’s Flute Quartet in D major KV285.
Figure 14. The structural outline, showing the grouping lines for (from outermost to innermost) the work as a whole, the second and third movements, the second movement, sections and phrases.
Figure 15. Phrase A, the first part of the second movement, bars 1-4

Figure 16. The gestural subdivision for phrase A

Figure 17. The labels assigned to the gestures and the associated gestures. The importance of the subdivision can be seen from the gesture labelled A which would most likely have been read as advancing(1) if the gesture was taken to encompass the whole first bar instead of only the first two beats.
Figure 18. The analytical tableaux showing the position of the gestures [A] to [H] and the meta-gestures [x] to [z].

Figure 19. The gestures are filled in according to the information from Fig. 16 and the meta-gestures as suggested by Appendix B.
Figure 20. The resultant and combinatorial gestures, calculated according to Table 7, are added.

Figure 21. The completed tableaux for phrase A. The gestures in the middle of the diagram are formed by combining the final resultants of the upper and lower lines of the first and second half of the phrase.
4.4 Adding the Second Phrase

4.4.1 Discussion

This phrase immediately follows the one in the above analysis, what was determined to be phrase B (see Fig. 22).

There is no apparent change in tempo here, but owing to the slightly contrasting nature of this phrase, i.e. there are fewer leaps, one could say that it is a more lyrical phrase than A, which perhaps suggests a fractionally slower tempo but not so much as to substantially affect interpretation.

While the melodic tension resulting from the large leaps in A may have relaxed somewhat, the harmonic tension has become much more acute [D: I-V(V)-I-IV\textsuperscript{7}-vii\textsuperscript{o}-b:vi\textsuperscript{o}-i-vii\textsuperscript{o}/V-\textsuperscript{6}-V-i] and the non-harmonic ornamentation is both more frequent and chromatic than was the case in A.

The grouping is less clear cut here. I have opted for a structure resembling that used in the first phrase, since a listener would most likely opt for a listening strategy which requires as little deviation as possible from what is expected. Mozart also places the tonic chord of the new (relative major) key at the start of bar 6, which strongly indicates the bar as a major structural division in this phrase. The melody meanwhile divides the bar in half. The sudden modulation (through the use of diminished sevenths) back to the tonic of the original b minor key interrupts this flow and leads to a slightly more complex final group.

The figures 23 to 26 show the rest of the process from the structural divisions through to the construction of the tableaux.

The final figure in this series (Fig. 27), shows the combined gesture for the phrases A and B with a final resultant gesture [\textsuperscript{\wedge}].
Figure 22. Phrase B with harmonic analysis

Figure 23. The gestural subdivision for phrase B

Figure 24. Gestural assignment for phrase B
Figure 25. The analytical tableaux for phrase B showing the positions of the gestures indicated in figure 21.

Figure 26. The completed tableaux for phrase B
Figure 27. The combined tableau for phrases A and B, the final resultant gesture bolded for clarity.
4.5 Completing the Second Movement

4.5.1 Discussion

By way of illustration I will conclude this chapter with an abridged derivation of the remaining sections. This part is intended to show how the technique can be applied to larger scale structures such as whole movements and pieces. Each section will be divided into gestural units, have gestures assigned to them (with no justification given at this point) and then displayed as tableaux.

*Figure 28. Gestural subdivision for section I phrase A'*

*Figure 29. Gestural assignments for section A'*
Figure 30. Gestural subdivision for section I phrase C

Figure 31. Gestural assignments for section I phrase C
Figure 32. Tableau index for phrases A’ and C
Figure 33. Completed tableau for phrases $A'$ and $C$
Figure 34. The analytical tableau for section I
Figure 35. Gestural subdivision for phrase D

Figure 36. Gestural assignments for phrase D. The gesture names here start from A again and will do so for each new section to avoid overlong labels. It may however be considered preferable to keep the labels running continuously.
Figure 37. Tableau index for phrase D. Where space is insufficient an arrow shows where the resultant appears. In the area where gesture [F] appears the resultant gesture of [G],[H] and [I] appears as a separate box underneath the simultaneously occurring [F], since simply stacking them would wrongly indicate a combinatorial and meta-gesture without any underlying gestures. The resultant of [F] with [G],[H] and [I] is placed at the head of the arrow originating at their centre.
Figure 38. Gestural subdivision phrase E

Figure 39. Gestural assignments for phrase E
Figure 40. Tableau index for phrase E
Figure 41. The completed tableau index for section II
Figure 42. Analytical tableau for section II
Figure 43. Gestural subdivision for phrase A''

Figure 44. Gestural assignments for phrase A''

Figure 45. Tableau index for phrase A''
Figure 46. Gestural subdivision for phrase B'

Figure 47. Gestural assignment for phrase B'

Figure 48. Tablea index for phrase B'
Figure 49. Gestural sub-division for section III Coda

Figure 50. Gestural assignment for section III Coda

Figure 51. Tableau index for section III Coda
Figure 52. The completed tableau index for section III
Figure 53. Analytical tableau for section III
Figure 54. The complete gestural tableau for the second movement 'Adagio' of Mozart's Flute Quartet in D major KV 285.
Chapter 5

Conclusion

5.1 The Hypothesis

The hypothesis which I set out to test in this dissertation was that it is possible for gestures to be used as a fundamental unit of a logical system which can be applied to musical analysis. By producing the analytical tableaux of the previous chapters this first objective has been met, it therefore remains for the second objective to be answered which means that this system needs to be shown to be predictive and falsifiable.

In the limited sense of predictability it is clear that the analytical tableau by its very nature has a predictive function, so that given a set of gestures and their meta-gestures we can always work out the resultant gesture. The converse is also true - given a resultant gesture and a meta-gesture, we can deduce what the combinatorial gesture is, and given a combinatorial gesture and one gesture we can deduce the nature of the other. Furthermore, it is possible to derive a set of compound rules such as the following:

<table>
<thead>
<tr>
<th>Rule</th>
<th>Description</th>
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<tbody>
<tr>
<td>If two consecutive gestures are forward the resultant must be either neutral or forward.</td>
<td></td>
</tr>
<tr>
<td>If two consecutive gestures are backward the resultant must be either neutral or backward.</td>
<td></td>
</tr>
<tr>
<td>In any series of gestures (that is gestures, combinatorial gestures and meta-gestures), if the number of forward and backward gestures is equal, even or zero the resultant must be neutral.</td>
<td></td>
</tr>
<tr>
<td>If a resultant gesture is not neutral there must be at least one consecutive or meta-gesture that is also not neutral.</td>
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</table>

Table 8. Some compound rules.
The system is also falsifiable, so that given a combinatorial gesture and a meta-gesture we are constrained to one resultant interpretation and given a different resultant interpretation we must conclude that the derivation of the gesture was in error, thereby falsifying the conclusion. This feature is crucial to the testability and applicability of the system because without it, one cannot have any justification for discarding the system if it proves to not correspond accurately to observation and therefore does not truly add to the sum of knowledge. This applies only to the syllogistic aspects of the system. The structural, grouping and assignation decisions are based purely on intuition at this stage; they are not falsifiable in the present study even while they are crucial to any successful analysis of this type.

5.1.1 Meta-systematic analysis

These concepts can be formalised by noting that the system as presented here can be wholly reduced to zeroth order (i.e. propositional) logical terms by assigning symbols to each gesture in the following manner:

**Combinatorial Gesture**

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<td>/</td>
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<tr>
<td>A</td>
<td>B</td>
<td>C</td>
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</tbody>
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**Meta-Gesture**

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<td>^</td>
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<tr>
<td>D</td>
<td>E</td>
<td>F</td>
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**Resultant**

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<td>^</td>
</tr>
<tr>
<td>G</td>
<td>H</td>
<td>I</td>
</tr>
</tbody>
</table>

Each unit of the analytical tableau can then be reduced to either a single symbol (G, H or I) or a syllogistic construction (If A then if D then G). In all then, the system describes a closed universe of discourse comprising eighty one such syllogisms and a further three freestanding resultants.

Given that it can be reduced to zeroth order logic the system is consistent, meaning that a single gesture cannot be both of one kind and another; and sound, meaning that only valid formulas can
be derived. This is in accordance with Gödel's completeness theorem of 1929. It may appear that neutral gestures are in effect gestures which are forward and backward, but they are not so defined. The proper negation of a forward gesture is [either a backward or neutral gesture].

The system can be said to be syntactically complete because, for each gesture, either the gesture is forward or it is [backward or neutral], which is the negation of forward. Similarly, the negations of backward or neutral are also theorems. In terms of this interpretation the symbol ‘/’ means not only ‘forward’ but also [not neutral and not backward], i.e. not [neutral or backward] in terms of DeMorgan’s law.

It may also be noted that given a certain resolution of analysis applied to the musical work under consideration, i.e. a certain fixed average number of gestures per unit of time, there is a fixed and enumerable set of valid tableau constructions. Furthermore, given an enumerable set of tableaux and the fact that for each tableau there is an enumerable set of valid gestural solutions it can be asserted that the set of valid interpretations under the present system is finite, given a ‘two second’ rule. In other words, the problem presented by the fact that there is an infinite number of interpretations for any given gesture is removed when we consider that gesture in a tableau of fixed average resolution. Now, there are an infinite number of valid resolutions, but we can circumvent this problem by asserting the axiom of choice, we assert that there is some (unspecified) function which we can use to pick the appropriate resolution.

The system is expressively complete over the universe of discourse of Hatten’s musical gestures themselves, that is: Every gesture, when it is perceived as a gesture must be perceived as forward, backward or neutral. Here it is important to note that this completeness does not preclude more complex constructions, but only stipulates that there is no conceivable complex construction which does not satisfy the criteria for being forward, backward or neutral.

I would furthermore assert that in terms of the second order connotational interpretation of Hatten’s gestural theory, outlined at the end of the second chapter of the present work, the system is expressively complete over every universe of discourse (an interpretation which may be thought of as strong gestural theory).
On the basis of the above analysis it can be affirmed that the system which was presented here is formally related to a Peano (or Zermelo-Fraenkel) type axiomatization of mathematical logic, in that it is a second order logical system. In terms of Gödel's incompleteness theorem the system is sound and complete (as shown above) but it is not effective at the level of gesture and tableau derivation, that is: there is no way to establish within the system itself whether that tableau is a valid interpretation of the music it derives from. It accepts the axiom of choice, as discussed above, but it denies the axiom of induction in the sense that given an immanent musical experience from which a certain tableau is derived we cannot assert that all similar experiences will yield the same tableau. In other words there is no single function which can be used to derive all tableaux. Alternatively the axiom of induction can be thought of in this context to represent the statement: "Given that musical pattern X is a gesture at time T, X will be the same gesture at time T+1". A stronger form of this statement, equally denied in the music context, is: "Given that X at time T is a gesture, X at time T+1 is also a gesture".

This denial of mathematical induction is required to account for the fact that in musical interpretation every predicate which can be applied to a musical extract must be considered to decide which gesture is assigned, or even whether the extract is interpreted as a gesture at all, rather the simple successorship that suffices in set theory. This is not meant to imply that the axiom of induction cannot be invoked in music at all though, indeed cadences may be examples where an inductive axiom is assumed, in that a composer who writes V-I at the end of a piece can be taken to expect it to be interpreted to signal the end of a piece every time he does so. A formulation may take the form "If pattern X in context Y is taken to be cadence Z, then pattern X in context Y+1 is also taken to be cadence Z" where context Y+1 is taken to refer to the next time the same set events occurs. Rather, the situation may be analogous to the way that mathematics may accept the axiom of choice, but may also reject it; the assumption is independent of the system. In fact, the case of cadences (as well as any number of tropes) may well be regarded as linguistic elements superimposed on top of music, rather than purely musical phenomena.

This line of reasoning suggests that any attempt to completely (in the logical sense) formalise a distinction between language, music and other modes of thought is ultimately a doomed enterprise.
5.2 Suggestions for Further Study and Application

The technique of analytical tableaux employing gestures as fundamental units displays all the important hallmarks of a useful analytical system. But what applications could such a device be put to, or is this simply an exercise in creative analysis, and what weaknesses does this system display which may be mitigated through further investigation?

5.2.1 Suggestions for Further Study

The most immediate objection which may be raised against the analytical tableaux is that the gesture assignation is fairly weakly supported and is based largely on intuition and ‘feel’. One way to overcome this may be to suggest a different system to perform these derivations, such as the system I propose in Appendix B or some variant of Lerdahl and Jackendoff’s sub-ordination tree structure applied to a lower level. The advantage of this is to allow a separate study of what are perceived to be gestures by individuals across different educational and social backgrounds. The kind of question which may be asked includes: ‘Do all societies experience a rise in pitch as a rise in tension?’ and ‘How does the flow of tension within a gesture affect the selection of the emphasised point?’

The decisions pertaining to the structural features may also benefit from the above treatment, but I suspect that they would be much harder to ‘pin down’, as it were, to a set of clear rules, without imposing exogenous structures (cf. Rosen: 1988) on works which may or may not be so structured. One possible solution to this would be to show that some structures are innately favoured, such as the golden ratio often found in nature, but even then it would be hard to prove that the structure is of the music itself and not simply an imposition from the analyst. Perhaps another solution may be to apply the ‘Aural Sonology’ approach of Thoressen (2007) where, rather than analysing the score as fundamental text, the actual sounds of a performance are analysed. This may be done at two levels, either by analysing the perceived structure or the structures as heard, although this may be subject to varying interpretation; or to analyse the wave-form level and see if any mathematical qualities hint at structural division. It is far from clear that this is in any sense achievable, since implied intention may be very far removed from any physical features of the sound and yet has a much greater impact on the perceptions of a listener.
I have included (as Appendix C) a recording of this movement as performed by the author at the final examination concert for this degree at the UNISA Sunnyside Campus Conference Hall in July 2007. Although I have not referred to this performance at all during the creation of this text, it may nevertheless be a matter of interest to see whether some of the conclusions I have reached here correspond to the performance decisions made on that occasion. A study conducted by Irène Deliège (1996:131-156) has indeed undertaken an investigation of this type and further work in this direction may yield useful results.

The other feature which may be empirically tested is the syntax rules that I proposed in Table 7: Given an individual who ascribes gestures in the expected manner (i.e. if we know which gestures and meta-gestures have been ascribed), are the combinatorial and resultant gestures as we have predicted them to be? Is this the case across different cultures and stylistic practices?

It is also possible to question the structural properties of the system I have laid out. Is it really the best solution to have each gestural or structural unit only affect the very next unit directly, or is it possible to devise a system where similar ideas are treated as being more conjunct such as in Nicholas Ruwet’s ‘Methods of Analysis in Musicology’ (in Everist 1987:3-36) I have also arbitrarily imposed some restrictions which, to me at least, seem commonsensical: This includes the breakdown of gestures so as to never have more than two simultaneous gestures, and also restrictions on the number of consecutive gestures that can be seen as one unit. These decisions are largely aesthetic, both aurally and visually, but it is conceivable that empirical testing may illuminate whether this sensibility is generally shared amongst listeners and whether there is any way to codify it.

Finally we can ask and investigate two questions about gestures themselves: How common is it for participants in the musical process to organise their aural experience around discrete gestures as I have proposed? And is it possible to further distinguish between gestures, e.g. can we expand the system to include gestures which have ‘nuclear points of emphasis’ near the end as opposed to at the end, or to distinguish those gestures which have a peak in pitch from those with a peak in volume? Any such expansion of the properties of the fundamental units would very quickly add to the overall complexity of an analytical system, so that if we perfectly identify each possible musical pattern with its own unique gesture the system would be
completely useless. The interpretive quality of this system comes largely from the abstraction of the gesture from the originating musical parameters; eliminating that process also eliminates the general nature of the insights which may be gained from it. Having said this, it may be more appropriate to have a little more complexity than the extremely pared down version I have presented; presumably there is a level of complexity which ideally captures the nature of the piece being analysed while maximising the interpretive power provided.

5.2.2 Application

Given that this system of analytical tableaux is accepted, even with the above reservations, it remains for me to suggest some useful aspects of this method of analysis.

Any analysis is always a useful tool for pedagogy and this kind may be especially so, since a student can assign an overall gesture which s/he wishes to achieve in a performance and work backwards through each preceding phrase to obtain clues as to their interpretation. Given a particular set of resultant, combinatorial, meta- and basic gestures it is possible to work out some elements of confusing parts of music in a way which may just satisfy the ‘but why’ response of a student. The system may also be useful to engage in comparative exercises between different cultural and stylistic practices, so that we can answer questions like: Does this practice favour using the same kind of gesture repeatedly and differentiate them using only meta-gestures? Or how does this particular culture structure their music in contrast to a neighbouring one? An example of such an application may be the contrast between the minimalist music of a composer such as Philip Glass with the gamelan music of Java: These may sound very similar at the level of individual gestures but may display completely dissimilar properties at larger levels.

A system of notating gestures may also be of use for performers where a conductor or guest artist wishes to communicate how s/he wishes a particular work to be performed since traditional notation does not necessarily eliminate one reading or another. Of course, gestures may be enacted in multiple differing ways, so it does not offer a positive solution to the problem (if indeed it is considered a problem). Even so, exotic applications are frequently adopted for novel techniques beyond the original intended scope.
Mathematical applications can also include improving the quality of computer-generated musical performances. The same kind of approach may also be used to analyse any of the fields discussed in the Meaning section of Chapter 2: If other fields of human endeavour are related to a gestural concept, they should be equally amenable to gestural analysis. Other mundane applications which can follow from this kind of mathematical approach may include fields where important decisions need to be made rationally on the basis of incomplete information, such as in the field of financial risk management.

The reason why I see Hatten's concept of gesture as an important musicological concept is precisely because it manages to capture the way in which musical ideas, what Scruton would term tones as opposed to sounds (1997:14-18), relate to one another. It is this relation which finds an analogue in similar relationships between other kinds of ideas and it is in that analogy that gestures have meaning. It is the author's hope that sufficient grounds have been provided to defend against Steven Pinker's speculation that music is mere "evolutionary cheesecake" (1997:528-538).

My closing contention, on the basis of the preceding study, is that musical thinking has a fundamental role in the process of human cognition and should, as such, play a central role in the study thereof.
Figure 55. The Mandelbrot set (Beyer: 2009), arguably the most famous fractal, which displays the property of self similarity also seen in the preceding analyses. The bottom image is an enlargement of a portion of the upper image. Notice that there is a well-defined starting point (i.e. where the whole structure is visible in the upper image) which corresponds to the starting point offered by gestures. Self similarity need not be exact (Mandelbrot:1982), and should not be confused with the more precise scale invariance possessed by some fractals.
List of Sources


Appendix A

For the purposes of this dissertation I will use the following definition of a formal theory:

A formal theory $T$ consists of:

(1) A countable set of symbols. (A finite sequence of symbols of $T$ is called an expression of $T$.)

(2) A subset of the expressions, called the well-formed formulas (abbreviated wffs) of $T$. The wffs are the legal sentences of the theory.

(3) A subset of the wffs called the axioms of $T$.

(4) A finite set of relations $R_1$, ..., $R_n$ on wffs, called rules of inference. For each $R_i$ there is a unique positive integer $j$ such that for every $j$ wffs and each wff $A$ one can effectively decide whether the given $j$ wffs are in the relation $R_i$ to $A$; if so, $A$ is called a direct consequence of the given wffs by virtue of $R_i$. For example, the rule modus ponens is a relation on three wffs, $A$, $A \rightarrow B$, and $B$, by which $B$ is a direct consequence of $A$ and $A \rightarrow B$.

Since the set of axioms is often infinite, this set is often specified by providing a finite set of axiom schemata. A schema is a statement form; it provides a template showing the form of a wff while leaving some pieces unspecified through the use of metavariables. In the above example $A$ and $B$ are metavariables which stand for wffs of the theory. An instance of a schema is a wff obtained from the statement form by substitution.

(Davis: 1989)
## Appendix B

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pitch</strong></td>
<td>The higher the pitch the higher the tension. / is low to high, \ is high to low.</td>
</tr>
<tr>
<td><strong>Tonal value of pitches</strong></td>
<td>The order of tension is assumed to be: Tonic: subdominant: dominant: sub-median: median: supertonic: leading note although this is largely a matter of feeling as well as the mode involved.</td>
</tr>
<tr>
<td><strong>Melodic tension</strong></td>
<td>Larger leaps are generally taken to create higher tension.</td>
</tr>
<tr>
<td><strong>Volume</strong></td>
<td>Louder = Higher tension.</td>
</tr>
<tr>
<td><strong>Timbre</strong></td>
<td>Darker sounds, more complex waveforms may be considered more intense. Chord density is a related concept.</td>
</tr>
<tr>
<td><strong>Harmony</strong></td>
<td>As for tonal value of pitches.</td>
</tr>
<tr>
<td><strong>Harmonic tension</strong></td>
<td>Using Hindemith’s classification, for which see figure 1.</td>
</tr>
<tr>
<td><strong>Rhythmic density</strong></td>
<td>More complex rhythms are assumed to have more tension.</td>
</tr>
<tr>
<td><strong>Textural density</strong></td>
<td>Close counterpoint is taken as higher tension.</td>
</tr>
<tr>
<td><strong>Integrated Gesture</strong></td>
<td>An averaged out gesture taken from the above parameters.</td>
</tr>
</tbody>
</table>

*Table 9. A list of parameters and their implementation.*
<table>
<thead>
<tr>
<th>Dimension</th>
<th>Gesture</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pitch</td>
<td>/</td>
<td>The G' at bar 1.2.2.1 is non-essential.</td>
</tr>
<tr>
<td>Tonal value of</td>
<td>/</td>
<td>The B at bar 1.2 is the tonic.</td>
</tr>
<tr>
<td>pitches</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Melodic tension</td>
<td>/</td>
<td>As above.</td>
</tr>
<tr>
<td>Volume</td>
<td>\</td>
<td>As suggested by the placement of strong beats.</td>
</tr>
<tr>
<td>Timbre</td>
<td>\</td>
<td>No clear indication, derived from volume.</td>
</tr>
<tr>
<td>Harmony</td>
<td>/</td>
<td>The B' is the root of the chord.</td>
</tr>
<tr>
<td>Harmonic tension</td>
<td>^</td>
<td>The G' momentarily produces a chord of type III (in Hindemith's typology). The resolution of this dissonance will tend amplify the decrease in volume toward the end of the gesture.</td>
</tr>
<tr>
<td>Rhythmic density</td>
<td>\</td>
<td>Suggested by the placement of the ornament slightly before the middle of the gesture.</td>
</tr>
<tr>
<td>Textural density</td>
<td>\</td>
<td>As for the rhythm.</td>
</tr>
<tr>
<td>Integrated</td>
<td>\</td>
<td>Mostly due to the volume and the resolution and the slightly dissonance of the non-harmony note in the first half.</td>
</tr>
<tr>
<td>Gesture</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 10. *The gesture referred to as [A] in figures 16 and 17 above.*
<table>
<thead>
<tr>
<th>Dimension</th>
<th>Gesture</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pitch</td>
<td>\</td>
<td>The E#' at 2.1.2.2 is the leading note of the dominant key whose harmony is found in this bar.</td>
</tr>
<tr>
<td>Tonal value of pitches</td>
<td>/</td>
<td>The leap at the end of the gesture is large and fairly large and unexpected.</td>
</tr>
<tr>
<td>Melodic tension</td>
<td>\</td>
<td>In line with the beats</td>
</tr>
<tr>
<td>Volume</td>
<td>/</td>
<td>Flautists will tend to darken the tone at the C#’ (bar 2.1) because it is an intrinsically weak note on the instrument; this may serve to accent the note because of the attention paid to it.</td>
</tr>
<tr>
<td>Harmony</td>
<td>\</td>
<td>The progression is from third to fifth to a raised seventh.</td>
</tr>
<tr>
<td>Harmonic tension</td>
<td>/</td>
<td>Starting as type I.1 it moves to type I.2 and then to II.2 at the very end.</td>
</tr>
<tr>
<td>Rhythmic density</td>
<td>/</td>
<td></td>
</tr>
<tr>
<td>Textural density</td>
<td>/</td>
<td></td>
</tr>
<tr>
<td>Integrated Gesture</td>
<td>\</td>
<td>The forward inclination is much stronger here than in [A]</td>
</tr>
</tbody>
</table>

Table 11. [B]
<table>
<thead>
<tr>
<th>Dimension</th>
<th>Gesture</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pitch</td>
<td>/</td>
<td></td>
</tr>
<tr>
<td>Tonal value of pitches</td>
<td>\</td>
<td>The E#' at 2.2 is the raised fourth degree of b minor.</td>
</tr>
<tr>
<td>Melodic tension</td>
<td>\</td>
<td>The semitone step is of low melodic tension.</td>
</tr>
<tr>
<td>Volume</td>
<td>\</td>
<td>Two-note slurs have a strong tendency to go from strong to weak.</td>
</tr>
<tr>
<td>Timbre</td>
<td>\</td>
<td></td>
</tr>
<tr>
<td>Harmony</td>
<td>\</td>
<td>From leading-note of the dominant key (F# minor/major) to its tonic.</td>
</tr>
<tr>
<td>Harmonic tension</td>
<td>\</td>
<td>From type II.2 to type I.2</td>
</tr>
<tr>
<td>Rhythmic density</td>
<td>^</td>
<td>The appoggiatura is presumed to be of crotchet length.</td>
</tr>
<tr>
<td>Textural density</td>
<td>^</td>
<td>As for the rhythm.</td>
</tr>
<tr>
<td>Integrated Gesture</td>
<td>\</td>
<td>A strong withdrawal.</td>
</tr>
</tbody>
</table>

*Table 12. [C]*
<table>
<thead>
<tr>
<th>Dimension</th>
<th>Gesture</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pitch</td>
<td>/</td>
<td>All the lines follow the same motion, except for the minor reversals in the violin part.</td>
</tr>
<tr>
<td>Tonal value of pithes</td>
<td>^</td>
<td>No outstanding moments.</td>
</tr>
<tr>
<td>Melodic tension</td>
<td>\</td>
<td>The large leap in the two lower parts is high in tension, after which the melody becomes more still.</td>
</tr>
<tr>
<td>Volume</td>
<td>/</td>
<td>Following the pitch lines</td>
</tr>
<tr>
<td>Timbre</td>
<td>\</td>
<td></td>
</tr>
<tr>
<td>Harmony</td>
<td>^</td>
<td>A slight increase in tension in the middle of the bar can be assumed because the violin outlines a second inversion chord.</td>
</tr>
<tr>
<td>Harmonic tension</td>
<td>\</td>
<td>As above.</td>
</tr>
<tr>
<td>Rhythmic density</td>
<td>^</td>
<td></td>
</tr>
<tr>
<td>Textural density</td>
<td>^</td>
<td></td>
</tr>
<tr>
<td>Integrated Gesture</td>
<td>/</td>
<td>There are three successive points of tension here, corresponding to each beat, each arising from a different source but following the line of pitch upwards.</td>
</tr>
</tbody>
</table>

Table 13. [G]
<table>
<thead>
<tr>
<th>Dimension</th>
<th>Gesture</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pitch</td>
<td>\</td>
<td>As for the previous gesture.</td>
</tr>
<tr>
<td>Tonal value of pitches</td>
<td>^</td>
<td></td>
</tr>
<tr>
<td>Melodic tension</td>
<td>\</td>
<td>As for the previous gesture.</td>
</tr>
<tr>
<td>Volume</td>
<td>\</td>
<td>Following the line of pitch</td>
</tr>
<tr>
<td>Timbre</td>
<td>^</td>
<td></td>
</tr>
<tr>
<td>Harmony</td>
<td>\</td>
<td>Because the outlined second inversion chord in the violin is now right at the end of the bar and in a very weak position the implication is effectively avoided. The first inversion chord implication, again in the violin, is stronger than the root position chord on the second beat.</td>
</tr>
<tr>
<td>Harmonic tension</td>
<td>\</td>
<td>As above</td>
</tr>
<tr>
<td>Rhythmic density</td>
<td>^</td>
<td></td>
</tr>
<tr>
<td>Textural density</td>
<td>^</td>
<td></td>
</tr>
<tr>
<td>Integrated Gesture</td>
<td>\</td>
<td>This gesture is effectively a mirror image of gesture [H]</td>
</tr>
</tbody>
</table>

Table 14. [H]
<table>
<thead>
<tr>
<th>Dimension</th>
<th>Gesture</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pitch</td>
<td>/</td>
<td>The whole of the second gesture is higher.</td>
</tr>
<tr>
<td>Tonal value of pitches</td>
<td>/</td>
<td>The main pitches in L1G1 are the tonic and the dominant of b minor while L1G2 has the mediant and supertonic of D major.</td>
</tr>
<tr>
<td>Melodic tension</td>
<td>\</td>
<td>The second gesture has a falling major second while the first has a rising third.</td>
</tr>
<tr>
<td>Volume</td>
<td>^</td>
<td>No substantial motion.</td>
</tr>
<tr>
<td>Timbre</td>
<td>/</td>
<td></td>
</tr>
<tr>
<td>Harmony</td>
<td>/</td>
<td>From b:i to b:V.</td>
</tr>
<tr>
<td>Harmonic tension</td>
<td>/</td>
<td>From a chord of type 1.1 to II.2.</td>
</tr>
<tr>
<td>Rhythmic density</td>
<td>\</td>
<td></td>
</tr>
<tr>
<td>Textural density</td>
<td>\</td>
<td>Textural density matches the rhythmic density here.</td>
</tr>
<tr>
<td>Integrated Gesture</td>
<td>/</td>
<td></td>
</tr>
</tbody>
</table>

*Table 15. Meta-gesture [x], derived from gestures [A] and [B], and seen in figure 17 above.*
<table>
<thead>
<tr>
<th>Dimension</th>
<th>Gesture</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pitch</td>
<td>\</td>
<td></td>
</tr>
<tr>
<td>Tonal value of pitches</td>
<td>^</td>
<td>The E# in the middle of the gesture is the focal point.</td>
</tr>
<tr>
<td>Melodic tension</td>
<td>\</td>
<td>Maximum tension also occurs at the leap from the C# to the E#.</td>
</tr>
<tr>
<td>Volume</td>
<td>\</td>
<td>As above, although some performers may accentuate the c# instead making the gesture ‘\’.</td>
</tr>
<tr>
<td>Timbre</td>
<td>\</td>
<td>As above.</td>
</tr>
<tr>
<td>Harmonic</td>
<td>/</td>
<td>Even though the harmony is most dense at 2.1.2.2, the release of tension happens soon after.</td>
</tr>
<tr>
<td>Harmonic tension</td>
<td>/</td>
<td>As above.</td>
</tr>
<tr>
<td>Rhythmic density</td>
<td>\</td>
<td></td>
</tr>
<tr>
<td>Textural density</td>
<td>\</td>
<td>Texture becomes more intense at 2.1.2.2.</td>
</tr>
<tr>
<td>Integrated Gesture</td>
<td>\</td>
<td>More intense both in advance and withdrawal than [x].</td>
</tr>
</tbody>
</table>

*Table 16. Meta-gesture [y] (derived from gestures [B] and [C])*
<table>
<thead>
<tr>
<th>Dimension</th>
<th>Gesture</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pitch</td>
<td>\</td>
<td>The fall is slightly greater than the rise.</td>
</tr>
<tr>
<td>Tonal value of pitches</td>
<td>\</td>
<td>Because of the change of harmony from b:I to b:V, and because the</td>
</tr>
<tr>
<td></td>
<td></td>
<td>accompaniment outlines the full</td>
</tr>
<tr>
<td></td>
<td></td>
<td>harmony, the tonal values rise.</td>
</tr>
<tr>
<td>Melodic tension</td>
<td>^</td>
<td>The variation in melodic tension effectively cancels out any strong</td>
</tr>
<tr>
<td></td>
<td></td>
<td>motion.</td>
</tr>
<tr>
<td>Volume</td>
<td>^</td>
<td>In line with the pitch.</td>
</tr>
<tr>
<td>Timbre</td>
<td>^</td>
<td></td>
</tr>
<tr>
<td>Harmony</td>
<td>\</td>
<td>b:I to b:V</td>
</tr>
<tr>
<td>Harmonic tension</td>
<td>^</td>
<td>Both chords are type I.1 (without seconds, sevenths or tritones,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>each with the bass note the same as the root).</td>
</tr>
<tr>
<td>Rhythmic density</td>
<td>^</td>
<td></td>
</tr>
<tr>
<td>Textural density</td>
<td>^</td>
<td></td>
</tr>
<tr>
<td>Integrated Gesture</td>
<td>\</td>
<td>A very slight advance which may be compensated for by the strength</td>
</tr>
<tr>
<td></td>
<td></td>
<td>of the withdrawal in the second gesture.</td>
</tr>
</tbody>
</table>

Table 17. *Meta-gesture [z] (derived from gestures [G] and [H])*