
Andrew S. Powell

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HARMONY IN TIME: MEMORY, CONSCIOUSNESS, AND EXPECTATION IN
BEETHOVEN’S WALDSTEIN SONATA, OP. 53

A Thesis
Submitted to the Mary Pappert School of Music

Duquesne University

In partial fulfillment of the requirements for
the degree of Master of Music

By
Andrew S. Powell

May 2010
HARMONY IN TIME: MEMORY, CONSCIOUSNESS, AND EXPECTATION IN
BEETHOVEN’S WALDSTEIN SONATA, OP. 53

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ABSTRACT

HARMONY IN TIME: MEMORY, CONSCIOUSNESS, AND EXPECTATION IN BEETHOVEN’S WALDSTEIN SONATA, OP. 53

By

Andrew S. Powell

May 2010

Thesis supervised by Dr. Jessica Wiskus

Harmonic expectations in Western tonal music are formed throughout an individual’s lifetime, created by the encounter of commonly recurring patterns of relationships of chords within music. The recognition and identification of these patterns, particularly when the anticipated patterns are denied, are expressed on a conscious level. Although identified and articulated from the conscious experience, a listener’s attention may not be actively engaged in harmonic processing; moreover, the identification of deviations may arise from nonconscious processing of harmonic events. This paper identifies the processes in formulating and expressing harmonic expectation and its subsequent denial, as well as the nonconscious processing which influences this recognition. Additionally, this paper theorizes that expectations on a larger scale, beyond the chordal level, may be generated and fulfilled nonconsciously. This paper concludes
with an analysis of Beethoven’s *Waldstein* Sonata, identifying moments of conflict between small-scale denials of expectations within the fulfillment of large-scale processes.
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Chapter 1: Identifying harmonic expectation

Western tonal music utilizes a hierarchical structure organized around a central tone, or tonic. Momigny (n. d.), when discussing this organizational structure, notes that “The tonic triumphs over all the other notes. ( . . .) It is the center of gravity, the purpose of all purposes, the end of all ends; in a word, it is to [tonic] that the scepter of the musical empire is entrusted.”\(^1\) Within tonal practice, this organization of tones (and chords) generates certain expectations of harmonic progressions based on the frequency of particular chordal relationships, such as the progression of dominant to tonic (V-I). Such common progressions become anticipated by the listener.\(^2\) As noted by Justus and Bharucha, "In the Western musical system, expectations are created for the listener through a harmonic context and are then fulfilled or violated to varying degrees" (1000). Justus and Bharucha continue to summarize the creation of harmonic expectations in listeners:

If the violation of expectations is important in musical aesthetics, then one must consider how such expectations are generated. One proposal is that harmonic schemata create expectations for sequential events typical of the musical environment. The mind is endowed with the ability to extract regularities from its surroundings, allowing an individual to process frequently encountered patterns more efficiently. Music is rich in regularities (. . .) (1000)

Because of the order established through this hierarchical arrangement, expectations concerning the key can be generated and ultimately fulfilled—or avoided. Recognizing deviations from common chordal progressions requires both retrospective

\(^1\) Quoted in Zbikowski (2002): 316.
\(^2\) Holleran et. al. (1995) summarize, "Listeners generate harmonic expectancies conforming to the more common chord patterns" (738).
and prospective processing. One must be able to place the current harmonic geography within the context of what has preceded with respect to the immediate material as well as throughout the duration of the entire piece. Anticipating what chord may come next, however, is a prospective act that is drawn from this retrospective processing, as well as previous experiences with similar music. Harmonic expectation is a forward-thinking process generated by the frequency of commonly recurring patterns and relationships, and its denial, when recognized, comes to the forefront of one’s conscious processing of the piece.

*Identifying elements through a review of literature*

A significant amount of studies have confirmed the existence of harmonic expectation within humans. While the evidence which supports the existence of harmonic expectation is too voluminous to recount within the scope of this project, some studies and discussions have identified critical components of the phenomenon. One essential element of harmonic expectation is memory—particularly, the use of working and short-term memory with respect to brief progressions of chords. In conjunction with working memory, attention and prior musical training greatly influence the recognition of denied harmonic expectation or unusual progressions. The connection of emotion to the denial of harmonic expectation (beyond the relationship of music and emotion in general) has also been identified as having a long-lasting impact, generating specific, identifiable (and recurring) reactions to the individual moment. Beyond harmonies, though, expectation is generated in a variety of musical elements; while the primary emphasis of “expectation” within this paper will focus on the harmonic aspects of music, the
integration of all elements of music should not be overlooked, as it is the culmination of all components which heightens the sense of expectation.

One study by Loui and Wessel (2007) identified the influence that attention and musical training had on participants’ reactions to tonally unrelated chords. In their four experiments, Loui and Wessel utilize the interaction of melody and harmony and manipulate how each participant attended to the musical excerpt. Participants responded to three different chordal progressions underneath a uniform melody: one with highly expected tonal progressions (with respect to "traditional" rules of Western harmony), one of moderate expectation (with some slight deviations from the common practice), and one that greatly deviates from expected progressions. When focus is limited to only the melody, the responses from participants with musical training were significantly impaired when accompanying harmonies were unexpected, while individuals without musical training were unimpeded in response time. When viewing identical passages holistically, however, both groups displayed similar responses (in terms of preferences); this particular experiment revealed that both groups, when not isolating the individual line, were sensitive to unusual harmonic progressions. When reducing the amount of time between individual chords and replicating the previous two experiments, the results

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3 Loui and Wessel (2007) summarize numerous studies which reaffirm the general notion. Numerous works have identified that expectation occurs within musicians and nonmusicians alike, regardless of levels (if any) of musical training. Additionally, Loui and Wessel have identified reaction time when responding to violations of harmonic expectation as an indication of implicit processing of harmonic patterns within individuals. The slower response of individuals (musicians or not) to tonally unrelated chords/progressions, Loui and Wessel note, suggests "that musical harmony can be processed implicitly and is independent of musical training" (1084).

4 This particular test removed selective attention which limited the immediate, conscious experience to only the individual melody, allowing participants to experience the progression. See Loui and Wessel (2007): 1090.
between musicians and nonmusicians remained similar. In discussing the effects of attention and musical training on the perception of unusual harmonic progression, Loui and Wessel (2007) summarize, "Musically trained participants were still sensitive to the influence of harmony, whereas musically untrained participants were unaffected by the manipulation of harmonic expectation" (1091). Moreover, one possible development from musical training includes the ability to form "automatic expectations for typical harmonies, so that musicians processed harmonies preattentively, regardless of their relevance to the task” (1091-92).

Not only do expectations exist, but such denial of harmonic expectation may create lasting emotional memories within individuals. A 1991 survey by Sloboda asked participants to recall specific emotional reactions to music, including such physical responses as shivering, racing heart, and crying. Additionally, participants were asked to pinpoint (if possible) exact locations in the music where such physical reactions were elicited. The overwhelming response to sections of music identified as having "new or unprepared harmonies" was shivering. When the specific sections of music were identified by participants, some common patterns emerged. Frequently, new or unprepared harmonies—as well as other features of music that generated shivers in participants—display "multiple level" expectancies that are realized on one level, but violated on another. One example involves melodic/pitch expectancies, where a melodic

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5 Loui and Wessel (2007) note, “The results could not be attributed to differential demands in working memory for musicians and nonmusicians, since speeding up successive chords in the chord progression did not change the pattern of results” (1090).

6 Sloboda (2005) favors physical reactions to emotions because they are considerably more memorable than generative, broad-sweeping summations such as "happy" or "sad" feelings. Sloboda notes, "It is very difficult to be mistaken about whether you cried or not to a piece of music. Such reactions are stereotyped, memorable, distinct from one another, and shared by all humans regardless of culture and vocabulary" (209).

7 For a complete table outlining the elements of music and their accompanying physical reactions by participants, see Sloboda (2005): 210.
expectation (such as a sequential series of pitches) is realized, but the underlying harmonic patterns violate the norm. This feature becomes even more prominent of an emotional memory when it occurs at an important structural boundary within the piece. Sloboda (2005) summarizes, "If there is some psychological dissociation or independence between the various mental analyses that may be carried out on music, then it could well be that some emotional responses come about when there is a mismatch between the output of two processing units" (212).

The concept of "various levels of expectation" interacting throughout different elements of music has been reaffirmed. Daniel Levitin identifies multiple features within music that generate their own expectations to the listener, and the emotional response generated to some pieces may be a reflection of the composer's careful manipulation of these elements. Formal structure, melodic phrasing (such as seven-measure phrase lengths), timbres (particularly combining timbres associated with one genre intermingled in other "distant" genres), and rhythm all carry their own set of "expectations" that have been cultivated through repetition. Because of the saturation of common practices and events within one's musical culture, these tendencies are accepted as the "normal" or prototypical practices. Levitin (2006) notes, "An important way that our brain deals with standard situations is that it extracts those elements that are common to multiple situations and creates a framework within which to place them" (115).

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8 Sloboda (2005) notes, "This dual characteristic of an event being both expected (at one level or according to one criterion) and unexpected (at another level or on another criterion) seems to be shared by several of the shivers-provoking passages" (211).

9 Levitin (2006) asserts that the ability to formulate expectations for music is essential for developing emotional responses to violations of these expectancies; music that is devoid of the unexpected, as described by Levitin, is emotionally "flat." Levitin summarizes, "The appreciation we have for music is intimately related to our ability to learn the underlying structure of the music we like ( . . ) and be able to make predictions about what will come next. ( . . ) The thrills, chills, and tears we experience from music are the result of having our expectations artfully manipulated by a skilled composer and the musicians who interpret that music" (111).
While these studies as well as many others have expressed harmonic expectation and identified elements such as memory, awareness (consciousness), and emotion, a large amount of the body of research removes the holistic experience of a piece.\footnote{To some degree, these preliminary approaches of limiting the amount of material provided to a listener to attend to and recall are necessary. Sloboda (1985) discusses that the process of recollection is perhaps the best source for expressing and identifying the musical experience for the listener. Sloboda notes, "Unless the material to be recalled is very short we are in danger of seriously underestimating the amount of musically related mental activity that has taken place" (151).} While the Loui and Wessel study utilizes a tonal melody harmonized by progressions identified as typical or unusual with respect to traditional Western (tonal) practice, the examples are considerably short, focusing solely on working memory. Sloboda’s survey concerning emotional response to music emphasizes the connection one makes to particular examples of music, but also relies heavily on the identification of individual moments within the music, not necessarily the experience of the piece in its entirety. Levitin’s discussion of numerous elements of one’s sense of expectation reinforces the importance of previous musical listening experience in the development of “rules” for a given system within a culture.

What is essential to the listening experience is the element of time. While the findings have expressed the existence of harmonic expectation, the window of time in which these instances are viewed is relatively small, especially in the context of larger pieces. Expectations of certain chordal progressions have undoubtedly been confirmed, but these findings focus almost explicitly on short-term and/or working memory. Loui and Wessel identified that there is nonconscious processing of harmonies in individuals—at the very least, those with musical training—which can transcend conscious processing and attention; aside from this brief realization of subconscious or nonconscious processing of harmonies, though, focus has continuously been placed only
on conscious activity. Only a superficial picture of the musical experience with respect to expectation has been depicted, overlooking such processes as long-term memory as well as subconscious and nonconscious processing. If harmony is unfolding over time, as numerous theorists (as well as psychologists) have discussed and expressed, is the human mind capable of identifying and/or processing harmonic passages that occur beyond the chordal level? Is there a difference between chordal expectation and harmonic expectation?

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**Long-term harmonic planning: Waldstein Sonata, mm. 1-13**

The first movement of Beethoven’s *Waldstein* Sonata incorporates numerous aspects of the previously described elements in the formation and identification of expected musical events. The piece uses a motivic figure that combines harmony, melody, and rhythm to produce a brief, memorable idea that not only generates the first tonal area of the exposition, but also provides a unifying link between all of the sections within the form (in this instance, single-movement sonata form). Additionally, other isolated areas within the piece display similar qualities of apparent denied chordal expectation contained within extended harmonic planning, but these passages do not contain the same thematic emphasis as the opening passage. Moreover, the relationship

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11 Sloboda (1985) notes that the recollection studies, while providing valuable insight to the experience one has when listening, gives only a glimpse of a “complete” musical experience. When relating the personal experience of listening to music outside of a set of limitations (in a more natural setting), Sloboda states, “I have frequently been unable to recall details of a long piece of music after a first hearing, even though I was totally engaged with the music when it took place.” He continues, “As when listening to a lecture, or reading a novel, the details of argument and plot may fully engage one’s intellect whilst one experiences the unfolding of ideas, but they may leave recoverable traces at the end of the session” (151).

12 The phrase “chordal expectation” has been proposed to reflect the idea of the limited scope through which “harmonic expectation” has been described. “Harmonic expectation,” in contrast, includes this level of relationships of harmony, but also expands beyond this notion, identifying relationships that occur in larger passages of music, such as themes or key areas as well as entire movements or pieces.
of keys exploits the (originally) suggested brevity of musical memory to recreate tonal geography, facilitating the modulation to distant keys.\textsuperscript{13}

In the first movement of Beethoven's \textit{Waldstein} Sonata, the harmonic planning of the piece has evolved away from a clearly established, strictly-linear (and predictable) hierarchy where all is centered around the tonic key. Chordal deviations from the "expected" tonal (hierarchical) process result from long-term expansions of the traditional rules, while long term violations of formal expectation are the result of conventional techniques on the local level. Moreover, the immediate recognition of unusual progressions might obscure the identification of long-term harmonic properties, while the fundamental, formal discrepancies are concealed through short-term progressions, enhanced by duration and other salient features of the music, such as rhythm and dynamics.

The first thirteen measures present a unique combination of apparent tonal conflict as well as unusual chordal progressions on a localized level. While the movement as a whole is in C major, the opening four measures contain the progression I-\(V^2/V-V^6\), a pattern that does not emphasize the tonic, but instead the dominant key of G major. Should this section be reconsidered in the key of G, the progression becomes IV-\(V^2\)-I\(^6\), which follows a typical cadential progression, presenting a pattern of predominant-dominant-tonic. Not only do the harmonies imply G major, but the melody also reinforces this key. The notes of the melody outline the essential pitches to defining the

\textsuperscript{13} Schenkerian analysis, which helps identify and reaffirm the notion of “long-term” harmonic planning and relationships beyond chord-by-chord process, may appear to contradict this assertion. Rather than attempting to relate the entire movement back to one unflinching tonic key (which would stress an arpeggiation of the tonic chord rather than modulating to other keys), the analytical technique has been limited to brief passages instead of providing a full-scale depiction of the voice leading in the piece. “Distance” between keys refers to a more “traditional” approach, with the relationship of common tones between particular keys (scales) serving as the basis for the comparison.
key: tonic (G) and dominant (D); the leap to the mediant (B) in m. 3 completes the major tonic triad.  

Yet, this preliminary instance of "tonal conflict" between C major and G major within just these four bars is unsubstantiated—barring predisposition to the piece. The only information from which one has to draw harmonically (tonally) is a firmly established predominant-dominant-tonic pattern in the key of G major, as well as the clearly outlined tonic chord in the melody. These four measures alone provide numerous contextual clues for developing a concept of the piece; Povel and Jansen (2002) note the "crucial importance of the development of an appropriate frame of reference, or schema, that identifies the context in which the tones in the input are interpreted and that guides further processing, possibly leading to a musical representation" (51). Though brief, mm. 1-4 provide a clearly defined schema of the "established order" of harmony (and the hierarchical organization of the pitches), emphasizing G major as the tonal area.

The next four measures (mm. 5-8), however, combine the familiarity of the melodic pattern (though transposed down a Major 2\textsuperscript{nd}) over a slightly modified harmonic background. While the original progression of IV-V\textsuperscript{2}-I\textsuperscript{6} is maintained through mm. 5-7, the last measure of this apparent sequence (m. 8) alters the "tonic" chord of the progression, creating a i\textsuperscript{6} and suggesting some form of mode switch. Following this abrupt change to the apparent "sequence," there is a rapid alternation of G\textsuperscript{7} and i\textsuperscript{6} in mm.

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\textsuperscript{14} Holleran, Jones, and Butler (1995) note, "When a tonal melody is accompanied by explicit chords that reinforce its key, this should provide a clear tonal context" (739).

\textsuperscript{15} Povel and Jansen (2002) continue, stating, "For tonal music, this frame of reference consists of a metrical frame that enables the interpretation of the rhythmical aspects and a harmonic frame that allows the interpretation of the melodic/harmonic aspects" (51). These four measures meet these criteria: the repetitive eighth notes, in conjunction with a melody that enforces the first and third beats of the measure, suggest 4/4 (common) time. Additionally, the harmonic pattern (IV-V-I) strongly establishes a sense of key, and the melodic outlining and reinforcing of tonic (m. 3) and dominant to tonic (m. 4) all seem to confirm the key from the onset.
9-10, though the melody primarily outlines the tritone of B-F. By outlining this tritone (a characteristic interval of a dominant-seventh chord) in the melody, the G chord assumes a dominant function (in the key of C); the melodic descent in m. 11 also contains the interval of an augmented 2nd (B-Ab), implying that the "new key" is C minor. The key of C minor is affirmed, as m. 12 consists solely of an arpeggiated C minor chord and arrives on a unison fermata on G in m. 13.

Figure 1. Ludwig van Beethoven, *Waldstein* Sonata, Op. 53, mm. 1-13.

In the above passage, Roman-numeral analysis implies the denial of harmonic expectation concerning both individual chords and keys. The concept of C as the tonic
key is absent until late in the section, when the prevailing harmonic pattern is altered to emphasize the minor mode of C. This key area is also prolonged, contrary to the preceding material; the opening melodic figure is also completely absent. Moreover, the temporary tonicization of F major—immediately after G major—unites two foreign keys without any sort of preparation; this "sudden modulation" also appears to violate traditional harmonic rules between keys, not just chords. This modulation, however, occurs within a melodic sequence, obscuring the juxtaposition, with the only difference between these two subgroups being the use of a minor tonic chord in m. 8.

While there is an apparent contradiction of traditional tonal functions within numerous sections of this passage, an alternative approach to these measures identifies a formal organization that not only clearly outlines one “definitive” key, but also articulates the fundamental tonal progression of tonic to dominant, as opposed to the suggestive predominant-dominant-tonic pattern. If viewing only the bass line, the first thirteen measures imply only C major as the tonic key. While the importance of the sequential pattern within the first eight bars cannot be denied, this passage occurs within the context of a descending chromatic bass line, suggesting that the two sections are not simply two distinct subgroups, but part of a cumulative whole. Moreover, this particular analysis suggests that the alternation of G⁷-f⁶ in mm. 9-10, which is not “functional” in a traditional interpretation, elaborate the note “G” (dominant of C major), with the “Ab” in the bass of the f⁶ functioning as an upper neighbor tone. Through the descending diatonic scale in m. 11 (and the subsequent arpeggio in m. 12), The key area of C minor not only reaffirms the tonic note of C, but also leads to the firm arrival of G, the true dominant.
This brief example emphasizes the complexity of harmonic organization and suggests the possibility of multiple levels of harmony that occur not only between individual chords, but also within a larger schemata. Throughout this passage, there are several possible "local levels" where harmonic expectation is either denied or exploited for dramatic effect: the first three measures, which outline a progression in the (dominant) key of G; the shift from G\(^6\) to a Bb major chord which generates a sequence that descends by a M2; the sudden coloring of the F\(^6\) chord in m. 8 that results in a change of quality from major to minor; and the rapid alternation between a G\(^7\) and f\(^6\) while the melody outlines a tritone (B-F). While these instances seem contradictory to expectations when focusing on the immediate "commonplace conventions" of Western music and its tonal hierarchy, alternative approaches identify and suggest larger harmonic structures and patterns which may function according to the "rules" of harmony, or may also divert from convention and explore novelty. In alternative approaches, this passage contradicts the developed expectations on only certain levels, while the "essence" of the passage is firmly grounded in a quintessential tonal pattern.

In the first movement of Beethoven's Waldstein Sonata as a whole, there are numerous instances where individual, localized moments of denied harmonic expectation
are in fact a part of a larger harmonic scheme, with these moments of heightened tension (or anxiety) resulting from expanded conventional processes. This particular movement suggests that the composer—and, plausibly, the listener—identified and perceived harmonic passages on a larger scale than simply note-by-note or chord-by-chord, which, in turn, advocates long-term harmonic expectations on multiple levels of comprehension.

Despite this apparent "long-term" explanation for the denial of expectation, the formal harmonic organization of the piece defies stereotypical harmonic format for single-movement sonata form; the relationship of keys within the various sections of the form itself, as well as the themes utilized in the exposition and the recapitulation, does not conform to the typical practices of the form, and these keys are considerably distant from each other. Most strikingly, though, this denial of harmonic expectation on the broadest level for the piece as one (complete) entity is blurred by individual notes or chords, prolonged over a period of time so that the chords become ingrained in one's memory and make the transition to a foreign key seem completely logical. Moreover, this movement stresses the concept of a relatively brief harmonic memory, which can be utilized to exploit longer harmonic relationships by blurring transitional chords or progressions with the idea of familiarity. This technique pacifies one's expectations immediately, but greatly disrupts the expectations one may have for the movement as a whole, particularly if the listener carries any predisposition to the typical conventions of single-movement sonata form. Is harmonic expectation strictly limited to the chord-by-chord identification, as numerous psychological tests have indicated and hypothesized, or does one truly perceive moments of extended harmonic planning, such as through the descending chromatic bass line evident in the introduction? Additionally, does the
perception of harmonic planning, in turn, receive its sense from moment-by-moment figuration? While the majority of the research will focus on the creation and identification of harmonic expectations as well as challenging the moment-by-moment approach of many studies, a brief discussion concerning the utilization of smaller passages that incorporates this reciprocity between small-scale and large-scale harmonic expectancies will be provided in Chapter 5.
Chapter 2: The importance of memory

Memory is an essential component for both the formation of harmonic expectations in general, as well as the recognition of the realization or violation of the anticipated events. Sloboda (1985) identifies the crucial importance of memory with respect to the perception of musical events:

The way one hears music is crucially dependent upon what one can remember of past events in the music. A modulation to a new key is heard only if one remembers the previous key. A theme is heard as transformed only if one can remember the original version of which it is a transformation. And so on. A note or chord has no musical significance other than in relation to preceding or following events. To perceive an event musically (that is, to recognize at least part of its musical function) is to relate it to past events. (175)

Beyond this general assertion that memory is integral to this phenomenon, though, harmonic expectation incorporates various levels and types of memory, ranging from a brief harmonic passage, to spanning entire pieces both within the listening experience as well as drawing from past experiences throughout one’s life. Expectation integrates both different levels of memory (covering various degrees and lengths of time), as well as different processes.16

Not only is the formation of memories on all levels critical to harmonic expectation, but the process (and apparent difficulties) in recalling previously stored memories greatly affect the response to musical stimuli. Musical memories also necessitate an acknowledgement of emotion, as well as its impact on the forming and recollection of memory; as previously discussed, the realization or violation of harmonic

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16 A condensed summary of the neurological formation of a memory is provided in Appendix 1.
expectations—as well as “traditional practices” within music in general—are directly linked to an emotional experience.

*Temporary information: short-term and working memory*

The memory processes identified by Loui and Wessl (as well as numerous others who have discussed harmonic expectation) involve two particular "levels" of memory: short-term memory, and working memory. Eichenbaum (2002) defines these levels as “a short-lived state where new information has achieved consciousness and thought” (16). Although both of these levels are nearly identical in the amount of time in which information is stored before it is removed (once it leaves one’s conscious attention directed toward the information), there is one critical difference between these two levels: any short-term memory is reflective of the amount of time in which it remains in consciousness, but working memory requires some form of manipulation of the material. 17 While the amount and duration of these two levels are heavily debated (ranging from six to ten items persisting for a matter of seconds), the type of information which can be stored is limitless; because of this feature of memory, different kinds of items may be interconnected, providing a wide-encompassing representation of what has been taken into memory.

The amount which can be stored within short-term and working memory with respect to music and, more specifically, chordal progressions, remains highly debated. One initial study suggested that the capacity for maintaining musical sounds was as small

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17 When separating working memory from the broad concept of short-term memory, LeDoux (1996) summarizes, “Working memory is pretty much what used to just be called short-term memory. However, the term working memory implies not just a temporary storage system but an active processing mechanism used in thinking and reasoning” (270).
as two seconds.\textsuperscript{18} The ability to maintain individual notes has also been shown to suffer when other pitches are interspersed.\textsuperscript{19} While these studies suggest that the amount of musical memory is greatly limited, some of these findings have also taken a "nonmusical context" approach. The organization and structure of music, with respect to both small- and large-scale features, facilitate one's memory of a piece. Because of the hierarchical structure of music, in which certain notes and chords take prominence over others, these essential features appear more frequently; likewise, larger formal organizations like single-movement sonata form reuse elements such as motives and themes as well as tonal areas.

This organization of music with respect to both micro as well as macro details generates numerous patterns within a piece (as well as across pieces), including melodic, rhythmic, harmonic, and formal qualities, in addition to numerous others. The detection of these patterns within music plays an integral role in the perception of the piece as a composite whole. Fiske (1990) notes, "Involved is a continuous comparison between what is occurring musically at a given instant and what the listener has already heard during the composition's performance" (24).\textsuperscript{20} Fiske further summarizes, "The recognition of patterns and their variations is the foundation of one's ability to deal with the structure of a musical composition" (24).

\textsuperscript{18} Loui and Wessel (2007) mention a study by Clarke (1999) when discussing their findings.
\textsuperscript{19} Sloboda (1985) mentions various studies by Deutsch, in which a note was played for the participant, and after a period of time (approximately five seconds), a second note was sounded, and the participant had to identify if the two notes were identical in pitch. In subsequent tests, the intervening space was filled with a series of numbers which the participant was also required to recall, as well as a variety of pitches, sometimes as close as a semitone to the initial tone. The results argue that pitch was the only factor to disrupt this memory, and that pitches with the closest proximity to the initial tone provided the greatest disruption.
\textsuperscript{20} Fiske (1990) presents this argument within the context of a philosophical "metalanguage" hypothesis of perceiving and responding to music. Using tonal and rhythmic relationships, Fiske conjectures that one's response to these relationships is a result of three critical elements of the experience: the detection of patterns in general, discrimination between numerous patterns, and the recognition of variations and modifications of these previously established patterns. (24)
While the presentation of significant amounts of stimuli may seem overloading from the onset, the identification of these patterns inherent in music actually facilitates the memory process. These patterns, when identified, are condensed through a method known as "chunking." As defined by Levitin (2006), chunking is “the process of tying together units of information into groups, and remembering the group as a whole rather than the individual pieces” (218). This process increases the amount of material that can be stored within working memory; rather than storing each individual unit of information, the group is stored as one single collection, occupying approximately the same unit of “space” within working memory as an individual item.21

When confronted with a new piece of music (foreign sounds to the ears), though, the process of memory is occasionally overwhelmed with new stimuli, and compensates by attempting to remember as much as possible. This newly acquired stimuli is typically repeated frequently, actively engaging the working (and short-term) memory.22 Although this task of analyzing and remembering new sounds provides a difficult challenge, the hierarchical arrangement of tonal music facilitates the process. Levitin (2006) argues, “Certain (. . .) notes in a musical piece are more important than others structurally, and we organize our learning around them” (219-20).23

Musicians utilize chunking in a variety of ways, including both the educational process and listening. Rather than storing individual notes, which may comprise multiple units within a working memory, the mind recognizes chords. Likewise, frequently

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21 LeDoux (1996) also notes that these condensed groups can take a variety of forms, including shapes, sounds, smells, etc. (271).
23 This hierarchical organization also generates its own tendencies when attempting to recall melodies or other musical units. Rather than beginning on random notes, there is a tendency to begin on pitches or sections that are of some structural significance. See Levitin (2006): 219-20
occurring progressions of chords, such as cadences, are often chunked together as well. Typical patterns of specific stylistic norms are also combined, creating personal schemas that identify genres.\textsuperscript{24} The overall effect of chunking in musical experience creates a chain of micro-to-macro elements: individual notes to chords, chords to progressions, etc. Rather than remembering all elements definitively, the experience is condensed, preserving more information, but occasionally removing specific details which may be critical in the recollection process later. "Chunking" occurs within listening to music as well. Sloboda (1985) discusses the process of chunking (or "coding") when listening to a piece of music:

Economy of coding is achieved if repetitions can be identified and noted. Then, rather than making two representations of the sequence in question, it can be represented in memory, and 'called up' on its various occurrences through the piece by some sort of 'marker' which locates the repetitions in the longer sequence. Second, inexact similarities could be noticed, and sections coded as variants of earlier sections. Maybe on a first hearing, the listener would not have the resources to code all the differences, but would be able to remember it as 'almost like' something that had gone before. Third, the listener could extract some underlying progression or pattern in a sequence of musical statements; such as traversing familiar tonal path (. . .) (190-91)

\textit{Beyond the moment: long-term memory}

Although the levels of short-term and working memory are critical in the immediate recognition of violations of harmonic expectation, larger musical examples beyond simple sequences of chords go beyond the capabilities of working memory. Single-movement sonata form necessitates a memory system with a larger capacity and duration; structurally significant musical events, such as motives, themes, key areas, 

\textsuperscript{24} For a detailed explanation of these three typical processes of chunking in musicians, see Levitin (2006): 218-19.
amongst others, must persist in some form to be recognized, particularly after passages which greatly manipulate themes and stray from originally stated keys.

While short-term memories have a relatively brief span, long-term memories can persist through the entire lifetime of the individual. A significant amount of research concerning long-term memory comes from a patient known as H. M. Suffering from epileptic attacks since he was a teenager, H. M. was operated on in 1953, and had large sections of both sides of the temporal lobe (where the “location” of his disease was deemed to be) removed. A side-effect from this surgery was that he lost all ability to formulate long-term memories, although he was capable of forming short-term and working memories. While the considerable size difference is the defining characteristic between the types of memory, long-term memories are created through short-term memories. LeDoux (1996) briefly summarizes the process of formulating long-term memories:

[L]ong-term memory involves at least two stages, an initial one requiring the temporal lobe ( . . . ) and a later stage involving some other brain regions, most likely areas of the neocortex. The temporal lobe is needed for forming long-term memories, but gradually, over years, memories become independent of this brain system. (185-86)

Additionally, the case study of H. M. reveals that new long-term memories are stored in different locations when compared to previously stored long-term memories; while H. M. was capable of recalling memories ranging from his childhood until a few years before the surgery, he was incapable of creating long-term memories after the surgery. This particular feature enforces that the temporal lobe is greatly involved in the process of storing new long-term memories. LeDoux (1996) notes, "It became clear that

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removal of regions of the temporal lobe in H. M. interfered with long- but not short-term memory, suggesting that the formation of long-term memories is mediated by the temporal lobe, but that short-term memory involves some other brain system” (185).

One specific area of the temporal lobe that is believed to be essential to the formation and storing of long-term memories is the hippocampus. As seen in the case studies of H. M., the temporal lobe—particularly the hippocampus—is actively involved in the creation of new long-term memories; while H. M. was capable of utilizing working memory to function in various tests, he would not be able to recall this information once it left his stream of consciousness. Additional studies on other patients confirmed the role of the temporal lobe and hippocampus in long-term memory.

Before receiving information from the neocortex, however, the stimuli pass through an intermediary location. One theory posits that there is a transition cortex which intermediates this flow from the neocortex to the hippocampus, and this transition cortex begins combining the wide array of individual input (such as sight, sound, smell, etc.) and developing a representation of the entire experience. LeDoux (1996) summarizes, "The transition region then sends these conceptual representations to the hippocampus, where even more complex representations are created” (198).

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26 The importance of the hippocampus in the formulation of long-term memories also comes from H. M. The surgery to remove the areas of the temporal lobe also removed portions of the hippocampus (as well as the amygdala). LeDoux (1996) notes, "Other patients were operated on in addition to H. M., and when these were all considered together it seemed that the extent of memory disorder was directly related to the amount of the hippocampus that had been removed. On the basis of these observations, the hippocampus emerged as the leading candidate brain region for the laying down of new memories” (186).

27 A correlation between the amount of the temporal lobe and hippocampus and the degree to which long-term memory was affected was also revealed. See LeDoux (1996): 184.

28 LeDoux (1996) notes that this transitory phase in the flow of input from the neocortex to the hippocampus is the separation of perception and conception. The organism is no longer identifying concrete elements and forming distinct memories of each item, but instead combining these into a complete, abstract representation of the entire experience. See LeDoux (1996): 198.
Long-term memories are reflected in the listening experience both throughout the entire duration of a piece, as well as across similar pieces. The mind develops a basic outline or plan, based on the numerous encounters with similar stimuli (in this instance, music). After recognizing a series of frequently recurring patterns or associations, the brain develops this plan, known as a schema. The mind develops musical schemas for a wide range of musical features, including genres, melodies, and harmony. While the listener may not be able to explicitly identify the exact names of individual chords, the relationships between certain chords within a clearly established key, as expressed through the hierarchical arrangement of tonality that provides a clearly defined order (such as the progression of dominant-to-tonic), is identified and articulated. Thus, the brain is not necessarily identifying the progression of chords "G" and "C" in the key of C major (barring perfect pitch or deliberate attempts to express chords by their specific names), but instead the relationships of the chords as "dominant" and "tonic" within a tonal, harmonic schema, which has formulated that the tonic will follow dominant logically.

*Recollection: Forming an interpretation*

The process of recalling created and stored memories yields subjective—and incomplete—images and experiences. Rather than creating definitive, unflinching pictures of objects in distinct locations, the brain stores various *representations* that are contained within several different areas of the cortex, and are reconstructed when the memory is recalled. Additionally, these representations are incredibly malleable, and can
be distorted and modified by age and new experiences. Although this organization of the mind permits considerably more “storage” than the traditional “filing system” theory of memory and representations, it does lead to inaccuracy and incompleteness. The neural activity between the creation of the memory and the recollection of the representation is fairly similar; Damasio (1994) theorizes, “( . . . ) explicit recalled mental images arise from the transient synchronous activation of neural firing patterns largely in the same early sensory cortices where the firing patterns corresponding to perceptual representations once occurred” (101).

While the recollection of memories bears much similarity to the physical creation neurologically, the final interpretation generated by the brain may differ from the actual experience. This is the result of the subjective, individualized experience of the event or object, as one’s own emotions and predispositions influence what elements are recalled, substantiated, or heavily influenced. Damasio (1999) enforces the personal perspective that shapes a particular memory, providing a subjective image based on one’s own physical and emotional experience of the stimuli:

The records we hold of the objects and events that we once perceived include the motor adjustments we made to obtain the perception in the first place and also include the emotional reactions we had then. ( . . . ) [E]ven when we “merely” think about an object, we tend to reconstruct memories not just of a shape or color but also of the perceptual engagement the object required and of the accompanying emotional reactions, regardless of how slight. ( . . . ) The perspective for a melody you hear ( . . . ) is, quite naturally, the perspective of your organism because it is drawn on the modifications that your organism undergoes during the events of hearing or touching. (147-48)

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30 Damasio (1994) suggests that this rekindling of connections coincides with the assertion that the memory is stored throughout, rather than within, the brain. He summarizes, “The activation results in a topographically organized representation” (101).
Not only does the physical and emotional experience of the memory play an integral role in the recollection, but past experiences of similar events and objects also facilitate and shape the images recreated. Although there is not one distinct “location” for a particular image or concept within the brain to be completely (and definitively) recalled, all of the experiences associated with a particular event or object—each contained within a different location in the brain’s higher-order cortices—are simultaneously incorporated and seamlessly united in the final representation of the recalled memory.\textsuperscript{31}

Levitin (2006) notes, “Music listening requires, according to the theorist Eugene Narmour, that we be able to hold in memory a knowledge of those notes that have just gone by” (117). Beyond this newly formed memory of the occurring notes, however, previous memories of similar music are incorporated in the experience. In discussing Narmour’s theory, Levitin further argues that these individual notes are contained within memory “alongside a knowledge of all other musics we are familiar with that approximate the style of what we’re listening to now” (117). He believes that there is a combination between the individual notes of the present experiences and the previous history of similar pieces contained within our schemas of music.\textsuperscript{32} Levitin (2006) discusses the storing and recollection of musical memories within the mind:

These aspects of music are not represented directly in the brain, at least not during initial stages of processing. The brain constructs

\textsuperscript{31} Damasio (1999) uses the concept of a \textit{hammer} to illustrate the workings of the mind in generating the “complete” picture of a hammer. The visual memories of a hammer greatly differ from the physical manipulation of the object, including both touch and use, and are also stored in different locations (cortices). Moreover, the memory of the nonphysical term \textit{hammer} is also separated geographically (on the brain) from these physical representations. Damasio summarizes, “Although the memory of separate aspects of our interaction with hammers are kept in separate parts of the brain, in dormant fashion, those different parts are coordinated in terms of their circuitries such that the dormant and implicit records can be turned into explicit albeit sketchy images, rapidly and in close temporal proximity” (220-21).

\textsuperscript{32} Levitin summarizes, noting, “This latter memory may not have the same level of resolution or the same amount of vividness as notes we’ve just heard, but it is necessary in order to establish a context for the notes we are hearing” (117).
its own version of reality, based only in part on what is there, and in part on how it interprets the tones we hear as a function of the role they play in a learned musical system. (. . .) [W]e have learned that certain sequences of tones go together, and we expect them to continue to do so. We expect certain pitches, rhythms, timbres, and so on to co-occur based on a statistical analysis our brain has performed of how often they have gone together in the past. (. . .) To some degree, (the brain) is storing perceptual distortions, illusions, and extracting relationships among elements. It is computing a reality for us, one that is rich in complexity and beauty. (114-15)

*Emotion in memory*

The strictest definitions of what "emotions" are vary greatly, depending on the approach taken when defining the term. Rather than identifying every emotion in terms of its characteristics, reflection through activity, etc., the physiological connection of emotion to memory will be briefly identified in this section, emphasizing the inclusion of an additional brain structure in the memory process. The physical manifestations of emotions and their relationship to a conscious experience will be discussed in Chapter 3.

One important element of emotional memories in general is the involvement of the amygdala. The location of the amygdala implies its role within processing: it is situated between "cortical information processing, limbic circuitry, and hypothalamic outputs to the brain stem that mediate emotional responses" (Eichenbaum, 2002, 265). Additionally, the amygdala is capable of influencing a significant amount of the cortex—even more areas than it receives from a stimulus.33

When considering emotional response to music, however, one must not overlook variations between individuals. Individuals' perceptions of particular musical events or the cumulative experience may differ greatly, depending on where particular attention is

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placed when listening. Sloboda (2005) describes the various elements of a musical experience in which one may place attention, producing multiple, different emotional responses:

Listeners can engage greater or lesser degrees of attention and concentration on a piece of music. They can choose different aspects of the music as a focus for their emotional attention. For instance, I can focus on a music event as structure, and experience an emotion commensurate with the interplay of tension and release, form and dynamic within music. ( . . . ) Because music is multidimensional and multifunctional, there is no one way to listen to a piece of music, and no one emotion appropriate to it. (218)  

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34 Sloboda uses a wide range of elements from which one may draw an emotional experience, including such events as a series of agents, the qualities of the sound (referring both to sonorities as well as timbre), and the cultural implications of pieces. One study performed by Waterman (1996) identifies as many as thirteen different features of music which may trigger a wide range of associated available emotions (218).
While memories of considerably different lengths are capable of being created and recalled, one is not fully aware of every single memory at every single moment. Although one may not be aware of the presence of a memory, a stimulus can trigger its recall, bringing it from the “depths” of its resting place. Levels of memory are directly linked to levels of consciousness, as certain types can only exist on one level, while others may traverse multiple areas of consciousness. Moreover, these various "levels" interact frequently, though we may experience (and thus, identify) only the final product of all of the processing that is taking place.

_On the immediate level: Consciousness and awareness_

Defining "consciousness" becomes extremely difficult, as numerous approaches to the question provide different elements of the defining characteristics of "consciousness." In particular, consciousness is strictly a subjective experience that occurs within an individual. What is identified and measured, however, is the physical expressions of conscious activity.\(^{35}\) Studying and recognizing what consciousness "is" as well as what conscious processing and thought are transpiring within an individual involves a three-way method: observers can identify a third-person account of the physical manifestations of conscious processing, the participant can provide a first-person narrative of the internal processing and manifestations, and the observer may relate the

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\(^{35}\) Damasio (1999) notes that efforts to describe consciousness from an outsider's perspective (observing and reporting third-person accounts) does not strictly define the conscious experience, but instead describes. He mentions, "consciousness is an entirely personal and private affair and that it is not amenable to the third-person observations that are commonplace" (82).
third-person observation with previous experiences from their own lives, providing a combination of internal and external relationships.

Different types of memory are also reflected in our consciousness. One such level is known as declarative memory. Eichenbaum (2002) defines declarative memory as the "everyday memory for facts and events that are subject to conscious recollection" (87). This type of memory is also very flexible; Eichenbaum further notes that this type of memory "can be explicitly expressed in many ways outside the conditions of original learning" (343). Declarative memory is a part of a larger conscious memory level known as explicit memory. This particular type of memory is defined as involving "conscious recollection generated by direct efforts to access memories" (99). Short-term and working memory both require this conscious level to persist; when one's attention diverts from retaining these memories, they cease to persist unless some portion (if not the entire memory) is converted to some long-term memory.

The amount to which one may be fully aware is relatively flexible, susceptible to the (conscious) efforts to control. This restriction on the amount of material to which one may attend, as defined by Sloboda (1985), is known as focal attention. Sloboda discusses the prospect of focal attention and its effect on the perception of a piece in its entirety:

In music we propose that only one melodic line can be treated as 'figure' at any one time. When so treated we may say that this line is being given 'focal attention'. Focal attention allows the noticing of relationships within the melodic line, so that the melody may be recognized, related to previous material, and so on. The other line, or lines, form the background. They are registered, but not processed focally. Instead, they are fragmented into a series of individual notes which are heard 'vertically' as chords which support or accompany the focal melody. Thus, there are two types of process taking place, melodic processing of the focal line, and harmonic processing of the other parts. Furthermore, each note of the melody being focally processed has a harmonic function which
is confirmed by the notes in the other parts, so both the melodic and harmonic processes contribute to the building up of a unified structural representation for the whole piece. (169)

Emotions are identified and expressed within our stream of consciousness once they are manifested in a physical form known as feeling. When discussing feelings, Damasio (1999) notes, “It is through feelings, which are inwardly directed and private, that emotions, which are outwardly directed and public, begin their impact on the mind; but the full and lasting impact of feelings requires consciousness, because only along with the advent of a sense of self do feelings become known to the individual having them” (36).

Memory and consciousness: Beyond the surface

Although the perception of music on the conscious level pacifies the notion of immediate chordal progressions and planning (fulfilling the suggested, though highly debated, brevity of elements of musical memory), it does not provide an adequate solution for the perception and identification of musical elements on a larger scale. Such recognition of larger structural levels of music (and long-term harmonic organization and planning), however, may occur in these deeper levels of consciousness—well below the "apparent" superficial levels in which the (identified and confirmed) immediate chordal expectations are recognized and subsequently fulfilled or denied. Fiske (1990) presents a hypothesis which emphasizes the role of the subconscious in the musical experience:

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36 Sloboda employs "focal attention" with particular respect to polyphonic music and multiple, independent melodic interacting with each other. Focal attention, as Sloboda describes, may be informally expressed when conductors can identify some error when rehearsing or performing a piece, but be unable to pinpoint the exact part in which the error occurred, as their primary attention was directed elsewhere.
Does a listener consciously ask these questions ( . . . ) while engaged in a legitimate music environment (versus a laboratory environment)? The recognition of pattern/form/stylistic relationships is most likely an outcome of subconscious metalanguage activity, triggered by a need to know, that yields realized tonal-rhythmic relationships. This realization may then generate additional, upper hierarchical-level processing. This does not exclude, of course, conscious question-posing. It merely separates one level of pattern generation/perception/processing behaviour from a second consciously analytical level where, once a relationship is recognized, a listener may voluntarily go after other (relevant or irrelevant) explanations. (34)

The persistence of these established musical memories, such as schemas as well as elements from a particular piece (such as a theme or tonal area within single-movement sonata form), may not require the conscious effort needed of explicit memory, especially if the focal attention is not placed on these features. Moreover, Sloboda’s definition of focal attention suggests that the element of attentive emphasis, such as a given melody, is placed in context with other elements which are not commandeering all of one’s collective conscious efforts. Listening to music is not a strictly conscious experience, but is enhanced by apparent nonconscious processing, facilitating the triggering of responses.

While the awareness and recollection of specific memories occurs on a conscious level, there are additional processes transpiring in the mind of which one may not be fully aware. Though unknown through one’s consciousness, these memories may greatly influence the overall feeling generated by conscious experiences. LeDoux (1996) summarizes the nonconscious influence on the conscious experience:

In order for you to consciously perceive an apple in front of you in space, the apple must be represented in your brain and that representation must be made available to the conscious part of your mind. But the mental representation of the apple that you consciously perceive is created by the unconscious turnings of
mental gears. As Karl Lashley long ago pointed out, conscious content comes from processing, and we are never consciously aware of the processing itself but only of the outcome. (27)

These "unknown" memories which elude the consist level and influence in nondirect ways are known as implicit memories. Strictly defined, implicit memories are considered “unconscious changes in performance of a task as influenced by some previous experience.”37

Emotion and feeling provide a powerful link for the influence of implicit memories on the processing of explicit memories. LeDoux (1996) notes, “There is a place, though, where explicit memories of emotional experiences and implicit emotional memories meet—in working memory and its creation of immediate emotional experiences” (201).38 The activation of certain implicit memories may trigger an emotional response, which arouses a physical feeling within the body. Although the mind may not consciously process these memories, their physical manifestations are perceived and become conscious in conjunction with the explicit memories associated with the event, creating an experience that contains both representations of what existed (identified by the explicit and declarative memory) and the emotional responses that were generated (contained within implicit memory). Sloboda (1985) reaffirms the nonconscious processing of music and the influence of emotions:

Within a given musical culture, and among individuals who have had a comparable prior musical experience, there may be some automatic and subconscious mental processes which are indeed determined primarily by the nature of the particular piece of music being heard. However, if these processes are predominantly inaccessible to consciousness, what is it that a listener may be aware of that derive directly from these processes but are neither

37 See Eichenbaum (2002): 99-100, for further differentiation between explicit and implicit memory.
38 In his discussion of fear, LeDoux uses a car accident as an example. While specific facts may be retained, they may be declarative facts of emotional events, not specifically the emotional response.
associations, nor verbal judgments? One major category of such objects of awareness is the category of affective experiences: feelings, moods, and emotions. (355)  

Sloboda summarizes, "It seems clear that there are at least some musically generated affective states which are not simply triggered through association to previously experienced instances of the same or similar music. Music has some inherent characteristics which promote affective responses” (355).

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39 This particular discussion centers on the use of music within a worship experience, producing some form of emotional response within this specific setting.
Chapter 4: A model for realizing harmonic expectation denial

The recognition of violations of harmonic (chrodal) expectation may be a combination of memory and consciousness on a wide range of levels. The short-term and working memory levels retain smaller series of harmonic progressions, but larger passages of harmonic planning require extended levels of memory; moreover, the formation of harmonic expectations and other musical schemas in general require long-term memory to retain the considerable amount of input throughout one's life. Additionally, as Sloboda suggests, the nonconscious and subconscious processing of music may greatly influence the emotional response to music.

While the interaction of all of these systems may occur, they are expressed—at least, the primary methods that have been used thus far—through conscious recollection of previous events, and the awareness of a change in feeling, often through the recognition in a change of body state. While this approach has identified how violations are expressed and identified, the emotional picture that is portrayed is an afterthought of numerous events transpiring simultaneously. The recognition of this immediate level response obscures the prospect of the mind processing events beyond these individual moments. Selecting brief chordal progressions, while confirming the existence of expectations, greatly diminishes or even eliminates the temporal unfolding of music in a natural setting outside of the selective methods utilized thus far.
A hypothesis for bodily awareness

Numerous hypotheses exist that attempt to explain how one becomes aware of particular physical feelings. One such hypothesis, known as the somatic-marker hypothesis, comes from neuroscientist Antonio Damasio. Focusing on the process of reasoning, Damasio argues that the mind is not the only participant in producing a viable response to a situation or stimulus; the body may supply additional support in the form of a "visceral change" of body state. This physiological change generates its own particular feeling, which the brain "incorporates" in the decision-making process. Damasio (1994) summarizes the processes involved in the somatic-marker hypothesis:

The key components unfold in our minds instantly, sketchily, and virtuously simultaneously, too fast for the details to be clearly defined. But now, imagine that before you apply any kind of cost/benefit analysis to the premises, and before you reason toward the solution of the problem, something quite important happens: When the bad outcome connected with a given response option comes to mind, however fleetingly, you experience an unpleasant gut feeling. (. . .) It forces attention on the negative outcome to which a given action may lead, and functions as an automated alarm signal (. . .) (173)

The somatic-marker hypothesis suggests that some physiological responses to stimuli occur instantaneously and nonconsciously. There are two distinct bodily states which the brain identifies and associates the physiological change, consisting of the body’s status prior to the change and the status following the somatic response. Because of this change—a physical reaction or “feeling” generated from the stimuli—the brain begins assessing the situation with the supplied information from the body, comparing the two different states. The response is not always limited to negative stimuli; a pleasurable sensation or feeling also facilitates the brain’s decision-making process, as
the favorable outcomes also attract the possible decisions. Additionally, the process does
not always produce a definitive outcome or the final decision from the brain.

The *somatic-marker hypothesis* serves to primarily provide more information
concerning the possible decisions and their expected outcomes. While the brain may still
continue reasoning and deliberating, certain plausible decisions and processes are
enhanced (either favorably or disfavorably), highlighted as the most beneficial for the
organism, or eliminated entirely from the decision-making process. Damasio summarizes
the fundamental purpose for his model:

In short, *somatic markers are a special instance of feelings generated from secondary emotions*. Those emotions and feelings *have been connected, by learning, to predicted future outcomes of certain scenarios*. When a negative somatic marker is juxtaposed to a particular future outcome the combination functions as an alarm bell. When a positive somatic marker is juxtaposed instead, it becomes a beacon of incentive. (173-74)

The physical reactions from the body to certain stimuli serve to provide an
automated, nonconscious reaction that facilitates the decision-making process. From the
reaction of the body, regardless of the positive or negative nature of the physical
response, the brain receives more input for developing a decision with the best possible
outcome. Moreover, the physical response to certain stimuli does not solely depend on
previous experiences within the organism’s own (individualized) life, but also from input
stemming from the development and acculturation of the individual.\(^{40}\) Damasio (1994)
notes, “[M]ost somatic markers we use for rational decision-making probably were

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\(^{40}\) Similar to operant conditioning, the repetition of behavioral patterns, with their inherent rewards or consequences throughout the maturation process, creates a predisposition for certain responses. Though every situation is not identical, the frequency and repetition of certain events—and their corresponding stimuli—do not seem to depend entirely on the full effect of the physiological change. Damasio (1994) suggests, "Decision-making strategies began depending in part on "symbols" of somatic states" (184). Moreover, the level of reliance on such "symbols" rather than the full physiological change and awareness of such change is not universal; Damasio believes that such a reliance is an individualized subject.
created in our brains during the process of education and socialization, by connecting specific classes of stimuli with specific classes of somatic state. ( . . . ) They are based on the process of secondary emotions” (177).

**Drawing from Damasio: Critical elements**

While Damasio's *somatic-marker hypothesis* emphasizes the supplemental input from physiological states of the body (the "visceral" contribution to the brain regarding some form of change), there are two critical factors to the hypothesis. One such factor is some level of memory, which facilitates the comparative process within the brain. Although one may not be fully conscious of the memory (or, more specifically, be fully aware of the first state), the pre-existing state and the conditions associated with this first instance cannot be compared without some form of memory of them. When there is a physiological change, the brain recognizes this discrepancy through comparison of the two body states and evaluates the degree of change, providing additional support.

Damasio believes that the level of memory most directly connected with his *somatic-marker hypothesis* is some form of working memory. While the amount of time between the physiological change and the conscious recognition is not consistent, the repetition of mental images and the manipulation of the memories of the previous state (as well as the newly formed memory of the acquired physiological state) are reflective of this type of memory. Information supplied by the body is not simply stored and recalled, but the comparative process itself captivates the mind, bringing to the forefront the apparent change. This process and acknowledgement of these two states requires working memory as well as attention to the feelings generated by the stimuli. Not only
must the mind consciously attend to the situation at hand, but also it must exclude any
superfluous information that is not associated with the two feelings which may interfere.
Damasio (1994) believes that the entire process is not sequential, but instead a
simultaneous combination of all three elements working together. He summarizes, "[A]
somatic state, negative or positive, ( . . . ) operates not only as a marker for the value of
what is represented, but also as a booster for continued working memory and attention"
(197-98).

While the attention to and working of input resides entirely in the consciousness
of individuals, Damasio acknowledges that somatic markers do not work only on the
conscious level. Events including the changing of body states may transpire without the
conscious recognition of the events. Moreover, although the physiological input may
apparently go unnoticed, it only bypasses the conscious level while still providing some
significant influence on the overall product, including the activity taking place within the
conscious experience.

Damasio’s model functions not only on the level of immediate awareness and
recognition (toward the forefront of consciousness), but also provides an explanation for
nonconscious processing. Damasio argues that although numerous decisions require
feelings (necessitating immediate levels of consciousness and awareness to be
acknowledged and incorporated in the decision-making process), many physiological
stimuli do not command all attention and awareness. The neural processing remains
similar between both conscious and nonconscious stimuli influence, but the level of
awareness of bodily states and changes is drastically different.\(^{41}\)

\(^{41}\) Damasio (1994) summarizes this phenomenon, noting, “[A] signal body state or its surrogate may have
been activated but not made the focus of attention. Without attention, neither will be part of consciousness,
An explanation for expectation?

Although Damasio's model for developing a sense of awareness focuses entirely on the change of physical body states, it provides a close parallel to the recognition of deviations of harmonic expectations on the extremely localized level. Rather than using "body states" as the two distinct points of comparison, chords may be substituted in the analogy. Based on previous experiences in music, which have developed their own musical memory of what harmonically (logically) occurs next in a given harmonic progression, the awareness of feeling comes from the sudden deviation away from expected harmonic tendencies rather than changes in body states.

Much like Damasio's model for awareness, the realization of the denial of harmonic expectation requires some form of musical memory, regardless of the level of consciousness. The identification of a deviation from the previously established musical schema (a form of long-term memory that has been ingrained through one's repeated experiences with music) generates some form of a stimulus, such as the emotional response identified by Sloboda, or some other form of response to a much lesser degree. One may not be precisely aware of what the specific chord may be, but this realization of the diversion of "tradition" generates some form of emotion—a feeling which may be acknowledged by consciousness. Rather than recognition of a physical response, one responds to a mental image that appears contradictory to the mental images of the "correct" tonal landscape as prescribed by the preceding material.

Although working memory, attention, and consciousness are all actively engaged in the recognition and declaration of the emotional response to a diversion from the

although either can e part of a covert action (. . .) While the hidden machinery underneath has been activated, our consciousness will never know it” (185).
anticipated course, Damasio's model suggests that more can (and may) occur within the subconscious and nonconscious. An amalgamation of the previously stated ideas by Sloboda and Fiske may concur and with Damasio's concept of the nonconscious activity. The focal attention of a listener's experience of a piece may not be directly placed on harmony, but harmony is not entirely excluded from the perceptual process and may be occurring subconsciously. Yet, if any amount of attention is placed on an element of music that involves pitch, it more than likely includes a strong connection to some form of harmony. The mind may not attempt to define each individual chord and provide the proper analysis, but identifying pitches requires the development and identification of their (harmonic) relationships both vertically and horizontally. When multiple pitches are sounded simultaneously, they are combined and expressed through their relationship to each other, and individual notes (such as a melodic line which may dominate focal attention) are compared to what notes have been previously sounded. This process helps generate the sense of direction and goal orientation that is essential to harmonic expectation.

This particular hypothesis provides a vivid design for the generation of feelings on the immediate, consciously aware level. While this also connects with the idea of chordal expectation which has been proven through numerous studies, it does not provide the definitive answer for complete "harmonic expectation," much like Damasio argues that the somatic-marker hypothesis does not provide a clear-cut solution for the entire depth of consciousness. The "answer" created by the somatic-marker hypothesis only reveals the topmost superficial layer of awareness, and yields little into the other levels of consciousness and memory, where other processes and connections are transpiring.
Damasio's model reflects that the identification of changes from previously established states (and, in this comparison, the previously established "normal" progression one anticipates) is a result of both conscious and nonconscious processing, brought to one's attention as it is manipulated through working memory. Just as the somatic-marker hypothesis suggests that both of these types of processing continue after the initial recognized change of state, these processes continue while one is actively engaged in the listening experience.

Damasio's model permits and encourages the concept of multiple layers of consciousness, which furthers the notion of harmonic expectation occurring in levels beyond the immediate, superficial level of awareness. Rather than a series of short, relatively simple progressions and melodies (as some studies have used "music" to discuss and identify the elements of harmonic expectation), music is unfolding over time, and requires the formulation of some form of long-term memories, not just the immediate recognition and working out of individual sections to be completely discarded after the initial hearing. Moreover, harmonic relationships do not exist only on the chord-by-chord level, with each subsequent harmony related only to its immediate predecessor. The unfolding of harmonic relationships over time requires both retrospective and prospective processing to various degrees, ranging from the immediate ("chordal expectation") to across sections as well as throughout the entire piece.
Localized denial of harmonic expectation, or larger harmonic scheme?

While the introductory section of the first movement of the *Waldstein* Sonata outlines the descending chromatic scale as the basis for the overlaying harmonic pattern, it is the progression of IV-V-I in some form that generates the fundamental harmonic pattern for the entire first tonal area. Following the fermata in m. 13, the opening harmonic gesture is repeated, implying the key of G major in a manner identical to the first four bars of the piece. When the tonal shift occurs in m. 18, however, there is a break from the descending chromatic line in the bass. Rather than continuing the introduction (and using IV-V²-I⁶ in F major in a similar manner as well), the motion in the bass shifts upwards, and becomes diatonically based (rather than chromatic, as suggested by the "introductory" passage). This deviation from the previous material "creates" a harmonic pattern of iv-V²-I⁶ in A minor.
While mm. 18-21 can be interpreted in A minor, this section is still well within the tonal realm of the original tonic key of C major. Despite this inherent proximity to the tonic key, the brief "A minor" section serves two critical functions: preparing for a modulation to the second tonal area of E major and perpetuating the underlying IV-V-I pattern in a significantly larger scale. This insinuation of A minor creates a lengthy subdominant (iv) in E major, and the motion to the dominant is extended with the Italian sixth chord in m. 22; the appearance of this chord also creates a brief ascending chromatic line, outlining A-A#-B in mm. 18-23 and strengthening the motion to the dominant (B). This differentiation from the introduction greatly expands the duration of the fundamental harmonic pattern of the first section, as IV-V-I lasts not just four measures, but instead eighteen measures in E major, with the fundamental harmonic
pattern of IV-V-I contained within one "chord" of the prolongation: iv (mm. 18-21 reflecting A minor), V (prolonged alternation of V and I\textsuperscript{64} in mm. 23-34), and I (arrival of E major and the beginning of the second thematic material and tonal center).

![Bass chordal reduction of Beethoven, Waldstein Sonata, mm. 18-35.](image)

**Figure 4.** Bass chordal reduction of Beethoven, *Waldstein* Sonata, mm. 18-35.

Although this change in direction in the motive from descending to ascending is recognizable (and thus appearing on the forefront of one’s attention), this second section fulfills the precedents established by the motive’s first occurrences. Much like mm. 1-13, this passage uses two direct statements of the motive, with the second statement altering the final chord, albeit one measure later, as the harmonic planning moves in a different direction. Also, each second statement of the motive begins one whole-step away from the IV-V-I progression in G. Additionally, these second statements both function as “predominant” in larger harmonic schemes that contain this harmonic pattern. A
comparison between the “ultimate goals” of these two passages reaffirms the importance of C major within this section beyond its role as a “predominant” in the G major motive. As previously noted, the chromatic descent in the bass leads from C down to G, with the arrival of G in m. 13 serving as the dominant. Inversely, however, this second statement ascends diatonically, leading up to E. These three areas C, G, and E recreate the major triad which can be connected to the first chord of the piece: C major.

![Figure 5](image.png)

Figure 5. Reduction of key areas within the first tonal area of the exposition.

Not only does the exposition display examples of larger-scale planning, but the development also contains examples of broader-level harmonic organization. One of the most striking passages in the development with respect to harmonic ambiguity and long-term relationships occurs in mm. 104-09. Throughout this passage, there is a two-measure melodic figure that recurs sequentially three times, with each iteration of the pattern beginning a third below the previous statement. Harmonically, though, this passage implies a series of "rapid temporary tonicizations," each outlining the same progression within a single measure unit. Beginning in m. 105, the N² in F minor serves as a pivot to Cb major, becoming V² (Gb) in the new temporary "key." This begins a series of descending keys, each outlining a progression of V²-I⁶ (or i⁶, depending on the key) within each measure: Cb (m. 105), Bb minor (106), Ab major (107), Gb major...
(108), and F minor (109). This pattern is altered with the repetition of the "final key" within this chain of descending keys, as F minor is tonicized by V\(^{43}\)-i—the only key within this series that has the tonic chord in root position.

Figure 6. Beethoven, *Waldstein* Sonata, Op. 53, mm. 104-10.

While these melodic and harmonic patterns each provide their own suggestive organizational layout for the passage, they also emphasize some apparent surface contradictions. Although the melodic sequence suggests three distinct two-measure groupings (with a one-measure extension following the last statement of the figure), the harmonic sequence implies a *one-measure* pattern with four uniform progressions in
descending keys with one additional variant at the conclusion. Additionally, there is a one-measure displacement between the beginnings of these two apparent forces, with the melodic sequences beginning in m. 104, and the harmonic sequences begin in m. 105. The "rapid tonicization" analysis of this section also runs into some difficulty, as each new "key" is identified by an imperfect authentic cadence, which does not provide much stability if attempting to establish each progression. Also, the chord on the downbeat of m. 108 (Db\(^2\text{(MAJ7)})\) disrupts the series of strictly dominant seventh chords before the "temporary tonics" in first inversion.

Much like the introduction, the melodic and harmonic patterns that exist in these measures may be "surface distractions" that occur over a long-term harmonic passage. Although there are clear cadential motions in five different keys for five measures, the descending bass line outlines only one key: F minor. Beginning in m. 104, the first (lowest) notes of the bass arpeggiations outline a descending F natural minor scale; the harmonies generated above these notes may be a byproduct of the extended harmonic figure.

![Figure 7. Bass reduction of Waldstein Sonata, mm. 104-10.](image)

This descending bass line approach provides an adequate solution for both appearances of a V\(^2\text{(MAJ7)}\) in mm. 105, 108; although the note "C" does not fit the
harmonic pattern (in which it would be "Cb"), it is within the F natural minor scale. Furthermore, the keys implied by the tonics of the cadential motions are almost all contained within F minor, with the exception of Cb major. Although the "dominant note" for F minor is flattened (if using this interpretation of the passage), this transpires over an Eb in the bass, which serves as the "primary note" of the diatonic descent. Thus, although the Gb major harmony in m. 108 may also be considered outside the F minor tonal sphere, the Bb—the first note of the arpeggiation—may instead be seen as the "primary note"; in this sense, the Gb major harmony functions similarly to a N6 chord, just as the Cb major harmony in m. 105 acted in the sudden tonicization of Bb minor. This bass line interpretation of only one key is further strengthened by the subsequent bass line, which recalls the descending chromatic line, although this descending chromaticism is obscured by triplets.

The beginning of the recapitulation—more specifically, the return of the first thirteen measures of the piece—not only disrupts the recollection of the previous thematic material, but also the arrival of the dominant. While the chromatic bass line (and the suggestive ambiguity of the excerpt) returns in mm. 156-166, the pattern is suddenly modified after the descending C minor arpeggiation; rather than landing on the dominant and completing the outline of motion from tonic to dominant, the descent arrives on Ab, the sixth scale degree and perpetuates the descending motion of thirds. This arrival utilizes the "predetermined" dominant function of the sustained note— as the Ab in m. 168 functions as a dominant—in the temporary key of Db major. This tonic triad of Db is also arpeggiated in m. 169, with the arrival of m. 170 also utilizing the sixth
scale degree (in this instance, Bb). This sixth scale degree also assumes a dominant role, permitting a pivot to Eb major.

While m. 171 seems grounded in the new key of Eb major, the arpeggiation of m. 172 quickly remove this firm tonal grounding. This motion is further obscured by the chain of suspensions in the soprano voice; beginning on the downbeat of m. 172, the soprano uses four consecutive 4-3 suspensions. This is particularly disruptive in the first two beats of m. 172, as the "resolution" to the third comes too late, for the chord (as well as the suggested key) have changed from $d^65$ to $b^2$. This quick modulation begins the progression $\text{vii}^{02}-\text{vii}^0\text{vi}^0/\text{VI-V}7-I$ in C major, and the recapitulation continues with the return of the first theme.

The extension of this passage through the preconceived roles of the "sustained dominant" notes (mm. 168, 170) utilizes two essential features of the first statement: the overriding harmonic pattern, and the role of the contour in the bass. While the pitches

Figure 8. Beethoven, Waldstein Sonata, Op. 53, mm. 166-73.
"Ab" and "Bb" do serve immediate dominant functions (both of which are immediately followed by their anticipated tonics), they also may be considered part of a larger harmonic entity in Eb major. Although the harmonies are not completely fulfilled, the harmonic outline of IV-V-I (Ab-Bb-Eb) appears in an extended form, blurred by the inclusion of the Db major triad in m. 169. This arrival in Eb (m. 170) following the fundamental harmonic pattern of the A section also begins the ascent of the bass leading to the dominant—contrary to the motion of the exposition (mm. 1-13) as well as the beginning of the recapitulation (mm. 155-166). This ascent is no longer entirely chromatic, as the primary bass line outlines Eb-F-F#-G. Although the motion is neither descending nor entirely chromatic, it still serves the same harmonic goal: leading into the dominant.

Denial of formal, large-scale norms within first movement of Waldstein Sonata

Although there are several instances of apparent violations of typical harmonic (tonal) rules and expectations amongst individual chords, a significant amount of these moments are contained within extended passages of harmonic planning—passages which "follow the rules" and fulfill expectations of idiomatic tonal practices on a level beyond a chord-by-chord basis. While a strictly "localized" (chord-by-chord) view obscures these extended relationships, it is this same analysis that can make sense of deviations from prototypical form—achieved by conventional practices, and rendered imperceptible by blurring the sense of tonal geography. Although the single-movement sonata form is inherently flexible, the relationship of keys within sections (as well as across the form) in the Waldstein Sonata are considerably distant; moreover, the use of familiar harmonic
and melodic material obscures a significant disruption of the harmonic organization typical of the form.

<table>
<thead>
<tr>
<th>Exposition</th>
<th>Development</th>
<th>Recapitulation</th>
<th>Coda</th>
</tr>
</thead>
<tbody>
<tr>
<td>[I: A B K :]</td>
<td>A B (K)</td>
<td>I VI/vi-I I-IV (iv) (bVI)-I</td>
<td></td>
</tr>
</tbody>
</table>

Figure 9. Formal diagram of keys in Waldstein Sonata.

Despite Beethoven's expansion of conventional practices of the form in this piece, this "denial of formal expectations" may be relatively imperceptible as a result of individualized harmonic instances. The modulation to E major as the secondary tonal area of the exposition, for example, seems to break from the norm; while "E" may be seen as the mediant of the original tonic triad (and, thus, may be considered a prolongation of the tonic triad in a Schenkerian analysis of this section), the key itself is considered significantly distant from C major. The modulation to the distant key, though, is blurred during the prolongation of the iv-V-I harmonic pattern that serves as the basic building block throughout the first tonal area. The extended duration of the dominant B—a sum total of twelve measures—saturates the listener's acoustic memory of key in preparation for the modulation.\(^{42}\) By using this extended passage, including seven consecutive measures of arpeggiations of either the dominant or second-inversion tonic

\(^{42}\) The duration of the dominant (B) chord (mm. 23-34) is more than enough time to enforce that particular note/chord as having a dominant function, despite the distance from the original tonic key. Loui and Wessel (2007) note, "Prior research in musical tempo (…) has shown that memory for musical sounds diminishes at the slow presentation rate of two seconds" (1091).
chords, the modulation to a foreign key is greatly facilitated, as the "dominant-tonic"
relationship that is fundamental to the tonal hierarchy is maintained.

The harmonic qualities of this modulation are further enhanced by modifications of the rhythmic content of the passage. Rather than using just eighth notes in the accompaniment, the rhythm has been diminished to sixteenth notes beginning in m. 14, generating intensity as it leads into the modulation. This intensity is maintained throughout much of the prolonged dominant, as the arpeggiation throughout mm. 23-30 are all utilizing sixteenth notes. While the significance of this preliminary rhythmic modification is debatable, it is the abrupt return of eighth notes in m. 31 that facilitates the drastic rhythmic differentiation between the first and second themes of the exposition. The radical slowing of the rhythm, in conjunction with the cessation of the *sforzando* accents and great diminishing of dynamics, assists in the transition. The modulation to a foreign key, breaking from typical formal elements, is not abrupt in this movement; it is a process involving "measured" or "deliberate" changes in rhythmic intensity, harmonic saturation, and dynamic contrast.43

The beginning of the development presents its own unique tonal qualities—which are more suggestive of "traditional" expository concepts—through its mimicry of the harmonic pattern that dominates the first section of the introduction. The development begins by continuing the descending closing gesture (which originally permitted the modulation back to C major for the repeat of the exposition), ultimately "arriving" in the key of F major by m. 90. This arrival of the new key is greatly elided, however, as the F

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43 While primary emphasis has been placed on harmonic analysis, the cumulative effect of multiple sources cannot be completely overlooked, especially when considering the effects of one's perception of the piece. Loui and Wessel (2007) note, "Listening to music could be conceived as an exercise in divided attention among different musical attributes (. . .) where harmony, melody, rhythm, and timbre are allocated cognitive resources in the formation of a unified musical percept" (1085).
major chord functions as a subdominant, recalling the opening "IV-V^2-I_6" harmonic pattern.

Figure 10. Beethoven, *Waldstein* Sonata, Op. 53, mm. 90-106.

It is in the beginning of the development, and not the exposition, that this progression first appears in the tonic key of the movement; this harmonic plan greatly contradicts the typical formal structure of single-movement sonata form. Rather than firmly establishing the key in the exposition (or, more specifically, the first tonal area).
the piece introduces only a recurring melodic and harmonic motive. This harmonic motive (IV-V-I) generates the entire first section of the exposition; each appearance of the motive is in a different key (G-F-G-a-E), and never once in the tonic for the piece as a collective whole. Additionally, the motive itself is expanded to serve as a transition to a foreign key, occurring in its standard (3-4 measure) duration as well as an extended duration simultaneously. When the pattern occurs in the tonic key for the first (and only) time in the movement, it is in the very beginning of the development. Its appearance, though, is blurred on both sides; the continuation of the descending melodic pattern from the end of the exposition suggests that F (not C) is the true tonic, and the "arrival" of the tonic chord is only temporary, as the development quickly modulates to G minor. Based on the previous experiences with this motive and its harmonies, the listener has already established an alternate idea of how this appearance of the motive functions. While this section perpetuates the “fundamental" progression in a multitude of levels, the first appearance of the progression with the harmonic relationship grounded in the “tonic” key is greatly displaced.

![Figure 11. Bass reduction and possible chordal analyses of mm. 92-106.](image)

This rapid modulation incorporates a key feature of the introduction—the chromatically descending bass line. Moreover, this modulation to G minor is further
outlined in the first notes in the melody at the beginning of each measure throughout mm. 92-95. Though constantly shifting registers (similar to the register shifts utilized in the introduction and first section), these notes sketch a portion of the descending G melodic minor scale: A-G-F#-Eb. While this brief scalar descent does not contain the "tonic-dominant" descent that was a crucial element of the introductory measures, it clearly outlines the characteristic augmented second (F#-Eb) that identifies the scale.

The return of the secondary thematic material in the recapitulation also deviates from conventional norms of single-movement sonata form, but this may result from harmonic processes of the first theme and tonal area. Rather than maintaining the tonic key (C major) throughout the recapitulation, the secondary theme begins in A major (also a distant key). The temporary modulation to A minor in the recapitulation (which corresponds to mm. 18-21) begins in m. 178. While the first three measures maintain continuity with the exposition, the melody deviates from its original design slightly; rather than outlining the chromatic ascent to B (the dominant of the new key), the "arrival" notes on each of the third beats in mm. 181-82 hovers around "A."

Additionally, the Italian sixth chord from the exposition is replaced with an F major chord (VI in A minor) in m. 182, maintaining the presence of the sixth scale degree—albeit in a new key—while altering the quality of the chord. The appearance of iv₆ on the third beat of this measure serves as the impetus for the return of the harmonic pattern that dominated the first tonal area, creating an expanded iv₆-(vii₆⁵⁵⁵⁶⁶⁵/V)-V-I pattern reminiscent of the exposition. Instead of harmonically preparing for a modulation to a foreign key (i.e., acting as "iv" in the expansion of the iv-V-I in E major), this A minor section utilizes a melodic alteration to outline the pitch "A," with the dominant chord prolonged.
twelve measures. With the return of the beginning of the second theme, the piece is firmly in A major, violating the principle of the tonic key persisting in the recapitulation. This "modulation," though, is the result of the expository material which necessitated A minor/major; the second section is only temporarily in a different key, as a swift mode switch to minor allows for the modulation to the tonic key—the relative of the resultant minor.

Summary

Harmonic expectation—as well as other forms of expectation in music—are created throughout one’s lifetime, generated entirely on the experience of listening to music. They are based on the construction of one's own schema, developed through the immense amount of samples from which one could cultivate a series of norms or "rules" that pacifies the definitions of what is deemed "standard" by the listener. While they are part of one's long-term memory, they are not necessarily the forefront of attention when listening to music. Rather, they may lay dormant (nonconscious), only to be triggered when an event violates the prevailing schema.

Damasio’s somatic-marker hypothesis, although primarily emphasizing the nonconscious influences on the decision-making process, provides a unique explanation for how an individual recognizes violations in harmonic expectation. Although one may be processing harmonies nonconsciously (as they attend to other features of the music, such as the melody), the sudden diversion from the norm may cause a change in body state. This feeling, a physical manifestation recognized in the mind, provides evidence of a disruption—a physical response to the music that instantly appears on the forefront of

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one's consciousness when one becomes aware of this feeling. While this theory provides a process for the conscious experience of the violation of expectation, it also asserts that nonconscious processing of stimuli (in this instance, series of harmonies), though not in the forefront of consciousness, is transpiring.

While harmonic expectation is expressed as a conscious experience through the generation of a feeling, it is a reaction to the sudden realization of unusual movement between individual chords. This "chordal expectation" may be immediately expressed through the conscious experience, but instances of longer-term harmonic planning, unfolding through time, may still persist—unbeknownst to the listener. What has been identified through numerous studies is the identification of unusual progressions, but not the comprehension of harmonic planning beyond the superficial chord-by-chord level.

Expectations concerning harmony and form in Western tonal music are contingent on a predisposition to Western music. Such a predisposition works to generate a prospective view of what may come next based on what has occurred in the immediate past and depends as well upon the recollection of previous material on a long-term scale (a trait central to single-movement sonata form). The traditional "hierarchical" approach to tonality enhances these expectations, but establishes as well a sense of "value" to certain pitches, chords, and keys.

The first movement of Beethoven's *Waldstein* Sonata seems to present a conflict between the short-term and long-term harmonic planning of the piece. Instances of violation of "standard practices" are often encapsulated within longer harmonic relationships, almost all of which do adhere to the "established rules" of proper tonal writing. Rather than consisting of an instantaneous succession of chords, harmonic
relationships may be prolonged over periods of time which extend beyond the chordal level.

But even as long-term harmonic relationships may negate the apparent surface contradictions of harmonic expectation, the converse is also displayed in this piece: "violations" of common formal practices are rendered imperceptible through conventional, localized harmonic progressions. While single-movement sonata form itself is inherently flexible with respect to key and structure, the great distance between tonal areas within the first movement of the *Waldstein* Sonata—particularly if the temporal qualities of the piece are removed to reveal the basic harmonic skeleton—would greatly violate the tonal/harmonic norms. However, this considerable distance between keys may appear as conventional and appropriate due to the adherence of tonal rules on the chord-by-chord level. Moreover, the use of time to subdue the senses and generate new concepts of tonal geography may pacify the original thoughts of where one should be and should be heading, and instead allows one to accept the new terrain as "correct" and passively follow the "proper direction"—a path that long-term analysis would identify as highly inappropriate in relationship to much of the preceding tonal area. The piece is but one example of how harmonic expectations in the traditional sense (within the chordal level) are identified and exploited on a conscious level, while underlying, long-term harmonic planning, with its own relationships (and inherent expectations), may influence a listener nonconsciously, pacifying the precedents established underneath the salient, attention-grabbing harmonic elements.
BIBLIOGRAPHY


Appendix 1

While a complete compendium on the subject of memory, covering the entire neurological process and every type of memory identified thus far, is well beyond the scope of the project, a brief overview summarizing the neurological and physiological creation of new memories, as well as the identification and differentiation of some levels, may provide insight into the various levels of harmonic expectation.

On the cellular level, the formation of new memories begins with neurons. Generally, neurons are composed of four primary parts: the cell body (soma), an axon, dendrites, and synapses. A neuron typically contains only one soma and one axon, but the number of connections in which either cell part is involved may be great; often, numerous axons from other neurons may connect to a single cell body of one neuron, and the one axon per cell may branch to connect several other neurons. Synapses are composed of two primary parts known as the presynaptic and postsynaptic elements. Communication between neurons "occurs" at the synapse; neurotransmitters from the presynaptic element of one neuron are released and diffuse across the synaptic cleft (a space between the two elements of the two communicating neurons), where they are received in the postsynaptic element of the other neuron. This communication between neurons transpires in three stages. While the first two stages involve the conduction of an electrical impulse, the final stage involves the transmission of the impulse from one

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45 Eichenbaum (2002) strongly reinforces the importance of this feature of neurons, noting, “These basic anatomical facts dictate that neurons receive and integrate information from a substantial number and variety of inputs, and then sum them up to a single main output that can affect one or many cells that are next in the circuit” (30).
neuron to the next. Eichenbaum (2002) summarizes the process of communication between neurons:

This initial phase of conduction, known as *electronic conduction*, typically begins at the postsynaptic site, and proceeds to the cell body. (. . .) The second type of electrical conduction, called the *action potential*, is initiated by a special mechanism at the cell body and conducted down the axon to the presynaptic elements. (. . .) When the action potential reaches the presynaptic element, the molecular processes of synaptic transmission are initiated and carry a chemical signal across the synaptic cleft to the postsynaptic elements of the next cell.\textsuperscript{46}

There is no specific “location” in the brain where all memories are stored (and subsequently recalled). Almost the entire cerebral cortex is involved with memory “location,” and these sites are directly linked to the type of stimuli which is encoded. While the various lobes of the cerebral cortex are actively involved in memory, aural memories specifically, such as the sounds of music, are stored within the temporal lobe of the brain. Music (as well as almost all memories), however, may not be strictly limited to this specific location, but may actively involve and stimulate numerous sites which combine to create (and recreate) a composite experience.

\textsuperscript{46} This description of the process of communication between neurons, as well as the summary of the elements of the neuron, is drawn from Eichenbaum (2002): 30-33.