“NOTE”ABLE ENDINGS: AN INVESTIGATION OF EXPECTED ANSWERS TO MELODIC QUESTIONS

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by
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ABSTRACT

The purpose of this study was to investigate if measurements of expectedness for melodic answers are consistent with Krumhansl’s (1979) tonal hierarchy when melodic questions are based on Meyer’s (1973) five theoretical melodic schemata. Consistency of participants’ chosen melodic answers with Krumhansl’s hierarchy was analyzed with two robust software programs, Moulton’s NOUS and Andrich and Luo’s RUMMFOLDss. Researcher’s hypothesis was that (1) when melodies are composed to conform to Meyer’s schemata (axial, changing-note, gap-fill, complementary, and triadic), the melodies imply questions (implications) and answers (realizations) similar to existing melodies, (2) participants will choose melodic answers consistent with Krumhansl’s four tonal levels, (3) participant answer choices will replicate, on average, pitch space distances similar to pitch space distances between the four tonal levels as reported by Krumhansl, and (4) participants’ responses are similar regardless of cultural background, age, or musical experience (Gestalt principles). Participants (n=25) listened to the “Note”able Endings Test (NET) and recorded their perceptions of melodic endings on a Likert-type scale of “4” (completely expected) to “1” (completely unexpected). Statistical evidence revealed significant expectedness measurements and supported that the newly composed melodies implied melodic answers (realizations) similar to existing melodies. Statistical evidence supported also that melodic endings chosen by participants were consistent in the same order as Krumhansl’s four tonal levels for three of five melodies, and replicated, on average, pitch space distances between the participants’ melodic answer expectancies similar to the pitch space distances between the four tonal levels as reported by Krumhansl. In addition, differences were revealed in participants’ answers among cultural background, age, and music experience. However, it is unclear if melodic expectedness interactions between implications (melodic
questions) and realizations (melodic answers), or individuals’ personal melodic ending preferences (Moulton, 2010) existed. An opposite set of measurements was revealed for Item Fit and Individual Response Fit. Significant lack of fit of Individual Responses indicated definite rater and/or melodic questions and answers interactions that violated the one-dimensional model, suggesting further investigation.
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CHAPTER ONE
MELODIC PERCEPTION

Melodic Schemata and Tonal Hierarchy

“A tune is not a tune simply by virtue of its physical properties, but only when it is perceived as such by a person” (Davis, 1978, p. 82). Melody exists uniquely as a human perception (Davies). The thought that a sequence of simple frequencies can evoke such a perception is a definitive fascination with this researcher. Drawn by this human perception, it seems to be so with others as well. Numerous researchers have investigated melodic perception and melodic organization by exploring how listeners perceive melody (Krumhansl, 1979, 1995; Krumhansl & Shepard, 1979; Larson, 2004; Lerdahl, 2001; Lerdahl & Jackendoff, 1983a, 1983b; Margulis, 2005; Meyer, 1973; Narmour, 1983, 1989, 1990, 1992; Rosner & Meyer, 1982, 1986; Schellenberg, 1997; Sloboda, 1985).

Synopsis of Study

Meyer’s (1973) melodic schemata theory and Krumhansl’s (1979) tonal hierarchy theory comprised the basis of the current study. Briefly summarized, Meyer (1973) proposed a perceptual theory with two parts, (1) perception of implications-realizations (also known as melodic questions-answers) and (2) melodic perceptual organization based on a premise of five basic melodic structures. Meyer named these five schemata gap-fill, triadic, complementary, axial, and changing-note. Krumhansl (1979) proposed a hierarchical theory of pitch space perceptions that includes the existence of four tonal levels within the 12-note chromatic scale. Krumhansl’s hierarchical theory of pitch space perceptions consists of four tonal levels. The four levels in perceptual order are: (1) notes one and eight comprising the tonic octave, (2) notes three and five comprising the remainder of the tonic triad, (3) notes two, four, six, and seven
comprising the remainder of the diatonic scale, and (4) the five remaining chromatic notes within
the octave.

Meyer’s (1973) and Krumhansl’s (1979) theories seem complimentary; however, there
does not appear to be previous research examining the possibility of a relationship. This present
study explored a possible relationship between the Meyer and Krumhansl perceptual theories.

_Melodic Simplicity_

Melody appears to be simultaneously both a simple and complex element of music. On
the surface, a melody is simply a tune that is an aural focal point for many listeners (Dowling,
1994). Other music elements such as rhythm, harmony, and form, and even non-musical
characteristics such as kinesthetic movements elicited by music, satirical topic, meaning of text,
subject matter, sound effects, male / female voices, and current events have been reported to be
notable features within music; however, melody was reported as one of the foremost features
(Knauss, 2005; Lipscomb, 1996). (See also fourth and fifth limitations.) As a result, melody is a
common aural event for young and old, and musicians and non-musicians alike in many Western
and non-Western cultures (Lipscomb). Further, the simplicity of melody renders it the musical
feature easiest to recognize, remember, and reproduce (Lipscomb), and many listeners in
Western cultures seem to use melody to distinguish between different pieces of music (Rosner &
Meyer, 1986). Among rhythm, harmonic structure, and other elements, melody seems to be a
notable element of many general (classroom) music education activities, as the National
Standards for Music (Mahlmann, Senko, Blakeslee, & Prosser, 1994) have recurring connections
to melody.

Melody, as a dominant music element, has been traced to have roots in the beginning of
known civilization. From a lifetime of historical research, Haïk-Vantoura (1991) concluded that
the diatonic scale has existed from the beginning of Sumerian civilization, that (2) diatonic melody may be considered a pre-eminent music element in ancient music from which other music elements emanated, and that (3) diatonicism appears to be innately congenital with all human beings.

Melodic Complexity

Beyond melody’s role as a primary aural focal point, melody is a complex perceptual and cognitive phenomenon involving numerous processes. Although the definitional boundaries between these processes are blurred throughout the history of melodic perception and cognition research, a sequence of broad processes is generally accepted (Lipscomb, 1996). Briefly considered are three processes of (1) perception and cognition (ear and mind interactions), (2) perceptual organization, both of which seem to be cyclical and interdependent, and (3) the further refinement of the aural perception process known as audiation (Gordon, 2003).

Perception and cognition. The first process, perception and cognition, or the interaction of ear and mind linking physical hearing with mental organization, can be described in two general steps. First, perceptually, the ear receives sound waves as physical vibrations. Physical vibrations are changed in the ear to electrical impulses transmitted to the brain as a series of pitches (Latham-Radocy & Radocy, 1996). Second, cognitively, the brain seeks to connect, or organize, the series of pitches. Mental organization, also referred to as perceptual organization, appears to utilize basic Gestalt principles of proximity, simplicity or good continuation, similarity, common fate or direction, and closure considered to be universal with all listeners (Lipscomb, 1996; Meyer, 1956, 1994). Mental (perceptual) organization appears also to reference listening experiences involving melodic, rhythmic, and harmonic structures, rather than allowing pitches to be heard in unrelated isolation (Meyer, 1994). Meyer (1994) briefly
explained the cognitive significance of this mental activity, “[The mind]… considers what kind of patterning underlies music, what implications are suggested by its melodic, rhythmic, and harmonic organization, and how these implications are realized or not realized in the ongoing sequence of music events” (p. 3). From these processes, the mind conceptualizes a melody (Davies, 1978). Thus, the ear responds to a series of physical vibrations (perception), after which the mind seeks to organize and conceptualize the series (cognition).

Perceptual organization. The second process, perceptual organization and consequent cognition of a melody, seems to be both sequentially and interactively dependent upon active listening, and short- and long-term memory of past musical experiences. The interdependency of active listening and short- and long-term memories creates a melody that may very well be unique to each person.

Active listening is considered to be the initiating component of the perceptual organization process. Active or concentrated listening, as opposed to merely hearing as in background music, can be defined as the listener consciously focusing attention on select prominent moments from the flow of musical sound, concentrating for a moment on one part and the next moment on another (Lipscomb, 1996). Attentive selection of prominent moments references previous experiences with melodic, rhythmic, and harmonic structures in the listener’s short-term and long-term memory (Cherry, 1953; Jones & Yee, 1993; Matlin, 1994; Neisser & Becklen, 1975).

Short-term and long-term memories are consequent components of the perceptual organization process. Short-term and long-term memories guide active, concentrated attention on select prominent moments, anticipations of what may happen next in the music, and interactively affect ongoing attention and focus. Short-term (episodic) memory is limited in capacity and
duration wherein items begin to fade after 30 seconds unless repeated in that time period (Jones & Yee, 1993; Miller, 1956). Items sufficiently repeated within the 30-second critical period are transferred into long-term memory. Long-term (semantic) memory has unlimited capacity and contains memories of melodic, rhythmic, and harmonic events that occurred decades ago, as well as a few minutes before, developed through repeated experiences with music (Bartlett, 1932; Cherry, 1953; Dowling & Harwood, 1986; Jones & Yee, 1993; Lipscomb, 1996; Matlin, 1994; Neisser, 1967; Neisser & Becklen, 1975).

The mind’s organizational process may be described as a cross-referencing, interactive network involving attention and focus, short-term memory, long-term memory, and melodic, rhythmic, and harmonic experiences. The process begins when a listener actively attends to (focuses upon) a musical (prominent) moment, and the mind references melodic, rhythmic, and harmonic experiences in short-term and long-term memory. Short-term memory is engaged with a new music event. Long-term memory is activated with sufficient repetitions of a new music event or retrieval of past music events. Short- and long-term memories in combination seem to direct the prominent moments on which the mind attends next in the ongoing flow of sound. Lipscomb (1996) alluded to the cyclical and interactive process among these components, “Guidance provided by these schemata [memory events] leads to expectations of what will happen next, influencing which elements are attended to and remembered” (p. 139).

**Audiation.** Gordon (2003, 2007) refined theories of music perception and the mind’s organizational processes with his theory of audiation, the third process. Gordon contended that aural perception takes place when we are actually hearing sound the very moment it is being produced, and that audiation of sound is only after we have aurally perceived it. Gordon defined audiation as the assimilation and comprehension “in our minds music that we have just heard
performed or have heard performed sometime in the past” (2003, p. 4). Gordon further defined audiation as the assimilation and comprehension “in our minds music that we may or may not have heard but are reading in notation or are composing or improvising” (p. 4). Gordon explained, in aural perception, the mind considers immediate sound events, while in audiation, the mind considers delayed musical events.

In summary of the three processes, music perception involves the listener’s ear and mind interactively responding to the sensory information of physical vibrations in a series of music pitches. Music cognition is the listener’s mind knowledgeably acting upon the sensory information (acquisition, storage, and retrieval) and perceptually organizing the information (melodic, rhythmic, and harmonic structures) (Lipscomb, 1996), and audiation is the mental assimilation and comprehension of music after aural perception before, during, and after the physical presence of music, while listening to, reading, and performing (Gordon, 2007).

Melodic Questions and Answers

Within perceptual organization, the principal organization of melodic structures seems to be melodic questions and answers. The prominence of melodic questions and answers may be indicated by their widespread acceptance in Western music (Bent & Pople, 2006) and music education (Mahlmann, Senko, Blakeslee & Prosser, 1994) as the most common feature of melodic structure. Consequently, the focus of this study involves melodic questions and answers and one way in which they may be explored (Meyer’s melodic schemata and Krumhansl’s tonal hierarchy), in combination with perceptual and cognitive organizational theories of melodic questions and answers.
Melodic Implications and Realizations

Melodic questions (implications) and answers (realizations) have their beginnings in the smallest defining part of a melody known as a motif. A motif is a fundamental melodic-rhythmic unit of a minimum of two pitches. Increasing in size, melodic-rhythmic units may be comprised of motifs, measures, phrases, and sections (Ringer, 2006). Motifs, measures, phrases, or sections, that seem unable to stand alone (unfinished) and indicate the need for more sound, are labeled melodic questions (implications). Motifs, measures, phrases, or sections, which satisfy melodic questions regarding the need for additional sound, are labeled melodic answers (realizations). Any size of melodic event (or structure) from a two-note motif to an entire section may function as a melodic question (implication) or answer (realization) (Meyer, 1973; Narmour, 1983, 1989, 1990, 1992).

Melodic Organizational Theories

Six relevant theories have emerged regarding how the brain perceptually organizes melodic event (or structure) information. In developmental as well as chronological order, the organizational theories discussed here are Meyer’s (1973) melodic schemata, Narmour’s (1983, 1989, 1990, 1992) implication-realization model, Krumhansl’s (1979) tonal hierarchy, Lerdahl and Jackendoff’s (1983a, 1983b; Lerdahl, 2001) generative theory of tonal music, Larson’s (2004) theory of gravity, magnetism, and inertia, and Margulis’ (2005) model of schematic melodic expectation. The first theory (Meyer’s melodic schemata) and the third theory (Krumhansl’s tonal hierarchy) constitute the nucleus of this study.

Meyer’s melodic schemata. Meyer (1973) outlined a theory of melodic implications (questions) and realizations (answers) within melodic events of varying lengths such as intervals, motives, and phrases, as well as entire melodies. Using Western melodies as supporting
evidence, he proposed melodies are organized into five basic patterns (or melodic schemata). Meyer noted that implications and realizations occurring within intervals, motives, phrases, and entire schemata create hierarchical levels of melodic structure. Implications-realizations at the schematic hierarchical level (schematic realizations comprised of multiple notes) later became identified as schematic completeness (Larson, 2004). Meyer’s implication-realization theory was later labeled the “if-then” condition in melody (Narmour, 1990).

Narmour’s implications and realizations. Narmour (1983, 1989, 1990, 1992) developed Meyer’s general theory of melodic implications (questions) and melodic realizations (answers), focusing on whether or not the uniqueness of any perceptual melodic event (implication-realization) can be captured in a specific analytical symbol. One such analytical symbol is [P] for Process consisting of small intervals in the same direction, that may imply a “need” (realization) for more small intervals in the same direction. As Narmour argued implication-realization events (1) are universally built on Gestalt principles, (2) are therefore free of all cultural or era contexts, and (3) applicable to all styles of melody, he contended the analytical symbols therefore were also universal to all melodies, cultural, tonal, and atonal. Narmour (1990, 1992) agreed with Meyer in proposing that implications (questions) and realizations (answers) are inherent not only between singular pairs of pitches, but at all hierarchical levels and various sizes of melodic events. Thus, the main contributions of Narmour’s theory are the determining and symbolizing of individual events (implications-realizations) and how individual events may be sequenced together comprising larger hierarchical events.

Krumhansl’s tonal hierarchy. Krumhansl (1979) theorized that Narmour’s uniquely individual implications and realizations may also involve perceived distances between pitches, known as pitch spaces. Krumhansl used tonal and atonal sequences as implicative stimuli and
various pairs of notes as realizations, and conducted experiments in which participants were asked to judge how similar the first tone was to the second after listening to the tonal or atonal sequence. Krumhansl concluded listeners extracted a pattern of pitch space (distances) among tones that not only revealed pitch height measurements, but also measurements from membership in the major triad chord and within the diatonic scale. Krumhansl’s findings seem to be the first to indicate possible strength differences within Narmour’s (1983, 1989, 1990, 1992) implication-realization events.

*Lerdahl and Jackendoff’s generative theory of tonal music.* Lerdahl and Jackendoff (1983a, 1983b; Lerdahl, 2001) detailed a generative theory of tonal music (GTTM) based on the premise that distances between pitches (pitch space), as described by Krumhansl (1979), and stability and instability conditions (Meyer’s and Narmour’s implications-realizations) are in principle the same. GTTM describes specific conditions of stability and instability of events within a piece’s temporal regions through four hierarchical structures in music: grouping structure, metrical structure, time-span structure, and prolongational reduction. Lerdahl proposed GTTM’s process may help explain a listener’s perceived relative stability and instability of events within a piece’s embedded temporal regions as the music dynamically flows from one part to another. Lerdahl and Jackendoff cited notable support for their GTTM pitch space model was, in particular, Krumhansl’s experimental research (Krumhansl, 1979; Krumhansl & Shepherd, 1979) and theories of melodic implication and melodic completeness at the schemata level (Meyer, 1973; Narmour, 1990, 1992).

*Larson’s theory of gravity, magnetism, and inertia.* Larson (2004) expanded Meyer’s (1973) and Narmour’s (1990, 1992) theories of melodic expectations (implications) and melodic completions (realizations) in terms of physical motions that relate to gravity, magnetism, and
inertia. Larson defined gravity as the tendency of an unstable note to descend; magnetism as the
tendency of an unstable note to move to the nearest stable pitch, which tendency grows stronger
the closer an implication progresses to its goal; and inertia as the tendency of a pattern of musical
motion to continue in the same fashion as what the listener perceives to be heard. Larson found
strong support between two algorithmic computer models and the experimental behavior of
participants in several experiments as the theory successfully predicted completions identical to
those performed by the participants. Larson concluded the striking agreement between computer-
generated and participant-generated responses suggests that the theory captures gravity,
magnetism, and inertia as critical aspects of melodic expectation (implication). Larson also
concluded that listeners’ melodic expectations of entire completions of multiple notes rather than
single notes (as in Krumhansl, 1979) should be regarded as schematic realizations. This
conclusion seems to be a reiteration of Lerdahl and Jackendoff’s (1983a, 1983b; Lerdahl, 2001)
and Meyer’s (1973) emphasis on schematic completeness.

Margulis’ model of melodic expectancy. Margulis (2005) proposed a model of schematic
melodic expectations (implications) that assigns composite ratings to the listener’s intuitive
expectedness of various levels of melodic events across the course of a melody. The ratings
depend on the hierarchical existence of four basic factors: stability governed by chord and key
contexts (atonal and non-Western contexts may possibly not apply), proximity (pitch spaces),
direction, and mobility (natural inclination that a melody will move). Margulis’ model includes
hierarchical expectancy formulas for pairs of pitches within existing authentic melodies as well
as sequences of pitches within various time-span reduction levels. A weighted average of
different levels’ formula ratings insures that expectations (implications with realizations or
denials) from adjacent events play a greater role than distant hierarchical ones in the
determination of overall expectancy ratings. Margulis contended the melodic expectation model addresses the implication content of music experiences (in practice) that are dynamic and fluctuate in quality from moment to moment in the flow of melody. Which, according to Margulis, is a weakness in Narmour’s (1990, 1992) theoretical and statically analytic model which considers implications-realizations in various levels of isolation.

In summary, these six relevant theories regarding how the brain perceptually organizes melodic structure information emerged in somewhat of a developmental as well as chronological order. However, there are four major ways in which they may be interconnected, and two notable unexplored considerations.

Melodic Perception Connections

*Meyer’s melodic schemata.* Although Meyer’s (1973) theory of melodic perception and cognition forms a foundation of much perception and cognition research to follow, Meyer’s melodic schemata seem to be largely uninvestigated in research (Rosner & Meyer, 1982, 1986). It appears only two studies, both by Rosner and Meyer, directly involved Meyer’s melodic schemata. First, Rosner and Meyer (1982) investigated whether or not participants could identify existing melodies as belonging to Meyer’s melodic schema categories of gap-fill versus non-gap-fill, changing-note versus non-changing-note, and gap-fill versus changing-note. Second, Rosner and Meyer (1986) investigated the role of melodic schemata in melodic perception. No evidence exists of studies applying Meyer’s (1973) melodic schemata to the perceptual organization of melodic questions and answers. Additionally, while Meyer’s melodic schemata and Krumhansl’s (1979) tonal hierarchy theories seem complimentary, there appears to be no previous research examining the possibility of an existing relationship. A possible relationship may exist between Meyer’s melodic schemata and Krumhansl’s tonal hierarchy in that both Meyer’s and
Krumhansl’s theories are comprised of melodic structure elements, rather than melodic perception and cognition (Lerdahl & Jackendoff, 1983a, 1983b; Lerdahl, 2001) or methods of perceptual measurement (Larson, 2004; Margulis, 2005).

**Theoretical connections.** While the basis of this study comprised the older theories of Meyer’s (1973) schemata and Krumhansl’s (1979) tonal hierarchy, credence was also drawn from more recent research of Lerdahl and Jackendoff (1983a, 1983b; Lerdahl, 2001), Larson (2004), and Margulis (2005). Lerdahl and Jackendoff maintained that pitch spaces are in principle the same as implications-realizations, seemingly connecting the Krumhansl, Narmour, and Lerdahl and Jackendoff theories. Larson’s and Margulis’ multiple-note melodic realizations (entire completions) as predictable schematic realizations, seemingly connects to question and answer melodic events in the Meyer and Narmour theories. Meyer, Margulis, and Lerdahl and Jackendoff theories collectively consider perceived melodic stability and instability in time-span reductions as actual music dynamically flows from one part to another.

**Two unexplored considerations.** Among the various theoretical connections between the older and more recent theories, a possible association between Meyer’s schemata and Krumhansl’s tonal (pitch space) hierarchy is yet unexplored. Krumhansl’s tonal hierarchy itself has not been examined as entire schematic completions, but only as individually paired pitches (Brown, Butler, & Jones, 1994; Cuddy & Badertscher, 1987; Jordan, 1987; Krumhansl & Kessler, 1982; Krumhansl & Sheppard, 1979; Speer & Meeks, 1985; West & Fryer, 1990). Therefore, this study explored a possible relationship between the Meyer, Larson, and Margulis considerations of schematic completions and the Krumhansl, Lerdahl and Jackendoff, and Margulis considerations of hierarchical pitch spaces, based on Meyer’s five original schemata and Krumhansl’s four tonal levels. Simply stated, perceptions were explored between melodic
questions comprised of Meyer’s five schemata, and melodic answers comprised of Krumhansl’s four tonal levels.

*Limited measurement methods.* None of the Narmour (1990, 1992), Krumhansl (1979), Lerdahl and Jackendoff (1983a, 1983b; Lerdahl, 2001), Larson (2004), or Margulis (2005) theories seem to address the question of measuring degrees of pitch space perceptions between Krumhansl’s four tonal levels within the context of entire schematic completions. Narmour’s theory seems only to indicate unmeasured individual and composite analyses of implication-realizations across a melody. Krumhansl’s tonal hierarchy is indicated from a multidimensional analysis of paired-note similarity ratings in response to tonal and atonal melodic fragments. Lerdahl and Jackendoff’s theory proposed only a generative explanation of the implication-realization perceptual process with no measurement considerations.

Larson’s theory, based on two algorithmic computer models, proposed to predict schematic completions across melodies. Margulis’ model proposed composite ratings for pairs of pitches and sequences of pitches across a melody, and proposed weighted rating averages only between initial melodies and time-span reductions. Margulis seemed to disqualify her own expectancy model for measuring all implications-realizations as she noted certain atonal and non-Western stability contexts may not apply. Margulis’ conclusion does not agree with the claimed universality of implication-realization principles noted in other perceptual theories. These models, at best, consider measurements horizontally across melodic events, rather than between melodic completions. As a result, two specialized tools needed to be found, one for determining dimensionality, model fitness, and participants’ melodic listening expectedness, especially if the expectedness dataset showed itself to be one-dimensional instead of multi-dimensional, and another for measuring expectedness responses between implication-realization
melodic completions, that is, strength of degrees of correctness and separation between
Krumhansl’s four levels of melodic answers (realizations).

Purpose and Hypothesis

Purpose

The purpose of the current study was to investigate if expectancies for melodic answers
are consistent with Krumhansl’s (1979) tonal hierarchy when melodic questions are based on
Meyer’s (1973) five theoretical melodic schemata.

Meyer’s (1973) melodic schemata theory and Krumhansl’s (1979) tonal hierarchy theory
comprised the basis of the current study. Briefly summarized, Meyer proposed a theory of
melodic questions (implications) and answers (realizations) based on five melodic schemata.
Meyer named these five schemata as gap-fill, triadic, complementary, axial, and changing-note.
The melodic questions used in the present study were based on these five melodic schemata.
Krumhansl investigated pitch space perceptions among the 12 notes of the chromatic scale
within an octave and proposed a tonal hierarchy theory of four tonal levels. The four levels in
perceptual order are: (1) notes one and eight comprising the tonic octave, (2) notes three and five
comprising the remainder of the tonic triad, (3) notes two, four, six, and seven comprising the
remainder of the diatonic scale, and (4) the five remaining chromatic notes within the octave.
The melodic answers used in the present study were based on these four tonal levels.

Researcher’s hypothesis. The present researcher’s hypothesis was that new melodies
could be composed based on Meyer’s schemata and these melodies would also perceptually
reflect Krumhansl’s four tonal levels. Specifically, these newly composed schemata illustrations
(NCSIs) would (1) imply melodic answers (realizations) similar to existing melodies, (2) prompt
melodic answer expectancies of participants consistent with Krumhansl’s (1979) four tonal
levels, (3) replicate, on average, pitch space distances between the NCSIs’ melodic answer expectancies similar to the pitch space distances between the four tonal levels as reported by Krumhansl, and that (4) in reference to Gestalt principles, participants’ responses would be similar regardless of cultural background, age, or musical experience.

Research Questions

The researcher’s hypothesis gave rise to three research questions that guided the investigation: (1) Are preferred melodic answers (realizations) to newly composed melodic questions (implications), composed to conform to Meyer’s (1973) melodic schemata, consistent with Krumhansl’s (1979) four tonal levels? (2) To what degree did participants anticipate the closing of melodic phrases individually comprised of the four Krumhansl tonal levels? (3) Are participant responses attributable to cultural background, age, or musical experience?

Definitions

Several terms used in this investigation were defined as follows.

Melodic schemata. Melodic schemata are cognitive knowledge and memory structures located in long-term (semantic) memory developed through past experiences with music (Bartlett, 1932, 1995; Cherry, 1953; Dowling & Harwood, 1986; Jones & Yee, 1993; Lipscomb, 1996; Matlin, 1994; Miller, 1956; Neisser & Becklen, 1975; Neisser, 1967).

Newly composed schemata illustrations. Newly composed schemata illustrations (NCSIs) are holistic, melodic phrases created from combining Meyer’s (1973) melodic schematic definitions and existing music literature examples, each exhibiting schematic completeness.

Implication-realization melodies. Implication-realization melodies are schemata illustrations exhibiting questions (implications) and answers (realizations) (Narmour, 1983,

**Tonal hierarchy.** Tonal hierarchy is four distinct pitch space levels of melodic answer expectancies (realizations) within the 12-note chromatic scale bounded by an octave (Krumhansl, 1979). The four tonal levels in perceptual order are as follows: (1) notes one and eight comprising the tonic octave, (2) notes three and five comprising the remainder of the tonic triad, (3) notes two, four, six, and seven comprising the remainder of the diatonic scale, and (4) the five remaining chromatic notes within the octave.

**Melodic authentic context.** Melodic authentic context is defined in this study as melodies in holistic phrase units (entire completions) consisting of questions (implications), answers (realizations), and appropriate rhythmic and tonal closures on the tonic, rather than fragmented synthetic stimuli (Bartlett, 1996; Sloboda, 1985; Watkins & Dyson, 1985).

**Authentic performance context.** Authentic performance context in this study refers to melodies performed for listeners using a digitally sampled piano inclusive of fundamentals and partials, rather than a synthetic sound wave void of harmonics (Aiello, 1994a; Bartlett, 1996; Sloboda, 1985).

**Melodic expectedness.** The perceptual relationship between melodic questions (implications) and melodic answers (realizations) is known as melodic expectedness (Larson, 2004; Lipscomb, 1996; Margulis, 2005; Narmour, 1990, 1992). Melodic expectedness is also known in melodic perception theories as perceived spaces between pitches (Krumhansl, 1979; Lerdahl & Jackendoff, 1983a, 1983b; Lerdahl, 2001; Margulis, 2005). In the present study melodic expectedness was defined as a perception of what a music listener may be inclined to anticipate or look forward to. This distinction is clearly differentiated from a preference, which is
an attitude or personal orientation. Melodic expectedness is characterized by measurements from weak to strong.

Limitations of the Study

Five limitations of this investigation were identified.

First limitation. Various event hierarchies (Lerdahl, 1991, 2001) of metrical structure, time-span reduction, and prolongational reduction and their possible influences on melodic perception were not investigated in this study. These three event hierarchies are related to rhythmic perception and harmonic perception (chord proximity within regions and across regions). While Lerdahl acknowledged these event hierarchies and tonal hierarchies are perceptually interdependent, and an event hierarchy cannot be constructed without an internalized tonal hierarchy, he contended there is also a separate and contrasting distinction between them.

Second limitation. Embellished or implicit schemata (Meyer, 1973), later referred to as time-span reductions (Lerdahl & Jackendoff, 1983a, 1983b; Lerdahl, 2001; Margulis, 2005), were not investigated in this study since they may involve a more complex level of melodic perception than is appropriate for this study. Implicit schemata are melodies elaborately embellished and adorned, for which a melodic reduction is required to visualize the otherwise hidden melodic schema (Meyer, 1973).

Third limitation. Two more recent schemata, known as children’s schemata (Mitroudot, 2001), identified as particular to children yet perfectly fitting Meyer’s (1973) theory, were not investigated because of their claimed exclusivity to children, and not appropriate for this study’s population of adults.
Fourth limitation. While text (also known as lyrics) has been identified as influencing melodic perception, cognition, and memory; text was not included because of its non-pitch characteristic and because researcher’s conclusions seem to vary widely concerning the interactions of melody and text (Aiello, 1994b; Crowder, 1993; Feierabend, Holahan, Getnick, 1998; Knauss, 2005; Peretz, Radeau, Arguin, 2004; Rutkowski, 2002).

Fifth limitation. As well as text or lyrics mentioned in the fourth limitation, musical characteristics such as tempo, timbre, harmony, rhythm patterns, phrases, musical form, and melody were reported to influence strongly listeners’ perceptions (Knauss, 2005). Knauss stated that participants also reported variables such as satirical topic, meaning of text, humorous text, subject matter, sound effects, drums, male / female voices, instrumentations, bass line, steady beat, current events, and style influenced melodic perceptions. For persons of various ethnicities, there are other notable distinctions, such as movement in music for Afro-Americans.

Among all the characteristics noted in the fourth and fifth limitations, this study, however, focused only on melody, and in particular melody comprised only of melodic questions defined by Meyer’s (1973) schemata and melodic answers defined by Krumhansl’s (1979) four tonal levels.
CHAPTER TWO

LITERATURE REVIEW

Purpose

The purpose of the current study was to investigate if expectancies for melodic answers are consistent with Krumhansl’s (1979) tonal hierarchy when melodic questions are based on Meyer’s (1973) five theoretical melodic schemata. Three research questions guided the investigation: (1) Are preferred melodic answers (realizations) to newly composed melodic questions (implications), composed to conform to Meyer’s (1973) melodic schemata, consistent with Krumhansl’s (1979) four tonal levels? (2) To what degree did participants anticipate the closing of melodic phrases individually comprised of the four Krumhansl tonal levels? (3) Are participants’ responses attributable to cultural background, age, or musical experience?

Overview of Chapter Two

Chapter two is organized into two major sections. Section one, Perceptual Theories, is an in-depth examination of this study’s six core theoretical foundations. Section two, Five Core Considerations, is a review of melodic perceptual studies that have explored various elements of (1) Meyer’s five melodic schemata, (2) Gestalt-based and universal principles, (3) authentic and synthetic melodic perception characteristics, (4) schematic completeness, and (5) two statistical analysis programs not previously applied to melodic perception investigations that are uniquely robust for this present study.

Melodic Perception Theories

Six relevant theories have emerged regarding how the brain perceptually organizes melodic structure information. In a somewhat developmental as well as chronological order, the perceptual theories described are Meyer’s (1973) melodic schemata, Narmour’s (1983, 1989,

*Meyer’s Melodic Schemata*

Meyer (1973) outlined a theory of perceptual melodic implications and realizations addressing melodic events such as intervals, motives, or phrases, inclusive of melodic questions and answers. Meyer proposed that all melodic events are cognitively organized by five melodic schemata, which he substantiated from existing music literature.

*Meyer’s perceptual theory.* Meyer’s (1973) implication-realization theory may be briefly described as a perceptual process concerning either melodic continuations or closure. The perceptual process begins with continuation, which may be any melodic event that promotes ongoing melodic activity. Regular and orderly melodic patterns tend to be continued until tonal-rhythmic stability (closure) is reached. Closure is a cessation of melodic events with no expected rhythmic or tonal continuation.

Among events such as intervals, motives, phrases, melodic questions, and answers, perceptual melodic events involving various continuations toward closure may be prolongations, proximate realizations, remote realizations, and delayed realizations. These perceptual melodic events are explained as follows. Melodic prolongations are an extension of a melodic event beyond initial regular and orderly melodic pattern(s). Proximate melodic realizations are subsidiary or alternate melodic goals occurring before the end of a melodic cadence or end of a significant melodic section. Remote melodic realizations, which are melodic continuations not
realized or realized only provisionally before significant closure has taken place, may be realized subsequently or sometimes as remote as an opening sonata theme not being realized until the final coda. Delayed melodic realizations of deflection and reversal often take place after a repetition of the initial pattern has reinforced the original implications. Melodic deflection is created by an event that generates a temporary alternative goal, after which the initial goal follows without further delay. Melodic reversal is an alternative goal, which generally involves a skip followed by a change in the direction of the motion.

*Meyer's melodic schemata.* Meyer (1973) analyzed existing melodies in Western music literature and, after applying his implication-realization principles, proposed that melodies originate from one of five basic schematic structures: gap-fill, triadic, complementary, axial, and changing-note. The five basic schemata structures are described as follows.

Gap-fill schema consists of two characteristics: a disjunct interval in a certain direction (usually upward), which comprises the gap, and a series of conjunct intervals in an opposite direction (usually downward), which fill the gap. Meyer (1973) used Geminiani’s Concerto Grosso in E Minor, Opus 3, No. 3 as a primary example of the gap-fill schema (p. 146). (See Figure 2.1.)

Figure 2.1: *Gap-fill schema*

![Gap-fill schema](image)

Triadic schema consists of disjunct intervals such as thirds, fourths, or fifths as these are syntactically understood as parts of normative patterning, namely triads. The unembellished

Meyer's melodic schemata. Meyer (1973) analyzed existing melodies in Western music literature and, after applying his implication-realization principles, proposed that melodies originate from one of five basic schematic structures: gap-fill, triadic, complementary, axial, and changing-note. The five basic schemata structures are described as follows.

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Figure 2.1: *Gap-fill schema*

![Gap-fill schema](image)

Triadic schema consists of disjunct intervals such as thirds, fourths, or fifths as these are syntactically understood as parts of normative patterning, namely triads. The unembellished
Mozart’s “Tuba Mirum” (No. 3) from the Requiem (K. 626) is a primary example of a triadic schema. (See Figure 2.2.)

Figure 2.2: Triadic schema

Complementary schema is one in which two successive melodic events are exact inversions of each other. Meyer (1973) presented the following beginning melody from the third movement of Brahms’ First Symphony as a primary example of a complementary schema (p. 167). A reduction of the melody reveals a descending stepwise pattern of E♭, D♭, C, B♭, and A♭ which is inverted to an ascending stepwise pattern of C, D, E♭, F, and G. (See Figure 2.3.)

Figure 2.3: Complementary schema

Axial schema consists of a main or axis-tone balanced by upper and lower neighbor tones. An axis melody exhibits two parts similar to a complementary melody with one part being the inversion of the other, also described as a model and its mirror. Both the model and mirror move from the axis tone to neighbor tones and back. The implicative relationship between the model and its mirror is that of repetition by inversion, which indicates a level of closure and not an ongoing process. The function of the upper and lower neighbor tones is generally non-chord tones not found on metrically strong beats. Meyer (1973) presented the first theme of the last movement of Dvořák’s “New World” Symphony as a primary example of an axial schema (p. 185). (See Figure 2.4.)
Figure 2.4: Axial schema

![Axial schema diagram]

Changing-note schema begins and ends on the same pitch similar to an axial melody, but the upper and lower neighbor tones are “relatively high-level, [harmonic and metric] structural tones” (p. 191). The changing-note pattern typically is found around the tonic and may also sometimes begin on the third degree of the scale (Bigand, 1993). Meyer (1973) presented the subject from Bach’s Fugue in C# Minor from *Well-Tempered Clavier, Vol. I*, as a primary example of a changing-note schema (p. 191). (See Figure 2.5.)

Figure 2.5: Changing-note schema

![Changing-note schema diagram]

*Embellished or implicit schemata.* Meyer (1973) further explained that the first three schema types (gap-fill, triadic, and complementary) are found in existing melodic literature as either explicit or implicit. Explicit schemata are straightforward, note-for-note examples. Implicit schemata are within embellished and adorned melodies which require melodic reductions to reveal the hidden schemata. Implicit or embellished schemata later became known as time-span reductions (Lerdahl, 2001; Lerdahl and Jackendoff, 1983a, 1983b; Margulis, 2005). As the present study was not concerned with embellished or implicit schemata, the following gap-fill triadic schema example will suffice as a representative explanation for all embellished categories.
Meyer (1973) explained gap-fill schemata may be found implicitly as gap-fill triadic schemata. In the gap-fill triadic schema, the initial octave gap is filled in with a series of ascending triadic tones followed by a descent fill to the tonic which may also contain triadic activity. Meyer illustrated with Bach’s subject of the D Minor Fugue from Well-Tempered Clavier, Vol. 2 (p. 149). (See Figure 2.6.)

Figure 2.6: Gap-fill triadic

As explained in detail in chapter three, this investigation involved the creation of melodic illustrations of Meyer’s five schemata. These newly composed schematic illustrations (NSCIs) are both unadorned and slightly embellished versions of Meyer’s definitions, but none are complex enough to warrant a clarifying reduction.

**Narmour’s Implication-Realization Model**


**Narmour’s five principles.** Narmour (1990, 1992) outlined five general principles as the core of his implication-realization analytical symbolic model to explain a universal level of melodic syntax for how listeners perceive melodic events. Narmour’s five general principles are registral direction, intervallic difference, registral return, proximity, and closure. First, the principle of registral direction states that if the implication interval is small (P4 or smaller), the
direction of the melody is expected to continue. If the implication interval is large (P5 or larger), then the direction of the melody is expected to reverse. Second, the principle of intervallic difference states that small intervals imply similarly sized realized intervals, and large intervals imply smaller intervals. Third, the principle of registral return is an expectation by the listener that the melody will return to the pitch region around the first tone of the implicative interval. Fourth, the principle of proximity is a general preference for small intervals. Fifth, the principle of closure states that stability is strongest when the implicative interval is large and the realized interval is smaller and reverses direction.

**Perceptual structures.** Narmour (1990) illustrated the five implication-realization principles with five analytical symbols of Duplication [D], Process [P], and Reversal [R], Intervallellic Motion [I], and Registral Direction [V]. Combinations of these analytical symbols produce Intervallellic Process [IP], Registral Process [VP], Intervallellic Duplication [ID], Intervallellic Reversal [IR], and Registral Reversal [VR]. Narmour created the following tonal melodies to illustrate. (See Figure 2.7.)

Figure 2.7: (a): Synthetic melody, and (b): Quasi-inversion of melody (a)
Duplication [D] is a small interval followed by the same small interval. With a change in registral direction, [D] is noted as Intervalic Duplication [ID]. Process [P] is a small interval to a similar small interval. With a change in registral direction, [P] is noted as Intervalic Process [IP]. Registral Process [VP] is a small interval to a large interval in same registral direction. Intervalic Reversal [IR] is a large interval to a small interval in same registral direction. Registral Reversal [VR] is a large interval to an even larger interval, but with a change in registral direction. An interval in any direction being the same as a duplication or lateral motion, hypothetically noted as [VD], is not possible. A single, non-implicative tone is designated as a monad or single tone structure [M].

Prospective or retrospective realizations. Melodic realizations may be prospective or retrospective (Narmour, 1992). A prospective realization is one in which the listener’s melodic expectancies are fulfilled as anticipated. Two examples of a prospective realization are the E at the end of a rising C-D-E processive pattern [P], and a descending C following an ascending G-E, which is a prospective or anticipated realization of a reversal [R]. A retrospective realization is one in which the listener’s melodic expectancies are not fulfilled as anticipated. Narmour denoted retrospective realizations by surrounding the analytical symbol with parentheses. Narmour created the following to illustrate seven retrospective realizations (p. 34). (See Figure 2.8.)

Figure 2.8: Retrospections
Perceptual implicative-realizational content. Three notable considerations reveal how radically different perceptual implicative-realizational content is from conventional modality concepts. First, in Narmour’s (1990, 1992) implication-realization model as in Meyer’s (1973) theory, it is not analytical pitch content such as melodic contour that distinguishes one melody from another and gives each its unique characteristics, but rather perceptual implicative-realizational content. While the melodic contour or pitch content of melodies (Figures 2.7 and 2.9) indicates completely opposite registral directions, the perceptual content is identical since all three melodies generate the same string of implications-realizations.

Second, Narmour’s theory places intervallic difference over intervallic equivalence. Intervallic equivalence states that intervals like thirds and sixths are simply inversions of each other. Yet intervallic difference considers that thirds imply Process [P], which are not perceptually related to larger intervals like sixths, and are not simply intervallic Reversals [R] (Meyer, 1990). Intervallic difference over intervallic equivalence also holds true for seconds and sevenths, fourths and fifths, and primes and octaves.

Third, melodic differences among the three melodies (a, b, and c) are not a result of the presence or absence of modality, but rather the contextual affects of implications and realizations of melodic intervals. Melodies (a) and (b) (Figure 2.7) are tonal in context, while melody (c) (Figure 2.9) is atonal in context, even though all three melodies generate the same string of implications-realizations. Narmour (1990) contended the sum total of perception, not the effect of modality, indicates “the aesthetic power of [fulfillment or] denial, whether complete or partial” (p. 8). Narmour created an example to illustrate (p. 8). (See Figure 2.9.)
Combining and chaining. Combining and Chaining are processes that determine the string of implications and realizations across an entire melodic event. Combining and Chaining help explain various hierarchies of implications and realizations from simple intervals involving as few as three pitches to complex groupings of melodic motifs and phrases. Most existing melodies contain not only a variety of these prospective structures in isolation, but combinations and chains of them. Chaining and Combining are critical processes (further described in chapter three) for insuring the various melodic answers created with Krumhansl’s tonal levels all contained the same string of implications as the initial newly created schematic illustration (NCSI).

Combining occurs when two or more different structures share intervals. Narmour (1990) created a re-composition of measures 3-4 of melody (a) (Figure 2.7) to illustrate (lower brackets added for structural clarity) (p. 10). The interval $B^b-G$ belongs both to a continuing descending ($F-D-B^b-G$) process [P] and to an intervallic ($B^b-G-A$) process [IP], thus the designation [PIP] is a combination in which the terminal realization of one structure is the initial implication of another. (See Figure 2.10.)
Chaining occurs when three or more structures share intervals. Narmour created another re-composition of measures 3-4 of melody (a) (Figure 2.7) to illustrate (brackets between staves added for structural clarity) (p. 10). Both measures become one structural chain [VPRPIP] by using dissonance to deform both the third beat of measure three and the third beat of measure four. The shared intervals are: [VP] and [R] share interval G-F, [R] and [P] share interval F-C, and [P] and [IP] share interval B♭-G. (See Figure 2.11.)

Narmour (1990) contended these perceptual laws do not explain music, but that music cannot escape their influence. Narmour argued his principles were (1) based on Gestalt principles being “context free and thus apply to all styles [and eras] of melody” (p. ix), (2) his perceptual
structures account both for a multiplicity of singular and plurality of melodic events, and (3) these principles and structures regulate the universal art of melody.

**Krumhansl’s Hierarchy of Tonal (Pitch Space) Levels**

Krumhansl (1979) used fragmented tonal and atonal melodic questions and pairs of 12 chromatic notes, in order to explore the possible quantification of tonal levels, or pitch spaces. Krumhansl’s model of tonal levels became a notable theory instigating numerous investigations involving pitch spaces being categorized in four levels. Lerdahl and Jackendoff (1983a, 1983b; Lerdahl, 2001) later theorized that pitch spaces and implications-realizations are the same.

In Krumhansl’s (1979) investigation, participants were asked, in a series of experiments, to judge how similar the first test tone in a pair was to the second test tone within the tonal or atonal melodic stimuli context provided. Tonal and atonal melodic stimuli were configured to be either authentically oriented (melody moves within the tonic to tonic, Do to Do range), or plagally oriented (melody moves above and below the tonic, usually within the Sol to Sol range). Krumhansl’s illustration follows (pp. 365 & 368). (See Figure 2.12.)

**Figure 2.12: Krumhansl’s (1979) tonal and atonal melodic stimuli**
Preceding a future trend of investigating melody in naturalistic, authentic settings, a flute stop on an electronic organ was the sound source for both the melodic sequences and paired probe tones because as it was deemed to approximate most closely a pure sine wave, inclusive of the fundamental tone and harmonic partial overtones.

Multi-dimensional analysis of similarity ratings from the participants of the probe tone pairs suggested that musical listeners demonstrated a pattern of relationships among tones that is not only determined by pitch height, but also by membership in the major triad chord and the diatonic scale associated with the tonal system of the context. Multidimensional scaling of the similarity ratings revealed a three-dimensional conical structure around which the tones were ordered according to pitch height. Krumhansl (1979) reported a clearly delineated tonal
Krumhansl (1979) explained how the conical shape represents the hierarchy of the 12 chromatic tones in a C Major context. The major triad components fall on a circular cross section of half the radius of the circular cross section containing the other diatonic tones, and one-quarter the radius of the circular cross section containing the non-diatonic tones. Krumhansl also explained, that in the conical representation, the components of the major triad (C, E, G, C’) are located on a place close to the vertex of the cone, the remaining diatonic tones (D, F, A, B) on a plane somewhat farther from the vertex, and the non-diatonic tones (C#, D#, F#, G#, A#) on a plane distant from the vertex. In this way, the configuration accounts for various considerations contained in the similarity data: (1) the effect of pitch height, (2) the high similarity of tones separated by the octave, and (3) the close relationships among the diatonic tones, particularly among the tones forming the major triad chord. Krumhansl’s tonal hierarchy of four levels
exploring the quantification of pitch spaces became a notable investigation that initiated many similar studies.

*Lerdahl and Jackendoff’s Generative Theory of Tonal Music*

Lerdahl and Jackendoff (1983a, 1983b; Lerdahl, 2001) detailed a generative theory of tonal music (GTTM) based on the premise that pitch spaces and hierarchy of tonal levels (per Krumhansl, 1979) and stability and instability conditions (implications-realizations) are in principle the same. GTTM describes specific conditions of stability and instability of events within a piece’s temporal regions through four hierarchical structures in music: grouping structure, metrical structure, time-span structure, and prolongational reduction. Grouping structure is the listener’s segmentation of the music into units of various sizes, which may include motives, phrases, periods, sections, questions, and answers. Metrical structure is the hierarchy of beats a listener attributes to the music, establishing a sense of meter. Time-span reduction establishes the relative structural importance of pitch-events heard within rhythmic units of the piece. Prolongational reduction involves the listener’s perception of recurring patterns of tension and relaxation among music events, establishing a sense of pitch stability. Lerdahl and Jackendoff acknowledged this last hierarchical structure, prolongational reduction, resembles aspects of Schenkerian analysis (Lerdahl, 2001). Among various theoretical connections within GTTM, Lerdahl explained notable ones involve Schenker, Meyer, Krumhansl, and pitch spaces.

Lerdahl (1988) illustrated the GTTM’s interaction of the four hierarchical structures (grouping structure, metrical structure, time-span structure, and prolongational reduction) in a flow chart (Figure 2.14). First, a listener’s perceived grouping and metrical structures combine to elicit time-span segmentation. Second, perceived time-span reductions and prolongational
reductions simultaneously combine to generate conditions of stability (or instability). Lerdahl proposed GTTM’s process may help explain a listener’s perceived relative stability and instability of events within a piece’s embedded temporal regions as it flows from one part to another. (See Figure 2.14.)

Figure 2.14: Generative theory of tonal music (GTTM)

Larson’s Theory of Gravity, Magnetism, and Inertia

Larson (2004) proposed a theory of melodic implications (expectation) in which listeners experience melodic realizations (completions) in terms of physical motions that relate to gravity, magnetism, and inertia. Larson defined gravity as the tendency of an unstable note to descend, magnetism as the tendency of an unstable note to move to the nearest stable pitch, which grows stronger the closer an implication progresses to its goal, and inertia as the tendency of a pattern of musical motion to continue in the same fashion. Larson’s theoretical claim was that listeners expect entire completions as opposed to individual-note realizations. Larson noted previous experimental work in music perception inordinately focused attention on single new notes as realizations instead of notes in plurality as entire completions. Huron (2007) reiterated the same (see chapter five, *ITPRA theory.*) Larson also contended previous theories (Krumhansl, 1995; Narmour, 1990, 1992; Schellenberg, 1997) do not offer testable explanations of how listeners generate entire completions.
Larson’s single-level and multi-level algorithmic computer models propose to quantify the implications of gravity, magnetism, and inertia. The single-level computer model calculates single note predictions (completions or realizations). The multi-level computer model calculates, from a melodic beginning and Schenkerian analysis of that beginning, a list of predictions (completions or realizations) of varying lengths. Multi-level predictions begin with the most basic level of analysis at the single-level model to produce a completion at that level. The model then fills in notes by choosing ongoing continuations of notes (realizations) that give in to inertia. Each level is more abstract than the previous as each move further away from the original. In this manner, hierarchical levels result from the multi-level predictions.

Larson tested his theory of gravity, magnetism, and inertia with participants’ experiential completions (answers) to melodic implications (questions). The participants’ completions (melodic answers) were tested against single- and multi-level computer models respectively on a single level of musical structure and on multiple hierarchical levels. Larson found strong support between the two computer models and the experimental behavior of participants in several experiments as the theory successfully predicted note-for-note completions identical to those performed by the participants. Larson concluded the striking agreement between computer-generated and participant-generated responses suggests that his theory captures gravity, magnetism, and inertia as critical aspects of units of melodic realizations (answers), which Larson labeled as entire (schematic) completions.

**Margulis’ Model of Melodic Expectancy**

Margulis (2005) proposed a model of schematic melodic expectations (implications) that assigns composite ratings to the listener’s intuitive expectedness of various levels of melodic events across the course of a melody. The ratings depend on the hierarchic happening of four
basic factors: stability (and instability), proximity (pitch space distances), direction, and
mobility. Stability denotes that listeners generally expect relatively stable melodic events
governed by chord and key contexts (atonal and non-Western contexts may not apply). Proximity
considers that listeners expect subsequent events to be not too distant from previous ones.
Direction implies that small intervals continue in the same direction with more small intervals
and large intervals suggest the expectation for reversal. This continues until extremely large
intervals suggest that the melody is comprised of two polyphonic levels. Mobility suggests the
natural inclination that a melody will move with infrequent expectancies for repetition.

Margulis’ model includes both hierarchical expectancy formulas for individual pitches
within an existing authentic melody and sequences of pitches within various time-span reduction
levels, and a weighted rating for distant hierarchical events. For individual pitches across a
melodic event, Margulis proposed an expectancy rating may be determined with a formula
calculating stability, proximity, direction, and mobility factors. For sequences of pitches within
various time-span reduction levels, Margulis also proposed a computation method for combining
hierarchic expectancy ratings in five rules. A weighted average of different levels’ ratings insures
that expectations (implications with realizations or denials) from adjacent melodic events play a
greater role than distant hierarchical ones in the determination of overall expectancy ratings.

Margulis also presented implicative denial ratings of three varieties: surprise-tension,
denial-tension, and expectancy-tension. Surprise-tension and denial-tension are backward
looking and interpret events in light of past ones; expectation-tension is forward-looking,
registering an expectation about event(s) to come.

Margulis contended her entire melodic expectation model addresses the implication
content of music experiences (in practice) that are dynamic and fluctuate in quality from moment
to moment in the flow of melody, which is a weakness in Narmour’s (1990, 1992) implication-realization (abstract) model of static events. In this dynamic aspect, Margulis claimed the model attempts to offer a quantification of affective, dynamic engagement with melody.

Summary of the Six Theories

The above six theories seem to remain the core of understanding melodic perception. Numerous investigations have emerged from them regarding how the brain perceptually organizes melodic structure information. These investigations seem to fall in the general categories of melodic schemata, Gestalt-based and universal, authentic (dynamic flow) and synthetic contexts, and schematic completeness.

Five Core Considerations

Five core considerations form a unique basis for this investigation. These considerations, not previously combined as in this study, are presented in the following order: Meyer’s (1973) schemata that have been infrequently investigated, Gestalt principles that are held to be universal, various researchers’ preference of authentic over synthetic contexts, schematic completeness, and two robust statistical rating scales uniquely applied, for the first time, to melodic perception data.

Meyer’s Melodic Schemata

A review of related research literature revealed two investigations involving Meyer’s melodic schemata in authentic, dynamic contexts. Rosner and Meyer (1982) investigated whether participants could identify authentic, existing melodies as belonging to the melodic schema categories of gap-fill versus non-gap-fill, changing-note versus non-changing-note, and gap-fill versus changing-note. The stimuli were authentic, dynamic aural melodies; that is, melodies excerpted from recordings of fully instrumented passages in existing literature.
Participants were undergraduate and graduate students at a large Pennsylvania university, and music majors and non-music majors alike. Participants had not received any prior exposure to analyses of melodic processes. Rosner and Meyer (1982) concluded that participants were significantly better at identifying gap-fill than melodies not gap-fill, significantly more successful identifying changing-note than not changing-note, but found no significant relationships between recognition of gap-fill versus changing-note or changing-note versus gap-fill.

Rosner and Meyer (1986) later investigated whether melodic processes involving the melodic schemata play a role in melodic perception. Participants were non-music undergraduates from a large Pennsylvania university without any particular musical training. Participants heard authentic, dynamic melodies; that is, melodies excerpted from recordings of fully instrumented passages from existing literature. In Experiment I, participants were asked to rate differences between changing-note melodies and various melodic passages that denote no actual melodic schemata. In Experiment II, participants were asked to rate differences between changing-note and complementary melodies. Multidimensional scaling and hierarchical cluster analysis indicated a clear separation between the identification of the two melodic processes in both experiments.

Gestalt-Based and Universal

Various investigations have explored elements of Gestalt-based and universal principles. Narmour’s (1990, 1002) implication-realization model, built on Gestalt principles, seems to transcend culture and age boundaries, and apply to musicians and non-musicians alike, as he proposed in 1990. Krumhansl (1995) investigated the anticipation of melodic answers to British folk tunes, atonal songs, and Chinese melodies presented in the context of Narmour’s model with
musician and non-musician listeners, as well as Chinese and Western listeners. Cross cultural investigations using North Sami yoiks music have compared the responses of listeners from differing cultures (Sami and Finnish musicians, South African traditional healers, and Western listeners). Despite listeners’ variations of experiences with one’s own music and a differing culture, Narmour’s music cognition principles seem to be supported (Eerola, 2003; Krumhansl, et al, 2000). From rating how well individual test tones continued melodic fragments, 8- and 11-year-old children and adults alike experienced similar melodic implications by expecting a forthcoming tone to be in closest proximity to the tone last heard, thus agreeing with Narmour’s implication-realization principles (Schellenberg, Adachi, Purdy, & McKinnon, 2002). These studies spanning various cultures, musical training levels, and ages seem to support Narmour’s (1990) claim that his implication-realization principles are Gestalt-based and are therefore universal.

**Authentic (Dynamic Flow) and Synthetic Contexts**

*Authentic versus synthetic.* Since melodies are usually heard as natural, holistic events in a dynamic flow, some researchers feel they should be investigated, not synthetically (melodic fragments), but authentically (entire completions) (Larson, 2004; Lerdahl, 2001; Lerdahl & Jackendoff, 1983a, 1983b; Margulis 2005). Some researchers believe that creating synthetic environments to examine perception (such as scales, triads, cadences, melodic fragments, probe tones, and experimental melodies) will not provide appropriate insight into actual melodic perception. For this reason, some researchers have voiced strong objections against performing experiments in synthetic contexts (Aiello, 1994a; Huron, 2007; Larson, 2004; Margulis, 2005; Sloboda, 1985; Watkins & Dyson, 1985). Aiello (1994a) stated there is a problem with studying melodic perception apart from attending a concert in a specially designed auditorium because the
laboratory is different from listening in surroundings conducive to an aesthetic experience. Watkins and Dyson (1985) objected to the synthetic laboratory approach and the use of experimental melodies because “veridical musical structure can be found only in existing melodies” (p. 73) as full musical intuitions of a composer are not embodied in the synthesis process. Sloboda (1985) endorsed and encouraged studying “cognitive skills in situations more closely resembling those in which people would normally employ them outside the laboratory [focusing on] how people deal with extended and meaningful material, rather than fragmented, meaningless stimuli” (p. 8).

**Synthetic contexts.** Krumhansl’s (1979) theory of four tonal levels has been thoroughly examined in a variety of synthetically derived contexts. Most of these investigations involve comparing various fragmented melodic stimuli with single or paired probe tones, which seem to provide much support for Krumhansl’s theory in the synthetic context. As stated previously, the synthetic context has been criticized as being inauthentic, and while Krumhansl’s theory seems supported by research in a synthetic context, it seems to lack support in an authentic context.

Investigations examining comparisons of major and minor scales with single probe tones from 12 chromatic notes within the octave seem to support the Krumhansl tonal hierarchical model (Brown, Butler, & Jones, 1994; Cuddy & Badertscher, 1987; Jordan, 1987; Krumhansl & Kessler, 1982; Krumhansl & Sheppard, 1979; Speer & Meeks, 1985; West & Fryer, 1990). Investigations comparing major and minor modalities using triads and cadences and 12 chromatic single probe tones also appear to provide support for the Krumhansl model (Halpern, Kwak, Bartlett, & Dowling, 1996; Janata & Reisberg, 1988; Krumhansl & Sheppard, 1979). Additionally, investigations utilizing diminished triads with 12 chromatic single probe tones provide plausible support for the Krumhansl model (Brown, Butler, & Jones, 1994; Cuddy &
Badertscher, 1987). Further, investigations involving tonal and atonal synthetically derived melodic fragments with 12 chromatic single probe tones seem to provide yet more support for the Krumhansl model (Brown, Butler, & Jones, 1994; Castellano, Bharucha, & Krumhansl, 1984; Cuddy & Badertscher, 1987; Halpern, Kwak, Bartlett, & Dowling, 1996; Janata & Reisberg, 1988; Jordan, 1987; Speer & Meeks, 1985; West & Fryer, 1990; Woloszyn, 2002). Lastly, an investigation using the octave divided into 48 eighth tones (rather than 12 chromatic tones) and the major scale also seems to support the Krumhansl model (Jordan, 1987).

**Authentic (dynamic flow) contexts.** The authentic context offers a more natural environment in which one may experience melody holistically in the dynamic flow of music. Lerdahl and Jackendoff’s (1983a, 1983b; Lerdahl, 2001), Larson’s (2004), and Margulis’ (2005) models emphasize the importance of the authentic context and dynamic flow of music for investigating perceived stability/instability conditions (Narmour’s implications-realizations) and pitch spaces (Krumhansl’s tonal hierarchy). While support for Krumhansl’s theory and the Lerdahl and Jackendoff, Larson, and Margulis models has come from many synthetic-context investigations, authentic-context investigations are few in number, described following.

Dibben (1994); Janata, Birk, Tillmann, and Bharucha (2003); and Toiviainen and Krumhansl (2003) conducted three authentic-context investigations. First, in Dibben’s study, listeners successfully matched performed reductions of tonal and atonal excerpts to the tonal and atonal pieces of music from which they were excerpted (although the tonal was reported more successful than the atonal). This seems to support the time-span reduction implications later addressed more thoroughly in the Margulis’ model (Dibben). Second, in the study by Janata, Birk, Tillmann, and Bharucha, participants listened to a composed melody that modulated continuously through all 24 major and minor keys and judged the fit of a singular pitch randomly...
placed throughout the modulations. The listeners’ comparative ratings appear to support Krumhansl’s tonal levels and Lerdahl and Jackendoff’s, Larson’s, and Margulis’ models emphasizing the dynamic flow of music. Third, in the Toiviainen and Krumhansl study, listeners’ preferential ratings of 12 chromatic probe tones individually played with the organ *Duetto* by Bach (BWV 805) also seem to support Krumhansl’s four tonal levels and Lerdahl and Jackendoff’s, Larson’s, and Margulis’ dynamic flow models. Whether involving improvised excerpts, a composed modulating melody, or an existing piece from music literature, these three investigations appear to support Krumhansl’s tonal levels in the authentic context and Jackendoff’s, Larson’s, and Margulis’ models emphasizing the dynamic flow of music.

While both synthetic- and authentic-context investigations support Krumhansl’s (1979) tonal levels and Jackendoff’s, Larson’s, and Margulis’ models emphasizing the dynamic flow of music, the smaller number of authentic studies appears to indicate a need for more investigations involving the authentic context and dynamic flow of music. As stated previously, an authentic context has not been thoroughly established.

*Schematic Completeness*

Schematic completeness, which involves a holistic presentation of melody in which the melody contains tonal and rhythmic cadence (as opposed to fragmented motifs and probe tones) is emphasized in the theories of Meyer (1973), Lerdahl and Jackendoff (1983a, 1983b; Lerdahl, 2001), Larson (2004), and Margulis (2005). Meyer’s theory of five basic melodic schemata originated entirely from his analysis of holistic melodies found in existing literature. Lerdahl and Jackendoff’s generative theory, to explain listeners’ perceived melodic stability and instability in the dynamic flow of music, is acknowledged by Lerdahl and Jackendoff to be largely supported by Meyer’s schematic completeness. Larson’s conclusion that listeners’ melodic expectations of
entire completions (schematic realizations) comprised of multiple notes rather than single tones, seems to support the importance of schematic completeness over fragmented motifs and individual probe tones. Margulis’ melodic expectation model addressed the implicative content of authentic music experiences within the dynamic flow of melody. A chronological trend among notable implication-realization investigations seems to indicate an ongoing transition away from melodic-fragmented settings and probe tones and an evolution toward more investigations in melodic-schematic completeness settings.

Two Robust Rating Scales

A study exploring the combination of schematic completeness (realizations) with Meyer’s five basic schemata and the strength of degrees of correctness and separation between Krumhansl’s tonal levels, such as this present study proposed to investigate, necessitated looking outside of current implication-realization formulae models and statistical software programs. Each of the Meyer (1973), Narmour (1990, 1992), Krumhansl (1979), Lerdahl and Jackendoff (1983a, 1983b; Lerdahl, 2001), Larson (2004), and Margulis (2005) models perceptually measure horizontally across melodic events, but none offer any means of perceptually measuring between melodic events.

Moulton’s NOUS. A robust tool for determining measurements of expectedness between melodic events and for determining dimensionality may be Moulton’s NOUS. Mark Moulton, of Educational Data Systems (www.eddata.com), an analyst specialist in Rasch models including Many-Facet Rasch Models, authored NOUS modeling and other multi-dimensional models in accordance with Rasch requirements for “objectivity.” The question underlying the creation of NOUS was: “Can a one-dimensional model have the properties of a Rasch multi-dimensional
model?” Yet undetermined in this study is whether the data is one-dimensional or multidimensional and how dimensionality may relate to melodic perceptual measurements.

Moulton’s NOUS psychometric model has been applied to audio listening tests (Moulton Laboratories and Lucent Technologies), program evaluation (Reading First), large-scale assessment (CHSPE), data mining (profiling travelers), and school district assessments (equating). Moulton’s specialty is Rasch models, including Many-Facet Rasch Models, and multidimensional models developed under the name NOUS in accordance with Rasch requirements for “objectivity.” Moulton’s company, Pythias Consulting, markets NOUS software for specialty applications, such as this study’s distinctive specialty. However, it seems no melodic perception studies to date have used Moulton’s NOUS.

Andrich and Luo’s RUMMFOLDs. A robust tool that may aid in revealing measurements of expectedness degrees of separation between melodic events may be Andrich and Luo’s RUMMFOLDs (Andrich, 1978a, 1978b; Andrich & Luo, 1998). RUMMFOLD has been found to be a statistically robust tool in analyzing perception or expectedness data from Likert-type or attitude, belief, or opinion type items. In response to the question “To what degree did participants anticipate the closing of melodic phrases?” sampling data were perceptual and expectedness ratings in that listeners were requested to respond to each tonal level realization (melodic answer).

While RUMMFOLD seems not to have been applied to any measurement of expectedness investigation involving music, as proposed in this investigation, previous non-music investigations involving RUMMFOLD have used the tool. A scale of gambling choices was administered to 57 first year psychology students, 104 electronic gaming machine players, and 49 self-referred problem gamblers to explore the hypothesis that the results yielded by factor
analysis and Andrich’s model would not agree with respect to the behavior of individual items (Kyngdon, 2004). The usefulness was examined of applying the Andrich model to high school grade data of Assessment Test Scores of English, Mathematics, Reading, and Science Reasoning (ACT) (Bassiri & Schulz, 2003). The relationships between self-reported approaches to studying and self-concept, self-capability, studying and learning behavior, and evaluation of learning from a convenience sample of 371 students in grades one to four was explored using the Andrich model to create a single scale of self-regulated learning (Waugh, 2003). While the Andrich model was also used for the construction and validation of a questionnaire on authoritarianism (Passini, 2003), for controlling for rater effects when comparing survey items with incomplete Likert data (Schulz & Sun, 2001), for examining the quality of judgments from judges who took part in the standard-setting process for the Georgia High School Graduation Test in the content area of mathematics using a Binomial Trials Model (Engelhard & Anderson, 1998), and for a latent trait analysis of a set of clinical, psychological, behavioral, and social signs characteristic of anorexia nervosa (Mannarini, 1996), it appears no music studies to date have used RUMMfold.

**Chapter Summary**

The present study proposed to investigate whether measurements of expectedness for melodic answers are consistent with Krumhansl’s tonal levels when melodic questions are based on Meyer’s theory of melodic schemata. Six perceptual theories, in a chronological and developmental order, comprised the theoretical core and seemed to have provided a resultant direction for this study’s particular focus. Refining this focus were core considerations that defined to this study’s uniqueness: Meyer’s (1973) five melodic schemata, Krumhansl’s (1979) four tonal levels (pitch spaces), Gestalt-based and universal implication and realization principles
(Narmour 1990, 1992), authentic over synthetic melodic perception characteristics (Margulis, 2005), schematic completeness (Larson, 2004), and two statistical analysis programs not previously applied to melodic perception investigations that are uniquely robust for this present study: NOUS (Moulton, 2010) and RUMMFOLD (Andrich, 1978a, 1978b; Andrich & Luo, 1998) for measuring expectedness degrees of separation between melodic perceptual events.

This investigation may extend backwards in completing a gap in past research and forwards in broadening recent research. In a backwards manner, from 1970s research, Meyer’s (1973) five melodic schemata have been yet unexplored as melodic questions and Krumhansl’s (1979) hierarchy of four tonal levels have been yet unexplored as melodic answers. In a forwards manner, combining these two older investigations may enable exploration of implications and realizations within melodic (schematic) completeness in an authentic setting. This investigation may also add to the limited existing methods for measuring melodic perception. Previously, Larson’s (2004) two algorithmic models were employed to investigate computer-generated and participant-generated responses of gravity, magnetism, and inertia. Also, Margulis’ (2005) model included hierarchical expectancy formulas for pairs of pitches within existing authentic melodies as well as sequences of pitches within various time-span reduction levels. These comprise measurements across melodic events. With all considerations combined, this study may provide insight into perceptually measuring between melodic events (melodic questions and answers), rather than horizontally across melodic events.
CHAPTER THREE

METHODOLOGY

Purpose

The purpose of the current study was to investigate if expectancies for melodic answers are consistent with Krumhansl’s (1979) tonal hierarchy when melodic questions are based on Meyer’s (1973) five theoretical melodic schemata. Three research questions guided the investigation: (1) Are preferred melodic answers (realizations) to newly composed melodic questions (implications), composed to conform to Meyer’s (1973) melodic schemata, consistent with Krumhansl’s (1979) four tonal levels? (2) To what degree did participants anticipate the closing of melodic phrases individually comprised of the four Krumhansl tonal levels? (3) Are participants’ responses attributable to cultural background, age, or musical experience?

Overview of Chapter Three

The method for this study is described in three major sections after a description of the design is offered. Section one, the Measurement Tool Development, provides a detail of the main procedures and sub-stages for developing the NET listening test, explanation of the pilot testing procedures, discussion of validity and reliability, and recommendations for the main study. Section two, Population Sample, is a description of the Internet use for collecting data and how the NET was styled to fit the Internet method. Section three, Main Study Procedures, describes the participants, procedure, and proposed data analysis for the main study.

Design of the Study

The design of this study was descriptive. Isaac and Michael (1997) defined descriptive research as having the purpose of describing systematically facts, characteristics, preferences, or attitudes of a given population. By means of expectedness measurements, this researcher was
trying to understand patterns of responses psychometrically for the “Note”able Endings Test (NET) in which the melodic answers most frequently chosen by participants are hypothesized to be consistent with Krumhansl’s (1979) tonal levels. The pattern of responses was also analyzed according to reported cultural background, age, and music experience.

Development of the “Note”able Endings Test (NET)

A data collection instrument appropriate to this study did not exist so the “Note”able Endings Test (NET) was developed. It was an Internet, cross-sectional, Likert-type survey to elicit expectedness data involving a perception rating (Dunn-Rankin, Knezek, Wallace, & Zhang, 2004). An aural listening survey method was deemed advantageous due to the expectedness listening responses (“Note”able Endings Test, or NET) desired from the participants (Gosling, Vazire, Srivastava, & John, 2004). The Internet was chosen as the preferred method of survey dissemination and data collection because the convenience population of the graduate students from a large central Pennsylvania university was deemed very familiar with the Internet and computers (Robins, Trzesniewski, Tracy, Gosling, & Potter, 2002). The financial and response economy of this study’s design featured an expense-free, rapid turn-around from immediate Internet dissemination directly to each participant’s computer, to immediate data collecting and automatic data compilation through the Internet programming languages of HTML, PHP, and SQL (Fraley, 2004).

In order to acquire participants’ measurements of expectedness for melodic answers (realizations) based on Meyer’s (1973) five schemata and Krumhansl’s (1979) four tonal levels, the test instrument needed to contain authentic melodies which conformed to the five schemata and four tonal levels. Establishing the test instrument required four main procedures: (1) composition of primary NSCIs and evaluation by Narmour’s (1990, 1992) implication-
realization model, (2) composition of altered NCSIs and another evaluation by Narmour’s (1990, 1992) implication-realization model, (3) authentication of the primary NCSIs by listening experts who were music education professionals, and (4) creating the test web pages with programming languages of HTML, CGI/Perl, PHP, and SQL.

The first procedure was to create 20 original melodic questions and answers (primary NCSIs) consistent with Meyer’s (1973) definitions of his five schemata. These 20 primary NCSIs needed to contain implications (questions) with realizations (answers) of tonic closure (schematic completeness), replicating Meyer’s five melodic schematic definitions. Thus, each primary NCSI, illustrating Meyer’s schemata, created with tonal closure on the tonic, automatically satisfied both schematic completeness and Krumhansl’s (1979) first tonal level comprising the tonic. In the second procedure, three subsequent realizations (answers) were created for each primary NCSI (altered NCSIs), compliant with Krumhansl’s three remaining tonal levels. In the third procedure, the 20 primary NCSIs were submitted to music education professionals deemed to be expert listeners for authentication ratings using a Likert-type scale of “4” being most compliant to “1” being least compliant. In summary, primary NCSIs are newly composed schematic illustrations containing Krumhansl’s first level on the tonic, which are authentically composed renditions of Meyer’s (1973) five original schemata ending on the tonic (schematic completeness). Altered NCSIs are primary NCSIs that have been altered with endings reflecting the second through fourth tonal levels of Krumhansl’s hierarchy.

**Composition of Primary NCSIs**

In order to address the first research question involving preferred melodic answers (realizations) to newly composed melodic questions (implications), the researcher composed melodies (primary NCSIs) that reflected Meyer’s five basic schemata definitions and melodic examples. These primary NCSIs needed to be complete implications (questions) and realizations
(answers) in holistic phrase structure and definitive closure (schematic completeness). The compositional procedure is explained in detail as follows. Newly composed schematic illustrations (primary NSCIs) were necessary for two reasons: (1) Meyer presented only melodic excerpts from existing music literature as schematic examples, and (2) avoidance of the mere-exposure effect, both explained as follows. First, the pre-existing excerpts lacked complete implications (questions) and realizations (answers), and schematic completeness of phrase structure and closure. Composed (primary) NCSIs, in satisfying all lacking elements, also satisfied automatically the first Krumhansl’s (1979) tonal level, in that tonal closure was rendered on the tonic. Second, composed (primary) NCSIs for testing purposes, rather than melodic excerpts from pre-existing music literature, were necessary to avoid the mere-exposure effect resulting from listeners’ past exposure to pre-existing music that could influence their expectedness responses (Bonnel, Gaudreau, & Peretz, 1998; Gandreau & Peretz, 1999; Seamon, et al., 1995; Wang, M-Y. & Chang, H-C, 2004; Zajonc, 1968).

*Primary NCSIs composition procedure.* Primary NCSIs were first composed to illustrate Meyer’s (1973) five basic schemata definitions and melodic examples. The primary NCSIs were then analyzed with Narmour’s (1990, 1992) implication-realization model to determine perceptual melodic events inherent in each. Primary NCSIs were created from an application of Meyer’s (1973) five schema definitions and existing, authentic melodies Meyer presented as supporting schema examples. These primary NCSIs resembled Meyer’s examples, yet were altered to render them unidentifiable from existing music literature, thus avoiding the mere-exposure effect explained previously. The creation of primary NCSIs from existing examples included the following alternations: (1) modality changes between major and minor, (2) removal of original articulations, (3) removal of embellished or implicit schemata elements which
necessitate melodic reductions to reveal the hidden schemata (refer to chapter two), (4) various rhythmic changes to the existing melodies, while retaining some rhythmic similarities, (5) metric changes between duple and triple, (6) inclusion of a definitive tonic closure for each schema, which satisfied both Krumhansl’s (1979) first tonal level and tonal schematic completeness, and (7) consistent phrase structure to satisfy structural schematic completeness. Following are Meyer’s five schematic definitions and specific transformation characteristics of each primary NCSI.

*Gap-fill NCSI.* Meyer (1973) defined a gap-fill schema and described three subcategories as gap-fill octave, gap-fill triadic, and gap-fill non-triadic. A gap-fill schema is defined by two attributes: a disjunctive interval in a certain direction, which comprises the gap, and a series of conjunct intervals in an opposite direction, which fill the gap. Meyer’s gap-fill octave example of Geminiani’s Concerto Grosso in E Minor, Opus 3, No. 3 (Figure 3.1), and gap-fill triadic with Mozart’s “Minuetto” from Flute Quartet in A Major (K. 298) (Figure 3.2), were combined to include both gap-fill subcategories of octave and triadic. Articulations were removed, the modality of E Minor was changed to E Major, and a tonic closure was included (Figure 3.3).

Figure 3.1: *Geminiani’s Concerto Grosso in E Minor, Opus 3, No. 3*

![Figure 3.1](image1)

Figure 3.2: *Mozart’s “Minuetto” from Flute Quartet in A Major (K. 298)*

![Figure 3.2](image2)
Triadic NCSI. Meyer (1973) defined a triadic schema and described two subcategories as triadic linked and triadic continuous. A triadic schema is defined as a series of disjunctive intervals, such as thirds, fourths, or fifths, syntactically understood as parts of normative patterning, namely triads. Meyer’s examples of triadic linked with “Hallelujah Chorus” from Handel’s Messiah (Figure 3.4), triadic continuous with Mozart’s Sonata for Violin and Piano in A Major (K. 305) (Figure 3.5), and triadic continuous with Brahms’ beginning melody of the first movement of his Fourth Symphony (Figure 3.6), were combined to include Handel’s perfect fourth linking (Figure 3.7, m. 1 notes G to C, and m. 4 notes B to E), Mozart’s and Brahms’ triadic continuous descent of thirds (Figures 3.5 and 3.6), Mozart’s use of compound meter (Figure 3.5), Brahms’ use of E Minor (Figure 3.6), and a tonic closure (Figure 3.7).
Complementary NCSI. Meyer (1973) defined a complementary schema and described three subcategories as complementary divergent, complementary convergent, and complementary divergent-convergent. A complementary schema is defined as two successive melodic events, which are similar inversions of each other. Meyer’s example of complementary-divergent with Brahms’ First Symphony, Third Movement (Figure 3.8), was transformed to exhibit complementary in that the antecedent and consequent are exact inversions of each other, divergent with the antecedent and consequent each implying no common meeting tone, and a tonic closure (Figure 3.9).

Axial NCSI. Meyer (1973) defined an axial schema as having two parts, a model and its mirror. Each of the two parts of an axial schema begins and ends with a main or axis-tone embellished by upper and lower neighbor tones. Upper and lower neighbor tones move from the axis and back. The model and its mirror are similar to a complementary melody with one part being a similar inversion of the other. The implicative relationship between the model and its mirror is that of repetition by inversion, which indicates a level of closure and not an ongoing
process. The function of the upper and lower neighbor tones is generally non-chord tones not found on metrically strong beats. Meyer’s example of axial with the first theme of the last movement of Dvořák’s “New World” Symphony (Figure 3.10), was transformed to exhibit rhythmic and intervallic exactness in model and mirror inversions, a change in modality from E Minor to E Major, a change of duple meter to triple meter, and a more definitive rhythmic closure (Figure 3.11).

Figure 3.10: First theme of last movement of Dvořák’s “New World” Symphony

![First theme of last movement of Dvořák’s “New World” Symphony](image)

Figure 3.11: Axial primary NCSI #1 (unadorned)

![Axial primary NCSI #1 (unadorned)](image)

Changing-note NCSI. Meyer (1973) defined changing-note schema as similar to an axial schema but with harmonic and metric structural differences. A changing-note schema begins and ends on the same axis-tone. Upper and lower neighbor tones departing and returning to the axis-tone are at high-level metric and harmonic structural positions. Bigand (1993) added the changing-note pattern typically is found around the tonic and may also sometimes begin on the third degree of the scale. Meyer’s example of changing-note with the subject from Bach’s Fugue in C# Minor from Well-Tempered Clavier, Vol. 1 (Figure 3.12), was transformed with a change in time signature, a change in modality from C# Minor to E Major, a change in clef from bass to treble, and a more definitive tonic closure (Figure 3.13).
In similar detailed manner to the previous five primary NCSIs, three additional primary NCSIs were created for each of Meyer’s (1973) five schema definitions. In all, 20 primary NCSIs were created; that is, four different primary NCSIs rendered for each of the five schemata. Without a detailed explanation as with the previous primary NCSIs, the additional primary NCSIs and their pre-existing models are as follows.

Additional gap-fill primary NCSIs are illustrated in Figures 3.14, 3.15, and 3.16. Gap-fill primary NCSI #2 (Figure 3.14) was created after Mozart’s “Minuetto” from Flute Quartet in A Major (K. 298) (Meyer, 1973, p. 103.) Gap-fill primary NCSI #3 (Figure 3.15) was created after Bach’s D Minor Fugue from Book II, Well-Tempered Clavier (p. 149). Gap-fill primary NCSI #4 (Figure 3.16) was created after Schubert’s “Das Wandern” from Die schöne Müllerin (pp. 153-4).
Additional triadic primary NCSIs are illustrated in Figures 3.17, 3.18, and 3.19. Triadic primary NCSI #2 (Figure 3.17) was created after the primary theme of Beethoven’s Piano Sonata in F Minor, Opus 2, No. 1. Triadic primary NCSI #3 (Figure 3.18) was created after Haydn’s Symphony No. 97, Movement II, Adagio (Meyer, 1973, p. 164). Triadic primary NCSI #4 (Figure 3.19) was created after Mozart’s “Tuba Mirum,” No. 3, from the Requiem (K. 626).

Additional complementary primary NCSIs are illustrated in Figures 3.20, 3.21, and 3.22. Complementary primary NCSI #2 (Figure 3.20) was created after Haydn’s String Quartet in Bb
Major, Opus 55, No. 3 (Meyer, 1973, p. 182). Complementary primary NCSI #3 (Figure 3.21) was created after Mozart’s “Linz” Symphony, Movement I (K. 425) (p. 177). Complementary primary NCSI #4 (Figure 3.22) was created after Mozart’s “Minuetto” of the String Quartet in A Major (K. 464) (p. 96).

Figure 3.20: *Complementary primary NCSI #2 (slightly embellished)*

Figure 3.21: *Complementary primary NCSI #3 (slightly embellished)*

Figure 3.22: *Complementary primary NCSI #4 (slightly embellished)*

Additional axial primary NCSIs are illustrated in Figures 3.23, 3.24, and 3.25. Meyer (1973) provided no additional examples for the axial schema, therefore the following additional primary NCSIs were modeled after no pre-existing melodies.

Figure 3.23: *Axial primary NCSI #2 (slightly embellished)*

Figure 3.24: *Axial primary NCSI #3 (slightly embellished)*
Additional changing-note primary NCSIs are illustrated in Figures 3.26, 3.27, and 3.28.

Meyer (1973) provided no additional examples for the changing-note schema, therefore the following additional primary NCSIs were created, but not after any pre-existing melodies.

Figure 3.26: Changing-note primary NCSI #2 (slightly embellished)

Figure 3.27: Changing-note primary NCSI #3 (slightly embellished)

Figure 3.28: Changing-note primary NCSI #4 (slightly embellished)

Implication-Realization Analyses of Primary NCSIs

All five primary sets of NCSIs were analyzed with the Narmour (1990, 1992) implication-realization model to determine perceptual melodic events inherent in each.

Perceptual melodic events within each were hierarchically described singularly, as well as chained and combined. In the following, one primary NCSI from each of the five primary sets is provided as an example of how all 20 primary NCSIs were analyzed for implication-realization.
**Gap-fill primary NCSI analysis.** The following example gap-fill primary NCSI, analyzed for implication-realization content, consisted of three chained events. Triadic-octave gap was an ascending Process \([P]\) of small intervals, defined by Narmour (1990) as perfect fourths or smaller. Fill was a descending Process \([P]\) of small intervals. A reversal of Registral Direction from a small interval to another small interval was an Intervallic Process \([IP]\). As each of three events shared intervals, the entire event sequence was Chained \([PIPP]\). Thus the gap-fill illustration sequence was noted as \([PIPP]\) (Figure 3.29).

Figure 3.29: *Gap-fill primary NCSI analysis \([PIPP]\)*

![Gap-fill primary NCSI analysis](image)

**Triadic primary NCSI analysis.** The following example triadic primary NCSI, analyzed for implication-realization content, consisted of seven separate events, two of which were paired and repeated three times. Retrospective Registral Reversal of unanticipated Registral Direction change was created by the first three notes B, G, and C \([(VR)]\) followed by a 4-note Process \([P]\) of descending small intervals. Retrospective Registral Reversal \([(VR)]\) and descending Process \([P]\) events occurred three times and shared intervals allowing Chaining. Retrospective Registral Reversal was also created by the last three notes \(D^\#\), B, and E. Thus the triadic illustration sequence was noted as \([(VR) \ P(\text{VR}) \ P(\text{VR}) \ P(\text{VR})]\) (Figure 3.30).
Figure 3.30: Triadic primary NCSI analysis [(VR) P(VR) P(VR) P(VR)]

Complementary primary NCSI analysis. The following example complementary primary NCSI, analyzed for implication-realization content, consisted of 11 separate events. Beginning notes A through C# created a descending Process [P] of small intervals. After an Intervallic Duplication [D] with a change in Registral Direction [ID], a descending Process [P] with small intervals continued to the low A, and an ascending Process [P] continued to the half cadence on E. An Intervallic Process [IP], of a small interval to a similar small interval but in different Registral Directions, occurred at the point in which these two Processes shared intervals. Antecedent sequence of events was noted as [P IDPIPP]. As the consequent was an exact inversion of the antecedent, consequent contained the same sequence of events [P IDPIPP]. Duplication [D] occurred between antecedent and consequent as a result of repeated notes on E. Thus the entire complementary illustration sequence was noted as [P IDPIPP D P IDPIPP] (Figure 3.31).

Figure 3.31: Complementary primary NCSI analysis [P IDPIPP D P IDPIPP]
Axial primary NCSI analysis. The following example axial primary NCSI, analyzed for implication-realization content, consisted of seven separate events. Beginning notes E through A created an ascending Process [P] of small intervals. Descending notes A through E created another Process [P] of small intervals. Intervallic Duplication [D] with a change in Registral Direction [ID] connected these two Processes [P] with shared intervals. Shared intervals allowed Chaining of these three events [PIDP]. As antecedent and consequent (axial model and mirror) were exact inversions of each other, consequent was the same event structure [PIDP]. Duplication [D] occurred between antecedent and consequent as a result of repeated notes on E. Thus the entire axial illustration sequence was noted as [PIDP D PIDP] (Figure 3.32).

Figure 3.32: Axial primary NCSI analysis [PIDP D PIDP]

Changing-note primary NCSI analysis. The following example changing-note primary NCSI, analyzed for implication-realization content, consisted of five separate events. Process [P] of a small interval to a similar small interval (E, D♯, G♯) but in different Registral Directions [IP] created an unanticipated Retrospective Intervallic Process [(IP)]. An unanticipated Intervallic Reversal [(R)] created a Retrospective Reversal (D♯, G♯, E). Three small descending intervals (G♯, F♯, E) created a Process [P]. The last four notes (F♯, E, F♯, E) created two shared Intervallic Duplications in different Registral Directions [ID]. All five events shared intervals, which allowed Chaining. Thus the entire changing-note illustration sequence was noted as [(IP)(R)PIDPID] (Figure 3.33).
The previous section described how primary NCSIs were created to illustrate Meyer’s (1973) five schemata categories, how each schema category was replicated four times, and how each of the resulting 20 primary NCSIs were analyzed with Narmour’s (1990, 1992) implication-realization model. All 20 NCSIs in the five primary sets were created with realizations (answers) of definitive closure on the tonic (schematic completeness), which automatically complied with Krumhansl’s (1979) first of four tonal levels. The creation of primary NCSIs were melodic implications, known also as melodic questions. The following section describes how altered NCSIs were created by attaching to each primary NCSI one of Krumhansl’s tonal levels. These tonal levels attached to each primary NCSI were melodic realizations, otherwise know as melodic answers. [Note: as mentioned before, compliance with Krumhansl’s tonal level one was already accomplished in the creation of primary NCSIs because of realizations (answers) of definitive closure on the tonic (schematic completeness)]. The compositional procedures for altered NCSI realizations (answers) are explained in detail as follows.

*Altered NCSIs composition procedure.* Krumhansl’s (1979) tonal levels were applied to the 20 primary NCSIs to create altered NCSIs. The altered NCSIs were then analyzed with Narmour’s (1990, 1992) implication-realization model to determine that perceptual melodic events inherent in each were the same as in each of their respective primary NCSIs. Krumhansl
(1979) described the four tonal levels as distinct levels of pitch preferences within the 12-note chromatic scale bounded by the octave. First level consists of the first and eighth scale degrees, the octave tonic notes. Second level consists of the third and fifth degrees of the scale, comprising the remaining notes of the tonic triad. Third level consists of the remaining diatonic scale degrees of the second, fourth, sixth, and seventh. Fourth level consists of the remaining chromatic notes of the sharped tonic, sharped second, sharped fourth, sharped fifth, and sharped sixth. The following procedure describes the creation of altered NCSIs, containing Krumhansl’s second, third, and fourth tonal levels, exemplified with a single primary NCSI drawn from each schema category (gap-fill, triadic, complementary, axial, and changing-note).

**Gap-fill tonal hierarchical realizations.** The following example gap-fill primary NCSI as an implication (question) in E Major was realized with four endings (answers) reflecting Krumhansl’s (1979) tonal levels in that key. Therefore gap-fill primary NCSI realization (1) employed the tonal center (E). Realizations (2) through (4) are altered NCSIs. Realization (2) employed the fifth (B) and third (G♯) degrees of the scale comprising the tonic triad positioned at metrically structural strong points. The fourth degree (A) was inserted in measure three to retain the primary schema structure and realization process of small descending intervals. Realization (3) employed the fourth (A), second (F♯), seventh (D♯), and sixth (C♯) degrees of the diatonic scale. Realization (4) employed the remaining notes of the chromatic scale (A♯, G, F, D, and C) (Figure 3.34).
Triadic tonal hierarchical realizations. The following example triadic primary NCSI as an implication (question) in E Minor was realized with endings (answers) reflecting Krumhansl’s (1979) tonal levels in that key. Therefore triadic primary NCSI realization (1) employed the tonal center (E). Realizations (2) through (4) are altered NCSIs. Realization (2) employed the fifth (B) and third (G) degrees of the scale comprising the tonic triad. Realization (3) employed the sixth (C♯), fourth (A), second (F♯), and seventh (D♯) degrees of the diatonic scale. The fifth (B) degree was inserted in measure four to continue the triadic schema structure and realization process. Realization (4) employed the remaining notes of the chromatic scale (C, A♯, F, D, and G♯). The fifth (B) degree was inserted in measure four to continue the triadic schema structure and realization process (Figure 3.35).
Figure 3.35: *Triadic primary NCSI realized with three altered NCSI endings*

Complementary tonal hierarchical realizations. The following example complementary primary NCSI as an implication (question) in A Major was realized with endings (answers) reflecting Krumhansl’s (1979) tonal levels in that key. Therefore complementary primary NCSI realization (1) employed the tonal center (A). Realizations (2) through (4) are altered NCSIs. Realization (2) employed the fifth (E) and third (C♯) degrees of the scale comprising the tonic triad. Realization (3) employed the sixth (F♯), seventh (G♯), fourth (D), second (B) degrees of the diatonic scale. Realization (4) employed the remaining notes of the chromatic scale (C, F, G, D♯, and A♯) (Figure 3.36).
Figure 3.36: *Complementary primary NCSI realized with three altered NCSI endings*

Axial tonal hierarchical realizations. The following example axial primary NCSI as an implication (question) in E Major was realized with four endings (answers) reflecting Krumhansl’s (1979) tonal levels in that key. Therefore axial primary NCSI realization (1) employed the tonal center (E). Realizations (2) through (4) are altered NCSIs. Realization (2) employed the fifth (B), first (E), and third (G♯) degrees of the scale comprising the tonic triad. The second degree (F♯) was inserted in measure four to retain the primary schema structure and realization process. Realization (3) employed the sixth (C♯), fourth (A), second (F♯), and seventh (D) degrees of the diatonic scale. Realization (4) employed the remaining notes of the chromatic scale (C, A♯, F, G, and D) (Figure 3.37).
Changing-note tonal hierarchical realizations. The following example changing-note primary NCSI as an implication (question) in E Major was realized with four endings (answers) reflecting Krumhansl’s (1979) tonal levels in that key. Therefore changing-note primary NCSI realization (1) employed the tonal center (E) at metrically strong points. Realizations (2) through (4) are altered NCSIs. The second degree (F♯) was inserted in measure four at a metrically weak point to retain the primary schema structure and realization process. Realization (2) employed the third (G♯) degree of the scale comprising the tonic triad at metrically strong points. The fifth degree (B) was not used, as it would depart from the initial schema structure and implication process. The second degree (F♯) was inserted in measure four to retain the primary schema structure and realization process. Realization (3) employed the seventh (D♯) and second (F♯) degrees of the diatonic scale. The fourth (A) and sixth (C♯) degrees were not used as they would depart from the initial schema structure and implication process. Realization (4) employed the remaining notes of the chromatic scale (D and F). The chromatic notes (G, A♯, and C) were not used, as they would depart from the initial schema structure and implication process (Figure 3.38).
Narmour’s (1990, 1992) implication-realization model was again utilized to analyze the implications (questions) and realizations (answers) of each altered NCSI. This procedure was necessary to insure the implications and realizations for each primary and altered NCSIs set were identical, thus permitting valid investigation of expectancy measurements between the four tonal level endings. Implication-realization analysis indicated each second, third and fourth tonal level ending was identical in hierarchical event sequence with the first tonal level ending. The five altered NCSIs implication-realization analyses are described following.

*Gap-fill implication-realization analysis.* The following example implication-realization analysis of gap-fill altered NCSIs indicated they were identical to the gap-fill primary NCSI. Descending small intervals in measures three and four in each of the tonal level endings continued the implied Process [P] of descending small intervals in measure two to fill in the triadic-octave gap established in measure one, which were identical in implication-realization content to the gap-fill primary NCSI (Figure 3.39).
Figure 3.39: *Implication-realization analysis of the gap-fill NCSI tonal hierarchical endings*

Triadic implication-realization analysis. The following example implication-realization analysis of triadic altered NCSIs indicated they were identical to the triadic primary NCSI.

Disjunctive intervals such as thirds, fourths, or fifths, (syntactically understood as parts of normative patterning denoted as triads), in measures three and four in each of the tonal level endings continued the implied Process [P] and Retroactive Registral Return [(VR)] of the thirds, fourths, and fifths established in measures one and two. Overlapping events chained comprised a [(VR)P(VR)] sequence in each of the endings, which were identical in implication-realization content to the triadic primary NCSI (Figure 3.40).
Complementary implication-realization analysis. The following example implication-realization analysis of complementary altered NCSIs indicated they were identical to the complementary primary NCSI. Measures seven and eight were three overlapping events of (1) small ascending intervals of seconds and fourths in measure seven (Process [P] with small intervals to small intervals), (2) thirds and fourths intervals in triadic process in measure eight (Process [P] with triadic small intervals to triadic small intervals), and (3) a change in Registral Direction [IP] between measures seven and eight in each of the tonal level endings complete the inversion of the melodic event initiated in measures one through four. Three overlapping events chained comprised a [PIPP] sequence in each of the endings, which were identical in implication-realization content to the complementary primary NCSI (Figure 3.41).
Axial implication-realization analysis. The following example implication-realization analysis of axial altered NCSIs indicated they were identical to the axial primary NCSI. Measures seven and eight were three overlapping events of (1) small descending intervals of seconds and thirds in measure three (Process [P] with small intervals to small intervals), (2) small ascending intervals of seconds, thirds, and fourths in measure four (Process [P]), and (3) a change in Registral Direction [IP] between measures three and four in each of the tonal level endings completed the mirror inversion of the axial model presented in measures one and two. Three overlapping events chained comprised a [PIPP] sequence in each of the endings, which were identical in implication-realization content to the axial primary NCSI (Figure 3.42).
Changing-note implication-realization analysis. The following example implication-realization analysis of changing-note altered NCSIs indicated they were identical to the changing-note primary NCSI. Measures three and four in each tonal level ending were comprised of two overlapping events of a small interval to the same small interval (Duplication [D]) but different Registral Directions [ID], which completed the changing-note schema implication of measures one and two. Two overlapping events chained comprised a [IDID] sequence in each of the endings, which were identical in implication-realization content to the changing-note primary NCSI (Figure 3.43).
In similar manner as the above five example primary NCSIs were converted to altered NCSIs and analyzed with Narmour’s (1990, 1992) model, 15 additional primary NCSIs in Figures 3.14 through 3.28 were also processed into altered NCSIs and analyzed with Narmour’s implication-realization model. Altogether, 80 primary and altered NCSIs comprised the complete set from which 20 were randomly chosen for the NET, equally representing each of Meyer’s (1973) five schemata and Krumhansl’s (1979) four tonal levels.

*NET Website Development*

*Internet data collection convenience.* Many researchers are reaching larger populations for data collection with greater degrees of convenience and are experiencing the same respondent accuracy as traditional data collection methods with widespread use of the Internet. Robins, Trzesniewski, Tracy, Gosling, and Potter (2002) reported, “accumulating evidence that Internet-based studies typically replicate studies using traditional methods of data collection” (p. 425). Robins et al. were able to compare their findings in some cases with studies using non-Internet samples. In a comparative analysis of six preconceptions about Internet questionnaires, Robins et al. advocated an increased use of the Internet as a research tool.
Internet data collection controls. For both the pilot and main studies, formal control for re-testers was embedded in the website’s HTML, CGI/Perl, PHP, and SQL languages for tracking the IP Internet address of each test participant. This is an effective control for every on-line situation except if the re-tester was dialing in on a modem. However, the use of the modem is virtually non-existent in an institution such as a large research university. As previous on-line researchers (Gosling, Vazire, Srivastava, & John, 2004) stated Internet samples are not seriously affected by either non-serious or repeat responders, this researcher did not institute any controls other than the embedded IP address tracking and the first question of the 4-question questionnaire that asked if participants had taken this test before.

The NET website design. The on-line test website contained three general sections consisting of greeting and informed consent information, 20 randomized primary and altered NCSIs for melodic listening items, and a short questionnaire, all comprising the “Note”able Endings Test or NET. The NET is briefly described following. An authentic display of the website test may be found in Appendix A.

First section: Greeting. Upon entering the Internet test website, participants were welcomed with a greeting and an Informed Consent Form dialogue box. The greeting included the test title, subtitle, and invitation as follows:

“Note”able Endings Test!

How Should a Melody End?

What are your favorite and least favorite ways you expect melodies to end? Take this 10-minute melodic test of 20 short melodies and find out! At the end of the test, an explanation and results of your responses will be reported to you.
At the Informed Consent Form dialogue box, participants indicated their consent by clicking the “I Agree” button. Clicking the “I Disagree” button exited participants from the website with a “Thank you for your consideration.” Upon clicking “I Agree,” participants entered the “Note”able Endings Test (NET) instrument. (See Appendix B.)

First section: “Note”able Endings Test. After brief instructions, participants were provided two practice melodies to which to listen as many times as desired, and to practice notating their expectedness responses. The NET followed the practice melodies. The NET consisted of 20 primary and altered NCSIs in random order performed by a professional pianist on a Yamaha seven-foot-five-inch grand piano and recorded in MP3 format. Participants were instructed to click on each NCSI to listen and were allowed to listen only once to control for legitimate expectedness. Participant indicated their expectedness of realizations (melodic answers) by clicking a “radio button” after each listening example, which assigned to each listening example a rating of scale of “4” (most expected) to “1” (least expected). Upon completion of the NET, participants clicked a “Continue” button to enter the questionnaire. If participants missed entering a rating after any listening selection, a message prompted them of such before allowing entry into the questionnaire.

Randomized NCSIs test selections. Twenty listening selections were randomly chosen from among the 20 primary NCSIs and 60 altered NCSIs. With the use of a standard statistical randomization chart, five primary NCSIs were randomly chosen from among the beginning 20 primary NCSIs, which was also Krumhansl’s first tonal level. Then, five altered NCSIs were randomly chosen from among the altered NCSIs featuring Krumhansl’s second tonal level. This same random selection process was enacted for the altered NCSIs from Krumhansl’s third and
fourth levels. Thus the randomly-chosen 20 primary and altered NCSIs comprised an equal representation of all of Meyer’s (1973) five schemata and Krumhansl’s (1979) four tonal levels.

Randomized listening NCSIs presentation. Presentation of the randomly-chosen 20 primary and altered NCSIs were further randomized within the “Note”able Endings Test (NET) on the Internet test site. With each participant’s entrance into the NET, the HTML, PHP, and SQL web languages were programmed so that the primary and altered NCSIs were presented in a different random order. (See Appendix C.)

Second section: Questionnaire. After participants completed the 20 NCSI listening examples, they were asked to complete a short questionnaire indicating nationality, age, and a self-evaluation of music experience. These particular four items were chosen to align with various ages, musician and non-musician, and Western and non-Western participant characteristics noted in previous melodic perception studies (Eerola, 2003; Krumhansl, 1995; Krumhansl, Toivanen, Eerola, Toiviainen, Järvinen, Louhivuori, 2000; Schellenberg, Adachi, Purdy, McKinnon, 2002).

The following format of questions and order asked were excerpted from Potter’s and Gosling’s (2006a, 2006b) Internet questionnaires. The 4-item questionnaire asked: (1) “Have you ever previously filled out this particular test on this site?” Participants chose a “radio button” for either “No, this is my first time” or “Yes, I’ve taken this particular test before.” (2) “What is your age? (in years).” Participants entered a number in a blank box. To avoid inflated responses, HTML, PHP, and SQL programming languages did not allow any entered number to be larger than two digits. (3) “What is your primary cultural or racial identification? (click for choices).” Participants selected from a drop-down list of 14 choices including: “Black, Chicano, Chinese, Pilipino, Indian/Pakistani, Japanese, Korean, Other Asian, Latino, Native American, Pacific
Islander, Puerto Rican, White/Caucasian, and Other.” (Potter and Gosling did not specify how this list was compiled.) (4) “How do you rate your own music ability?” Participants chose among three “radio buttons” that specified “Musician with much training,” “Musician with little or no training,” or “Non-musician.”

Third section: Exit salutation. At the end of the test, participants chose to submit data by clicking a “Submit” button or to exit the website without submission by quitting the Internet browser. Just above the “Submit” button was the following reminder statement, which was taken from Potter and Gosling (2006a, 2006b):

There are no foreseeable risks to you from participating in this research. By clicking “Submit” you acknowledge that your answers will be recorded. Your participation in this research is completely voluntary, and all responses to this test are anonymous and will be kept confidential. You may refuse to answer any of the questions, and you may withdraw your consent and discontinue participation in this study by leaving the site. The Informed Consent Form states more information about how data is collected and contains contact information should you have questions.

Fourth section: Response summary reply. After completion of the questionnaire and clicking the “Submit” button, participants received a brief explanation of the NET and a summary of their responses. The results reported the participant’s expected endings for each of the five types of primary and altered NCSIs and if the measures of expectedness were aligned with the researcher’s hypothesis. (See Appendix A: Internet test instrument, Website Page Six.)

Internet data collection. Internet data collection was accomplished by electronic submission and storage. Participants’ responses were encoded in SQL database language, and
converted to a text file with numbers and commas as delimiters. Upon clicking “Submit” at the end of the NET, the responses returned to the researcher and entered into a data-accumulating file for storage awaiting statistical analysis.

Additional NET Development Considerations

Two considerations of authentic melodic context and authentic performance context were also considered in developing the NET.

Authentic melodic context. Many previous perceptual melodic investigations (Brown, Butler, & Jones, 1994; Castellano, Bharucha, & Krumhansl, 1984; Cuddy & Badertscher, 1987; Halpern, Kwak, Bartlett, & Dowling, 1996; Janata & Reisberg, 1988; Jordan, 1987; Speer & Meeks, 1985; West & Fryer, 1990; Woloszyn, 2002) (refer to chapter two) used aural stimuli of individual or paired pitches rather than natural authentic melodies and authentic performance contexts. Based on these various researchers’ suggestions, all NCSIs in this study contained consistently similar holistic, authentic characteristics to permit valid investigation. First, the NCSIs were derivations of existing, historical melodies initially presented by Meyer (1973). Each NCSI and its comparable historic melody are noted in Appendix C. Second, the NCSIs were composed around the primary vocal range, appropriate strong and weak beats, rhythmic and metric structures, consistent phrase lengths, symmetrical periodicity, half cadences on micro (meter) beats, and full cadences mostly on macro (tempo) beats. The NCSIs were compositionally centered around the primary age vocal range of middle D to middle A (Rutkowski, 2002). Tonally, some NCSIs were authentically oriented (melody moves within the tonic to tonic, Do to Do range), and others were plagally oriented (melody moves above and below the tonic, usually within the Sol to Sol range). Appropriate uses of strong and weak beats were strong rhythmic and harmonic events on strong beats, with passing tones, lower/upper
neighboring tones on weak beats. Rhythmic structures were unembellished macro beats, micro beats, macro and micro divisions, macro and micro subdivisions, and various macro and micro division and subdivision elongations. The meters employed were duple and triple. Both duple and triple meter NCSIs generally contained eight macro beats per phrase with appropriate micro beats determined by the numerical time signature. NCSIs were structured into symmetrical periods in that each NCSI’s antecedent and consequent phrases were identical. Antecedents concluded harmonically with half cadences inferring the dominant function, and concluded rhythmically on micro beats. Consequents cadenced rhythmically on strong macro beats, with one or two exceptions on a strong micro beat. With these characteristics in various combinations, the NCSIs in this study were presented as holistic phrase units consisting of questions (implications), answers (realizations), with appropriate rhythmic and tonal closures (entire schematic completions), rather than fragmented synthetic stimuli. (See Appendix C.) Consequent to melodic authenticity, an authentic performance context was also developed.

*Authentic performance context.* An authentic performance context was developed by this researcher performing the primary and altered NCSIs of holistic phrase units (schematic completeness). A Yamaha seven foot-five inch grand piano was chosen for an authentic performance instrument, which included fundamentals and partials in the harmonic overtone series regularly found in most performed music. Samson’s Zoom H4 digital stereo recorder was used to record and create a MIDI Internet “mp3” formatted file of each primary and altered NCSI.

*Content Validity*

Authentication of the 20 primary NCSIs (see Appendix D) and content validity to determine if they aligned with the above authentic melodic context was provided by expert
listeners. Expert listeners, music education professionals with advanced musical training who were uninformed about the purpose of this study, volunteered to evaluate the compositional content of the 20 primary NCSIs for compliancy with Meyer’s (1973) schematic definitions. These listeners (n=5) were music professors (instructors of band, conducting, chorus, orchestra, music theory, composition, and music education) in two university music departments in north-central and north-eastern Pennsylvania. The authentication survey provided both written schema definitions and 20 musically notated primary NCSIs. The music professionals were asked to review the definitions and the 20 original NCSIs and rate them on a Likert-type scale of “4” being most compliant to “1” being least compliant. A limitation was noted that the expert listeners, being professionally trained music readers and performers, provided their own means of hearing the 20 primary NCSIs.

Results of the melodic schemata survey instrument for the compositional compliancy of the 20 primary NCSIs yielded mean scores and standard deviations and established content validity. Mean scores between 3.00 and 4.00 (from a Likert-type scale of “4” being most compliant to “1” being least compliant) were deemed to be satisfactory for use in the study and for determining content validity, while below 3.00 was unsatisfactory. All 20 primary NCSIs were considered validated (satisfactorily compliant with Meyer’s schemata definitions) as all mean scores were within the range of 3.00-4.00, and all standard deviations were less than one standard deviation from the mean. Statistical analysis supported that content validity was established. (See Table 3.1.)
Table 3.1: *Melodic schemata survey results*

<table>
<thead>
<tr>
<th>Factors</th>
<th>Gap-fill</th>
<th>Triadic</th>
<th>Complimentary</th>
<th>Axial</th>
<th>Changing-note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary NCSI #1</td>
<td>4.00 .00</td>
<td>4.00 .00</td>
<td>3.90 .20</td>
<td>4.00 .00</td>
<td>4.00 .00</td>
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<tr>
<td>Primary NCSI #2</td>
<td>3.40 .49</td>
<td>3.30 .75</td>
<td>3.20 .75</td>
<td>3.40 .49</td>
<td>4.00 .00</td>
</tr>
<tr>
<td>Primary NCSI #3</td>
<td>3.00 .89</td>
<td>3.70 .40</td>
<td>3.00 .63</td>
<td>3.60 .49</td>
<td>3.80 .40</td>
</tr>
<tr>
<td>Primary NSCI #4</td>
<td>3.60 .80</td>
<td>3.70 .40</td>
<td>3.40 .80</td>
<td>3.60 .49</td>
<td>3.80 .40</td>
</tr>
</tbody>
</table>

**Pilot Study**

*Purpose.* The purpose of the pilot study was to determine the feasibility of the “Note”able Endings Test (NET) as a data collection instrument and to assess the reliability of the 20 random primary and altered NCSI listening selections.

*Participants.* Participants for the pilot study were a convenience population of summer graduate students from a large central Pennsylvania university. Each of the deans, heads, or chairpersons from the university’s 92 programs, colleges, schools, or departments were contacted by email to invite beginning of summer graduate students (last week of May and first week of June) for participation in the pilot study. These graduate students were emailed an invitation to participate in the NET. (See Appendix E.) This was done according to the university’s Policy AD56, “Use of Group E-mail to Communicate University Business to Employees and Staff.” Mathieu (2007) stated this policy prevents sending unauthorized mass emails to university affiliated people to recruit for a study, but it does indicate approval to recruit using listservs (i.e., departmental listservs, club listservs, and college listservs) as long as permission has been
granted by the listserv administrator (i.e., deans, heads, or chairs) (Mathieu, J. L., personal email communication, April 26, 2007).

Procedure. Upon receiving an email invitation containing the “Note”able Endings Test (NET) website URL, the summer graduate students clicked on the hyperlink, opened the test website, and followed test-taking directions to enter their expectedness responses. At the end of the NET, pilot study participants received a response summarizing their responses, reporting each participant’s melodic ending expectancies within the 20 randomized primary and altered NCSIs and if the measures of expectedness were aligned with the researcher’s hypothesis.

Population sample. The pilot test study population sample was n=123. Eighty one participants entered complete response sets. Four participants entered partial response sets. Thirty eight potential participants exited the NET website without entering any responses. The 81 participants who entered complete responses sets inclusive of the questionnaire, represented a variety of cultural backgrounds, ages, and music abilities. Within cultural backgrounds, one each was Black, Chinese, Indian/Pakistani, and Korean; three were Latino; 31 were White/Caucasian; and three identified themselves as Other. Within ages, two were ages 0-19, 52 were ages 20-29, 17 were ages 30-39, four were ages 40-49, and six were ages 50-59. Within music experience, 19 identified themselves as “Musicians with much training,” 34 as Musician with little or no training,” and 28 as “Non-musicians.” From the variety within the pilot test population, it was deemed that this population was appropriate for completing the main study test and to provide the diversity desired to answer the third research question.

Reliability. The pilot study test data were analyzed to determine the reliability of the “Note”able Endings Test (NET). Data were expectancy ratings of listeners who responded to each melodic answer (tonal realization level) by indicating a rating of expected ending to
unexpected ending. Participants responded using a scale of “4” (most expected) to “1” (least expected). The reliability under investigation was the consistency, among the graduate population, with which the NET was able to discriminate between the four different endings (melodic answers). Results and conclusions of the pilot study reliability analysis and a recommendation resulting from the pilot study are following.

SPSS analysis for both the 82 complete response data sets and 86 complete and partial responses data sets revealed satisfactory reliability among participants. Data were analyzed for reliability through Cronbach’s Alpha because it determines the reliability of a set of categorical ratings such as this study’s expectancy ratings of 4 = completely expected, 3 = somewhat expected, 2 = somewhat unexpected, and 1 = completely unexpected (as stated in the NET test website). Cronbach’s Alpha was .682, and no items when deleted dramatically improved Cronbach’s Alpha. The analysis revealed that the Gap-fill melody with hierarchical tonal level one (tonic Do or Do’) had the highest mean (3.74), and that the Triadic melody with hierarchical tonal level four (chromatics Di, Ri, Fi, Si, and Li) had the lowest mean (1.54). Standard deviation among the 20 listening selections ranged from .562 to .984; that is, each item’s standard deviation was less than one. Reliability was concluded to be satisfactory for use in the main study.

*NET alteration.* One small alteration to the NET was made as a result of four pilot study participants who may have prematurely exited the test. These participants exited the test after entering partial responses consisting only of the first 10 melodies. It was concluded that this premature exiting may have been the result of a systematic error in the NET’s website design. When any listening responses were left blank, the website was designed to report an error message to the test participant of “Please fill out the entire survey!” before being allowed to
continue to the next the page. Since the error message appeared at a place in the webpage where the participants could not immediately view it without scrolling downward, perhaps they exited the test thinking the website failed to operate correctly. The systematic error in the website design was corrected to feature the wording, “Please complete all responses to listening selections 1-10 before clicking Submit, otherwise the website will not progress to listening selections 11-20” and be visibly and permanently placed just above the “Submit” button at the bottom of the webpage. This correction enacted for the main study NET seemed to be successfully remedial in that fewer participants (two) in the main study prematurely exited the test at the point in question.

Main Study

Purpose. The main study purpose was to investigate if measurements of expectedness for melodic answers are consistent with Krumhansl’s (1979) tonal hierarchy when melodic questions are based on Meyer’s (1973) five theoretical melodic schemata.

Participants. The population for the study was a diverse representation of participants consisting of a large number of readily available graduate students in a large central Pennsylvania university with easy access to the Internet, which afforded minimal data collection controls and economic test dissemination and data collection.

As this present study targeted participants described as youth and adult listeners, musicians and non-musicians, and Western and non-Western listeners similar to preceding melodic perception and cognition studies (Eerola, 2003; Krumhansl, 1995; Krumhansl, Toivanen, Eerola, Toiviainen, Järvinen, Louhivuori, 2000; Schellenberg, Adachi, Purdy, McKinnon, 2002), the Internet afforded access to a readily available graduate population at a large central Pennsylvania university. The graduate population of this university may be
considered a diverse population of ethnicities, research students of sundry interests, and all graduate degree levels. As of Fall, 2009, the enrollment by ethnicity were Hispanic/Latino 3%, American Indian/Alaska Native <1%, Asian 3%, Black/African American 3%, Native Hawaiian/Pacific Islands <1%, Two or more races 1%, White 48%, Race/Ethnicity unknown 4%, and International 37% (Penn State, 2010). The university’s graduate population may also be considered a population of various ages, Western and non-Western cultural backgrounds, and musicians and non-musicians. The graduate population, however, may not be considered representative of the global population, but rather a diverse representative sample from within the global population that represents many of the characteristics of a global population. The graduate population, for both the pilot and main studies, was chosen over the undergraduate population because the undergraduate typically comprises a large percentage of United States nationals rather than a diverse representation.

Procedure. Main study participants (excluding the pilot study participants) were emailed and invited to complete the “Note”able Endings Test (NET) in the same manner as the pilot study. The invitation emails were sent at the two-thirds point in the Fall semester, giving students the remaining weeks of the semester to complete the survey. Availability to take the NET remained open until the end of the first month of Spring semester. Graduate students entered the NET website, responded to the listening items and questionnaire, and data were returned to the research upon each participant clicking the “Submit” button. Upon clicking “Submit,” each main study participant received a summary response the same as the pilot study participants reporting the order of melodic ending expectancies within the 20 randomized primary and altered NCSIs. (See Appendix A: Internet test instrument, Website Page Six.)
Data analysis. Expectancy data were multi-dimensionally analyzed with the Moulton’s Educational Data Systems Analysis (NOUS) and Andrich and Luo’s RUMMfold for exploring possible consistency with Krumhansl’s tonal levels when melodic questions were based on Meyer’s five theoretical melodic schemata. NOUS analysis determined the dataset’s dimensionality and measures of expectedness (Moulton, 2010). RUMMfold determined strength of degrees of correctness and separation between NCSI melodic answer measurements of expectancy (realizations). Both NOUS and RUMMfold are robust statistical tools for perception or expectancy data from Likert-type or attitude, belief, or opinion type items (Andrich, 1978a, 1978b; Andrich & Luo, 1998; Moulton, 2010). With these determinations, NOUS and RUMMfold addressed the first two research questions, (1) Are the melodic answers most frequently chosen by participants consistent with Krumhansl’s (1979) tonal levels? and (2) What is, on average, the strength of degrees of correctness and separation among the expectancy responses of the participants? A comparison of the expectancy scores with the other variables of cultural background, age, and musical experience addressed the third research question, (3) Are relationships among participants’ responses attributable to cultural background, age, or musical experience?
CHAPTER FOUR

RESULTS

Chapter four is organized into three major sections. Section one, Main Study, is a review of the purpose, reporting of the response rate, overview of the main study procedure, and overview of the main study data analysis. Section two, Results, explores the various analyses of the dataset, and the interpretation of the statistical results to answer the three research questions and address the researcher’s hypothesis. Section three, Chapter Four Summary, provides the study’s overall analysis conclusion.

Main Study

Purpose

The purpose of the main study was to investigate if expectancies for melodic answers are consistent with Krumhansl’s (1979) tonal hierarchy when melodic questions are based on Meyer’s (1973) five theoretical melodic schemata. Three research questions guided the investigation: (1) Are preferred melodic answers (realizations) to newly composed melodic questions (implications), composed to conform to Meyer’s (1973) melodic schemata, consistent with Krumhansl’s (1979) four tonal levels? (2) To what degree did participants anticipate the closing of melodic phrases individually comprised of the four Krumhansl tonal levels? (3) Are participants’ responses attributable to cultural background, age, or musical experience?

Participants

The population for the main study was comprised of graduate students (exclusive of the pilot study participants) of a large central Pennsylvania university as previously discussed (chapter three, Large university Internet population). The graduate population of this university as a whole may be considered a diverse population of ethnicities, research students of sundry
interests, and all graduate degree levels. As of Fall, 2009 when the main study data were
collected, the enrollment by ethnicity were Hispanic/Latino 3%, American Indian/Alaska Native
<1%, Asian 3%, Black/African American 3%, Native Hawaiian/Pacific Islands <1%, Two or
more races 1%, White 48%, Race/Ethnicity unknown 4%, and International 37% (Penn State,
2010).

Of this diverse population, 25 graduate students participated in the “Note”able Endings
Test (NET) for the main study. It must be noted that these 25 participants were a very narrow
cross section of the university’s graduate population and a number of ethnicities were not
represented. Participants identified themselves as 15 White Caucasian (60%), one Latino (4%),
one Korean (4%), one Other Asian (4%), two Indian Pakistani (8%), and two Chinese (8%), for a
total of 22 participants. Three test participants did not answer any items in the questionnaire so
their ethnicity was not identifiable (12% ethnicity unknown). Unfortunately, this representation
was missing Hispanic/Latino, American Indian/Alaska Native, Black/African American, and
Native Hawaiian/Pacific from the university’s graduate population. Also of the 25, the dataset
was comprised of 23 complete responses for melodies 1-20, and two participants recorded
responses for only melodies 1-10. The missing data for melodies 11-20 for two participants did
not have any significant influence on the data analysis (Moulton, 2010). Although 25
respondents were less than the ideal 30, it was concluded 25 were acceptable for this analysis
because the standard errors were consistently small and that the analytical pattern was stable
(Andrich, 2010; Moulton, 2010).

Since the pilot study and main study population constituency were the same graduate
student body in the same university, a check for possible test retakers was enacted in two ways.
The first one was hidden in the programming of the test website and the second were two
different occasions in which the participant was asked directly. One, the website programming flagged any matching computer IP addresses within the pilot study and main study, and noted this in the data report. Two, if any matches were detected, the programming brought up a page asking the participant if s/he had taken the test previously. If a No answer was submitted, (s)he was allowed to enter the main test. Also, the first question at the end of the test was, “Have you taken this test before?” (See Appendix A, *Internet test instrument*, Website Page Two-B: “Test Retaker” and Website Page Five: “Questionnaire.”) Of the 25 participants, there were no flagged entries and there were zero Yes answers to the first question in the NET questionnaire.

*Procedure*

Main study participants were emailed and invited to complete the “Note”able Endings Test (NET) in the same manner as the pilot study. Internet dissemination of the “Note”able Endings Test (NET) was accomplished electronically across a large central Pennsylvania university campus through an email sent to each dean, head, or chair of each program, college, school, or department, requesting their approval to have the test invitation and website URL distributed to all levels of graduate students. (See Appendix E: *Invitational email to university programs’, colleges’, schools’, and departments’ deans, heads, and chairs.*) The graduate students then entered the NET website, responded to the listening items and questionnaire, and data were returned to the researcher upon each participant clicking the “Submit” button. Main study participants received a summary response reporting the order of melodic ending expectancies within the 20 randomized primary and altered NCSIs. (See Appendix A: *Internet test instrument*, Website Page Six.)
**Data Analysis Overview**

The main study data were analyzed in two broad stages. First, data were analyzed for dimensionality, and dichotomy or polytomy; and second, data were analyzed for exploring possible measurements of expectedness between melodic questions (implications) and answers (realizations). Two robust statistical software programs, NOUS and RUMMFOLD, were used to address the three research questions. Moulton’s (2010) Educational Data Systems Analysis (NOUS) determined the dataset’s dimensionality, model fitness, and participants’ melodic measures of expectedness, and Andrich and Luo’s (1998) RUMMFOLD determined strength of degrees of correctness and separation between NCSI melodic answer measurements of expectancy (realizations) for comparison to Krumhansl’s (1979) reported tonal hierarchy.

This researcher concluded that typical regression t-test or ANOVA analyses were inappropriate in this study for two reasons. (1) NOUS is a unique procedure for determining dimensionality, model fitness, and especially melodic measures of expectedness among expectancy datasets rather than between participants’ singular response items. (2) As will be explained later in chapter four, research question three asked if relationships existed in measurements of expectedness among various datasets, such as the five NCSI datasets and three variables of cultural background, age, and music experience datasets.

**First Stage Data Analysis**

*Moulton’s NOUS analysis software.* A robust tool for determining measurements of expectedness between melodic events and for determining dimensionality may be Moulton’s NOUS. Mark Moulton, of Educational Data Systems (www.eddata.com), an analyst specialist in Rasch models including Many-Facet Rasch Models, authored NOUS modeling and other multi-dimensional models in accordance with Rasch requirements for “objectivity.” The question
underlying the creation of NOUS was: “Can a one-dimensional model have the properties of a Rasch multi-dimensional model?” In this study, Moulton’s NOUS model was employed to determine dimensionality, model fitness, and measurements of participants’ melodic listening expectedness, which as follows, was shown to be one-dimensional. One-dimensionality is clearly “best” over two-, three-, four-, and five-dimensionality with a measure of .82. (See Table 4.1.)

Table 4.1: Dimensionality

| Pseudo Residuals and Correlation of One, Two, Three, Four, and Five Dimensionalities |
|----------------------------------------|------|-------|------|
| Model       | Dimension | Pseudo-RMS Residual | Correlation |
| Descriptive | 1      | 0.82          | 0.65 |
| Descriptive | 2      | 0.84          | 0.64 |
| Descriptive | 3      | 0.97          | 0.55 |
| Descriptive | 4      | 0.94          | 0.61 |
| Descriptive | 5      | 1.11          | 0.44 |

**Determining dimensionality.** Data analysis began with determining dimensionality. Dimensionality was determined in NOUS by the Pseudo-Root-Means-Square-Residual. That is, the average discrepancy between the observed value and the model estimate, where the model estimate is calculated after making the observed value missing. Simply stated, various data were randomly deleted in numerous test runs and analysis was then made on how well the existing data could predict what was deleted. In reality, this was a measure of prediction error.

Dimensionality was also determined by correlation of dataset items. A perfect one-dimensional dataset would have all of the \((5 \times 4 = 20)\) melodies perfectly correlated with each other, with all participants rating the melodies and their endings more or less the same way.
Correlations of .5 and above indicate a one-dimensional dataset. One-dimensionality had the highest correlation, among the other dimensionalities, of .65. (See Table 4.1.)

*Dichotomous responses.* Depending on one’s philosophical perspective of this study and treatment of the data, it seems this study’s data may be considered to be either dichotomous or polytomous. If dichotomous, then the answers may be either right or wrong and mutually exclusive among the four choices of “4” (expected ending) to “1” (unexpected ending) as per Krumhansl’s (1979) four level hierarchy. If polytomous, then the answers could be preferential responses across an ordinal scale, dissociated from mutually exclusive right answers among distractors that are wrong. But the argument can also be made that the participants’ responses were not preferential at all (attitudinal), but rather perceptual (cognition of expectedness).

Moulton (2010) concluded, and this researcher agreed, that this study’s data not be treated dichotomously in a traditional fashion, as in a response of 4 was either a Yes (1) as correct or No (0) as incorrect. Instead, the data should be treated as perceptual expectedness data that simply evidenced dichotomous characteristics due to certain internal consistencies within the construction of the NET’s listening selections, and that the measurement of one dimensionality seemed to verify this perspective of the data.

Moulton (2010) explained that three specific consistencies defined these dichotomous characteristics. First consistency, the Likert-rating scale of “4” (expected ending) to “1” (unexpected ending) was constructed with Krumhansl’s (1979) strength of expectedness responses in mind. These responses were perfectly aligned with Krumhansl’s reported strengths of expectedness. A rating of “4” (completely expected) was hierarchical tonal level one with either the lower Do or upper Do’ of the scale, the tonic tonal center, Krumhansl’s reported strongest level and closest association. A rating of “3” (somewhat expected) was hierarchical
tonal level two with Sol and Mi, the two remaining notes of the tonic triad, slightly less in strength and less in association. A rating of “2” (somewhat unexpected) was hierarchical tonal level three with Re, Fa, La, and Ti, the four remaining notes of the diatonic scale, notably weaker in strength and association. A rating of “1” (completely unexpected) was hierarchical tonal level four with Di, Ri, Fi, Si, and Li, the five notes in the chromatic scale, with very little or no strength or association. Therefore, the ranking of the four melodic answers (implications) denoted degrees of adherence to an “expectation hierarchy.”

Second consistency, as Moulton (2010) explained, was that the four expectancy response choices (explained above) were of identical hierarchical construction for each of the 20 NCSI melodies, and in the same order across the Likert-type scale of 4 (expected ending) to 1 (unexpected ending). Third consistency, each of the four tonal level endings (melodic answers) without exception was comprised of the same exact scale degrees for each of the five schemata (Moulton). These three consistencies created an alignment or adherent responses.

Aligned responses explained. A perfectly aligned or adherent response for axial NCSI level one ending (H1 = Do, Do’) is “4” (completely expected). An aligned or adherent response for axial NCSI level two ending (H2 = Mi, Sol) is “3” (somewhat expected). For axial NCSI level three ending (H3 = Re, Fa, La, Ti), it is “2” (somewhat unexpected), and for axial NCSI level four ending (H4 = Di, Ri, Fi, Si, Li), it is “1” (completely unexpected). Since the four endings, each without exception, was comprised of the exact same scale degrees for each of the five NCSI sets, the same order of aligned responses held true for each set.

One-dimensionality and data characteristics conclusion. Therefore, with the determinations of one-dimensionality and the alignment characteristics of the data, the
considerations of multi-dimensionality and polytomy, as previously inferred from the study design, were deemed inappropriate considerations for answering the research questions.

Second Stage Data Analysis

Moulton’s NOUS software of the dataset revealed one-dimensionality, which then also determined measures of melodic listening expectedness (implications and realizations). Andrich and Luo’s (1998) RUMMfoldss software was employed for subsequent analysis.

*Expectancy alignments and means compared.* As revealed by NOUS, most notable about the means among the tonal levels is that they very closely approached their perfect alignment responses. All five tonal level one’s (H1) means very closely approached the response of four; all five tonal level three’s (H3) means very closely approached the response of two; and all five tonal level four’s (H4) means very closely approached the response of one. However, less notable is tonal level two’s (H2) means in four out of five NCSI sets which did not closely approach the response of three, except for the Gap-fill schema. (See Table 4.2.)

*Range of means of four tonal level endings.* The range of means from hierarchical tonal ending one (H1) to ending four (H4) for among the five NCSI sets showed a pattern of “completely expected” to “completely unexpected.” Note that in each NCSI group, the high means was closely aligned with the response of “4” while the low means was closely aligned with the response of “1.” Three NCSI sets (axial, changing-note, and triadic) were more closely aligned with each tonal level than were the remaining two NCSI sets (complementary and gap-fill). (See Table 4.2.)
<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>SD</th>
<th>Error</th>
<th>(Max-Min)/Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Axial H1</td>
<td>3.42</td>
<td>0.42</td>
<td>0.08</td>
<td>31.24</td>
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<tr>
<td>Axial H2</td>
<td>1.92</td>
<td>0.24</td>
<td>0.05</td>
<td></td>
</tr>
<tr>
<td>Axial H3</td>
<td>2.06</td>
<td>0.26</td>
<td>0.05</td>
<td></td>
</tr>
<tr>
<td>Axial H4</td>
<td>1.67</td>
<td>0.21</td>
<td>0.04</td>
<td></td>
</tr>
<tr>
<td>Changing-note H1</td>
<td>3.57</td>
<td>0.44</td>
<td>0.09</td>
<td>32.43</td>
</tr>
<tr>
<td>Changing-note H2</td>
<td>2.47</td>
<td>0.31</td>
<td>0.06</td>
<td></td>
</tr>
<tr>
<td>Changing-note H3</td>
<td>2.02</td>
<td>0.25</td>
<td>0.05</td>
<td></td>
</tr>
<tr>
<td>Changing-note H4</td>
<td>1.63</td>
<td>0.20</td>
<td>0.04</td>
<td></td>
</tr>
<tr>
<td>Complementary H1</td>
<td>3.69</td>
<td>0.46</td>
<td>0.09</td>
<td>18.07</td>
</tr>
<tr>
<td>Complementary H2</td>
<td>2.56</td>
<td>0.32</td>
<td>0.06</td>
<td></td>
</tr>
<tr>
<td>Complementary H3</td>
<td>2.60</td>
<td>0.32</td>
<td>0.07</td>
<td></td>
</tr>
<tr>
<td>Complementary H4</td>
<td>2.40</td>
<td>0.30</td>
<td>0.06</td>
<td></td>
</tr>
<tr>
<td>Gap-fill H1</td>
<td>3.68</td>
<td>0.46</td>
<td>0.10</td>
<td>22.29</td>
</tr>
<tr>
<td>Gap-fill H2</td>
<td>3.02</td>
<td>0.37</td>
<td>0.08</td>
<td></td>
</tr>
<tr>
<td>Gap-fill H3</td>
<td>2.76</td>
<td>0.34</td>
<td>0.07</td>
<td></td>
</tr>
<tr>
<td>Gap-fill H4</td>
<td>2.03</td>
<td>0.25</td>
<td>0.05</td>
<td></td>
</tr>
<tr>
<td>Triadic H1</td>
<td>3.66</td>
<td>0.45</td>
<td>0.09</td>
<td>32.02</td>
</tr>
<tr>
<td>Triadic H2</td>
<td>2.34</td>
<td>0.29</td>
<td>0.06</td>
<td></td>
</tr>
<tr>
<td>Triadic H3</td>
<td>2.49</td>
<td>0.31</td>
<td>0.06</td>
<td></td>
</tr>
<tr>
<td>Triadic H4</td>
<td>1.58</td>
<td>0.20</td>
<td>0.04</td>
<td></td>
</tr>
</tbody>
</table>

*Measurements of expectedness.* As illustrated in Table 4.2, the column labeled (Max-Min)/Error indicated measurements of melodic expectedness, which are implications and realizations. Expectedness is calculated in two steps. First, within each NCSI set, the means of tonal level four (H4) is subtracted from the means of tonal level one (H1). Then, that answer is divided by the average of that NCSI set’s four individual standard errors (H1, H2, H3, and H4).
Results

Research question one. A conclusion from the range of means within each NCSI set and the measurement of expectedness overall in each NCSI set was suggested for research question one. “Are the melodic answers most frequently chosen by participants consistent with Krumhansl’s (1979) tonal levels?” As previously noted, since the individual means (H1 to H4) for the majority of the NCSI sets closely approached each tonal level’s perfectly-aligned or adherent response, and since the measure of expectedness was clearly significant for the five NCSI sets (axial, changing-note, complementary, gap-fill, and triadic), this researcher concluded affirmatively that the NCSI endings chosen by participants were consistent with Krumhansl’s (1979) four tonal levels.

Research question two. “What is, on average, the strength of degrees of correctness and separation among the expectancy responses of the participants?” To determine this answer, separation ratio, item fit, and reliability were analyzed. Separation and reliability measurements were derived from the ratio of spread of the one-dimensional model estimates of each person’s melodic expectedness, to the standard error. These measurements showed that the separation ratio was more than acceptable with a range of 4.69 to 4.90, and the reliability for all items was
significant with all approaching 1.00. (See Table 4.3.) Item fit was also analyzed. Item fit statistics greater than “2” or less than “-2” indicated that the participants’ responses to the 20 NCSI listening items were significantly greater than, or significantly less than, what the one-dimensional model predicted. Item fit measurements, with a range of 0.99 to 1.02, were aligned with what the model predicted, thus indicated a good fit. (See Table 4.3.)

Statistical analysis affirmatively supported the separation ratio with a range of 4.69 to 4.90, reliability approached 1.00 for all listening items, and significant item fit measurements showed a good fit. Therefore, this researcher concluded that the interaction (implications) of the five NCSIs and four tonal endings (realizations) did indeed prompt melodic answer expectancies consistent with Krumhansl’s (1979) four tonal levels.

Research question three. Determination of expectedness measurements within the variables of cultural background, age, and musical experience, as well as correlational comparisons of expectedness measurements among cultural background, age, and music experience addressed the third research question, “Are relationships among participants’ responses attributable to cultural background, age, or musical experience?” In actuality, this question is asking if relationships exist among measurements of expectedness in the participants’ responses among and within the variables of cultural background, age, and music experience. Therefore, investigating question three necessitated two procedures: one to determine expectedness measurements among the five NCSI sets (axial, changing-note, complementary, gap-fill, and triadic) within the three variables (cultural background, age, and music experience), and two to determine expectedness measurements in various break-out groups within each of the three variables. Following is the first procedure for determining expectedness measures among the three variables (cultural background, age, and music experience).
Table 4.3: *Separation, item fit, and reliability*

*Measurements of Degrees of Separation and Item Fit*

<table>
<thead>
<tr>
<th></th>
<th>Separation</th>
<th>Item Fit</th>
<th>Reliability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Axial H1</td>
<td>4.90</td>
<td>1.00</td>
<td>0.96</td>
</tr>
<tr>
<td>Axial H2</td>
<td>4.90</td>
<td>0.99</td>
<td>0.96</td>
</tr>
<tr>
<td>Axial H3</td>
<td>4.90</td>
<td>0.99</td>
<td>0.96</td>
</tr>
<tr>
<td>Axial H4</td>
<td>4.90</td>
<td>1.02</td>
<td>0.96</td>
</tr>
<tr>
<td>Changing-note H1</td>
<td>4.90</td>
<td>1.01</td>
<td>0.96</td>
</tr>
<tr>
<td>Changing-note H2</td>
<td>4.90</td>
<td>1.00</td>
<td>0.96</td>
</tr>
<tr>
<td>Changing-note H3</td>
<td>4.90</td>
<td>1.01</td>
<td>0.96</td>
</tr>
<tr>
<td>Changing-note H4</td>
<td>4.90</td>
<td>1.00</td>
<td>0.96</td>
</tr>
<tr>
<td>Complementary H1</td>
<td>4.90</td>
<td>1.01</td>
<td>0.96</td>
</tr>
<tr>
<td>Complementary H2</td>
<td>4.90</td>
<td>1.00</td>
<td>0.96</td>
</tr>
<tr>
<td>Complementary H3</td>
<td>4.69</td>
<td>1.00</td>
<td>0.96</td>
</tr>
<tr>
<td>Complementary H4</td>
<td>4.69</td>
<td>1.00</td>
<td>0.96</td>
</tr>
<tr>
<td>Gap-fill H1</td>
<td>4.69</td>
<td>1.00</td>
<td>0.96</td>
</tr>
<tr>
<td>Gap-fill H2</td>
<td>4.69</td>
<td>1.00</td>
<td>0.96</td>
</tr>
<tr>
<td>Gap-fill H3</td>
<td>4.69</td>
<td>1.00</td>
<td>0.96</td>
</tr>
<tr>
<td>Gap-fill H4</td>
<td>4.69</td>
<td>1.00</td>
<td>0.96</td>
</tr>
<tr>
<td>Triadic H1</td>
<td>4.69</td>
<td>1.00</td>
<td>0.96</td>
</tr>
<tr>
<td>Triadic H2</td>
<td>4.69</td>
<td>1.00</td>
<td>0.96</td>
</tr>
<tr>
<td>Triadic H3</td>
<td>4.69</td>
<td>1.00</td>
<td>0.96</td>
</tr>
<tr>
<td>Triadic H4</td>
<td>4.69</td>
<td>1.00</td>
<td>0.96</td>
</tr>
</tbody>
</table>

*First procedure overview.* Expectedness measures were calculated for each NCSI set (axial, changing-note, complementary, gap-fill, and triadic) within each variable (cultural background, age, and music experience), and then were correlated in two ways. The first correlation was binomial between the three variables, and the second correlation was binomial
between the three variables and each of the 20 NCSI item responses. Measures of expectedness for the three variables are displayed in Table 4.4. Correlations of expectedness measures for strength of relationships among the three variables (cultural background, age, and music experience) are displayed in Table 4.5. Correlations of expectedness measures for strength of relationships among the three variables (cultural background, age, and music experience) and individual NCSI item responses are displayed in Table 4.6.

The expectedness measurements for each NCSI set (axial, changing-note, complementary, gap-fill, and triadic) within the three variables (cultural background, age, and music experience) were significant. Where the measurements of expectedness are greater than two, it suggests of the four level endings that “Completely expected” is significantly higher than “Completely unexpected.” Upon examination of the expectedness measurements, it appears that all three variables for each NCSI set, have clearly expected endings. (See Table 4.4.)

Table 4.4: NCSI measures of expectedness for cultural background, age, and music experience

<table>
<thead>
<tr>
<th>NCSI Measures of Expectedness</th>
<th>Cultural Background</th>
<th>Age</th>
<th>Music Experience</th>
</tr>
</thead>
<tbody>
<tr>
<td>Axial</td>
<td>6.16</td>
<td>5.42</td>
<td>7.36</td>
</tr>
<tr>
<td>Changing-note</td>
<td>7.38</td>
<td>9.09</td>
<td>7.96</td>
</tr>
<tr>
<td>Complementary</td>
<td>3.28</td>
<td>6.01</td>
<td>4.79</td>
</tr>
<tr>
<td>Gap-fill</td>
<td>4.89</td>
<td>9.59</td>
<td>6.09</td>
</tr>
<tr>
<td>Triadic</td>
<td>5.75</td>
<td>13.16</td>
<td>8.77</td>
</tr>
</tbody>
</table>

Three variables strength of relationships. Expectedness measures for the three variables were correlated for strength of relationships to address research question three, “Are relationships among participants’ responses attributable to cultural background, age, or musical
experience?” In terms of correlative expectedness measures, research question three may be asked another way, “How much are the expectedness measures in the variables of background culture, age, and music experience ‘alike’ each other?”

Correlation coefficients of 0.00 to 0.34 are generally accepted by many statisticians as weak, 0.35 to 0.69 are moderate, and 0.70 to 1.00 are strong. The correlation between background culture and age was a very weak positive direct correlation (0.268). The correlation between background culture and music experience was a strong positive direct correlation (0.827). Between age and music experience was a moderate positive direct correlation (0.624). In summary, statistical analysis supported that background culture and age did not seem to generate similar responses; whereas, background culture and music experience generated very similar responses, and age and music experience generated somewhat similar responses (see Table 4.5). Statistical analysis supported that there were strong expectedness relationships between background culture and age, while between age and music experience was moderate relationships, and between background culture and music experience was weak.

_NCSI item responses strength of relationships._ The three variables (cultural background, age, and music experience) and twenty NCSI item responses (axial H1, H2, H3, H4, changing-note H1, H2, and so on) were also correlated for strength of relationships to answer research question three, “Are relationships among participants’ responses attributable to cultural background, age, or musical experience?” These coefficients are displayed in Table 4.6.
Between the 20 NCSI item responses and cultural background, 17 of 20 were weak correlations, and the remaining three were moderate correlations (axial H1 and H3 and changing-note H1). Secondly, between 20 NCSIs and age, 14 of 20 were weak correlations, 5 of 20 were moderate (axial H4, complementary H3 and H4, gap-fill H3, and triadic H2), and a remaining one was a strong correlation, (axial H3). Lastly, between 20 NCSIs and music experience, 19 of 20 were weak correlations, and a remaining one was moderate (triadic H1). Overall, 50 of 60 NCSI to variable correlations were weak, while 9 were moderate, and one was strong. (See Table 4.6.) Statistical analysis supported that there were strong expectedness relationships in 50 of 60 NCSI item responses between the three variable groups, 9 of 60 NCSI item responses were moderate, and one was weak.
### Table 4.6: NCSI item responses strength of relationships

<table>
<thead>
<tr>
<th>Cultural Background, Age, and Music Experience</th>
<th>Cultural Background</th>
<th>Age</th>
<th>Music Experience</th>
</tr>
</thead>
<tbody>
<tr>
<td>AxH1</td>
<td>-0.358</td>
<td>0.116</td>
<td>0.294</td>
</tr>
<tr>
<td>AxH2</td>
<td>0.289</td>
<td>0.054</td>
<td>0.114</td>
</tr>
<tr>
<td>AxH3</td>
<td>0.429</td>
<td>0.188</td>
<td>0.046</td>
</tr>
<tr>
<td>AxH4</td>
<td>-0.252</td>
<td>0.280</td>
<td>0.094</td>
</tr>
<tr>
<td>CnH1</td>
<td>-0.630</td>
<td>0.138</td>
<td>0.270</td>
</tr>
<tr>
<td>CnH2</td>
<td>0.270</td>
<td>0.057</td>
<td>0.189</td>
</tr>
<tr>
<td>CnH3</td>
<td>-0.222</td>
<td>0.070</td>
<td>0.096</td>
</tr>
<tr>
<td>CnH4</td>
<td>0.018</td>
<td>0.147</td>
<td>0.056</td>
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<tr>
<td>CmpH1</td>
<td>-0.316</td>
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<td>0.241</td>
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<td>CmpH2</td>
<td>0.197</td>
<td>0.169</td>
<td>0.214</td>
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<td>CmpH3</td>
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<td>0.427</td>
<td>0.312</td>
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<td>CmpH4</td>
<td>0.183</td>
<td>0.361</td>
<td>0.153</td>
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<tr>
<td>GfH1</td>
<td>-0.225</td>
<td>0.229</td>
<td>0.046</td>
</tr>
<tr>
<td>GfH2</td>
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<td>0.155</td>
<td>0.012</td>
</tr>
<tr>
<td>GfH3</td>
<td>-0.207</td>
<td>0.355</td>
<td>0.112</td>
</tr>
<tr>
<td>GfH4</td>
<td>0.299</td>
<td>0.319</td>
<td>0.316</td>
</tr>
<tr>
<td>TriH1</td>
<td>-0.211</td>
<td>0.309</td>
<td>0.579</td>
</tr>
<tr>
<td>TriH2</td>
<td>0.038</td>
<td>0.435</td>
<td>0.16</td>
</tr>
<tr>
<td>TriH3</td>
<td>0.025</td>
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<td>0.287</td>
</tr>
<tr>
<td>TriH4</td>
<td>0.177</td>
<td>0.224</td>
<td>0.008</td>
</tr>
</tbody>
</table>

**Second procedure overview.** The second procedure for research question three addressed the groupings as reported by the NET test participants within the variables of cultural background, age, and music experience. Measures of expectedness were determined for the participant groups within the three variables, and then were examined for expectedness.
significance. A group is defined as those participants who identified themselves from a certain
culture, their age, and music experience level; such as, Latino within cultural background, non-
musician within music experience, and so on. One qualification remains constant for all groups
and their measures of expectedness is that any comparisons of expectedness measures are limited
due to extremely uneven group distributions. The following variables and their groups are
considered in the same order in which they appeared in the NET questionnaire: (1) cultural
background, (2) age, and (3) music experience. Twenty-two participants answered the four
questions in the test questionnaire, whereas three test participants did not answer any questions
about themselves.

**Cultural background identifications.** Participants identified their cultural background in
the questionnaire from a drop-down list of 14 widely-accepted cultural designations (Potter &
Gosling, 2006a; 2006b). (See Appendix A, Internet test instrument, Website Page Five: “Drop-
Down Menu for Questionnaire Question Three.”) As was noted previously, participants
identified themselves as 15 White Caucasian (60%), one Latino (4%), one Korean (4%), one
Other Asian (4%), two Indian Pakistani (8%), and two Chinese (8%), making a total of 22. Three
test participants did not answer any items in the questionnaire (12% ethnicity unknown).
Unfortunately, this representation was missing Hispanic/Latino, American Indian/Alaska Native,
Black/African American, and Native Hawaiian/Pacific from the university’s graduate population,
and the 25 participants were considered by this researcher to be a very narrow cross section of
the university’s ethnicities. For analytical purposes and solely a numerical decision, since single-
answer datum does not compute, the one Latino, one Korean, and one Other Asian were placed
together into a miscellaneous group. (See Table 4.7.)
Table 4.7: Cultural background expectedness measurements

<table>
<thead>
<tr>
<th>Six Ethnicity Identifications</th>
<th>White Caucasian</th>
<th>Latino, Korean, Other Asian</th>
<th>Indian Pakistani</th>
<th>Chinese</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( n = 15 )</td>
<td>( n = 3 )</td>
<td>( n = 2 )</td>
<td>( n = 2 )</td>
</tr>
<tr>
<td>Axial H1</td>
<td>3.53 (10.64)</td>
<td>4.00 (8.78)</td>
<td>3.50 (3.20)</td>
<td>2.00 (2.00)</td>
</tr>
<tr>
<td>Axial H2</td>
<td>1.80 (2.00)</td>
<td>2.00 (2.00)</td>
<td>2.50 (3.50)</td>
<td></td>
</tr>
<tr>
<td>Axial H3</td>
<td>1.93 (1.67)</td>
<td>2.50 (1.50)</td>
<td>1.50 (1.00)</td>
<td></td>
</tr>
<tr>
<td>Axial H4</td>
<td>1.60 (2.00)</td>
<td>1.50 (1.00)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Change n H1</td>
<td>3.93 (12.18)</td>
<td>3.67 (9.33)</td>
<td>4.00 (5.33)</td>
<td>2.50 (2.67)</td>
</tr>
<tr>
<td>Change n H2</td>
<td>2.47 (2.00)</td>
<td>3.50 (3.00)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Change n H3</td>
<td>2.07 (1.33)</td>
<td>2.00 (1.50)</td>
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<td></td>
</tr>
<tr>
<td>Change n H4</td>
<td>1.60 (1.33)</td>
<td>2.00 (1.50)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Comp H1</td>
<td>3.93 (9.46)</td>
<td>3.67 (1.00)</td>
<td>3.00 (-1.33)</td>
<td>4.00 (4.00)</td>
</tr>
<tr>
<td>Comp H2</td>
<td>2.40 (3.33)</td>
<td>3.00 (2.50)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Comp H3</td>
<td>2.60 (1.33)</td>
<td>4.00 (3.50)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Comp H4</td>
<td>2.20 (3.33)</td>
<td>3.50 (2.00)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gap-fill H1</td>
<td>3.80 (9.81)</td>
<td>4.00 (7.50)</td>
<td>3.50 (1.60)</td>
<td>3.50 (0.67)</td>
</tr>
<tr>
<td>Gap-fill H2</td>
<td>2.93 (3.33)</td>
<td>3.00 (3.50)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gap-fill H3</td>
<td>2.93 (2.00)</td>
<td>3.50 (2.00)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gap-fill H4</td>
<td>2.00 (1.67)</td>
<td>2.50 (3.00)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Triadic H1</td>
<td>3.73 (10.99)</td>
<td>4.00 (7.00)</td>
<td>4.00 (3.00)</td>
<td>3.00 (2.00)</td>
</tr>
<tr>
<td>Triadic H2</td>
<td>2.40 (2.33)</td>
<td>2.50 (2.50)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Triadic H3</td>
<td>2.53 (2.33)</td>
<td>2.00 (3.00)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Triadic H4</td>
<td>1.53 (1.67)</td>
<td>2.50 (1.50)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The analysis of the cultural background variable was similar to the procedure for research question one for means alignment and measures of expectedness, calculated in the same manner (see previous discussion of Measurements of expectedness). As follows, two observations were
made from the cultural background variable; first, the alignment of means for the four tonal endings within each NCSI set, and second, measures of expectedness.

The means alignment within each NCSI set showed a somewhat less close approach to their perfect alignment responses than was found in the primary dataset described previously. Upon examination, only four of 20 NCSI set means ranges very closely approached their perfect alignment responses. In the White Caucasian group, it was changing-note and triadic. In the miscellaneous group, Latino, Korean, and Other Asian, it was gap-fill and triadic. The remaining 16 showed the same direction of means range but not as closely aligned.

However, opposite from the range of means findings, the measurements of expectedness showed very clearly expected endings across the cultural background variable. Where the measurements of expectedness are greater than two, it suggests of the four level endings that “Completely expected” is significantly higher than “Completely unexpected.” Upon examination of the five expectedness measurements for each of the four cultural background groups, it appeared that in 16 out of 20 NCSI sets, participants perceived clearly expected endings. The remaining four NCSI sets with expectedness measurements less than two were complementary for Latino, Korean, and Other Asian, complementary and gap-fill for Indian Pakistani, and gap-fill for Chinese. Statistical analysis supported that measurements of expectedness were significant within the variable of cultural background. (See Table 4.7.)

Age identifications. Participants identified themselves with a range of ages from 21 to 58. For exploration of age comparisons, participants were grouped into decades of 20s, 30s, 40s, and 50s. Sixteen participants spanned an evenly spread range of ages of 21 to 28. Three participants were ages 30, 31, and 37. One participant was age 43, and two others were ages 50 and 58, totaling 22 participants. Three test participants did not answer any items in the questionnaire.
Participant’s responses were grouped as ages 20-29, ages 30-39, and ages 50-59. For analytical purposes and solely a numerical decision, since single-answer datum does not compute, to include the one 43 year old, another group of ages 40-59 was created. (See Table 4.8.)

Table 4.8: Age identification expectedness measurements

<table>
<thead>
<tr>
<th>Ages by Decade</th>
<th>Ages 20-29</th>
<th>Ages 30-39</th>
<th>Ages 50-59</th>
<th>Ages 40-59</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n = 16</td>
<td>n = 3</td>
<td>n = 2</td>
<td>n = 3</td>
</tr>
<tr>
<td>Mean (Max-Min)/Er</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Axial H1</td>
<td>3.44</td>
<td>4.00</td>
<td>2.50</td>
<td>3.00</td>
</tr>
<tr>
<td></td>
<td>9.69</td>
<td>7.00</td>
<td>2.00</td>
<td>2.97</td>
</tr>
<tr>
<td>Axial H2</td>
<td>1.94</td>
<td>2.00</td>
<td>1.67</td>
<td>2.00</td>
</tr>
<tr>
<td>Axial H3</td>
<td>1.94</td>
<td>2.50</td>
<td>2.67</td>
<td>2.33</td>
</tr>
<tr>
<td>Axial H4</td>
<td>1.63</td>
<td>1.00</td>
<td>1.67</td>
<td>1.33</td>
</tr>
<tr>
<td>Change-n H1</td>
<td>3.69</td>
<td>4.00</td>
<td>4.00</td>
<td>3.00</td>
</tr>
<tr>
<td></td>
<td>10.20</td>
<td>5.60</td>
<td>12.00</td>
<td>8.57</td>
</tr>
<tr>
<td>Change-n H2</td>
<td>2.50</td>
<td>2.50</td>
<td>2.67</td>
<td>2.67</td>
</tr>
<tr>
<td>Change-n H3</td>
<td>1.94</td>
<td>1.50</td>
<td>1.67</td>
<td>2.00</td>
</tr>
<tr>
<td>Change-n H4</td>
<td>1.63</td>
<td>1.00</td>
<td>1.67</td>
<td>1.33</td>
</tr>
<tr>
<td>Comp H1</td>
<td>3.88</td>
<td>4.00</td>
<td>4.00</td>
<td>3.00</td>
</tr>
<tr>
<td></td>
<td>7.47</td>
<td>8.00</td>
<td>8.00</td>
<td>8.57</td>
</tr>
<tr>
<td>Comp H2</td>
<td>2.44</td>
<td>2.50</td>
<td>2.00</td>
<td>2.67</td>
</tr>
<tr>
<td>Comp H3</td>
<td>2.81</td>
<td>2.00</td>
<td>1.00</td>
<td>2.00</td>
</tr>
<tr>
<td>Comp H4</td>
<td>2.50</td>
<td>1.00</td>
<td>1.67</td>
<td>1.33</td>
</tr>
<tr>
<td>Gap-fill H1</td>
<td>3.69</td>
<td>4.00</td>
<td>4.00</td>
<td>3.00</td>
</tr>
<tr>
<td></td>
<td>7.37</td>
<td>10.00</td>
<td>14.00</td>
<td></td>
</tr>
<tr>
<td>Gap-fill H2</td>
<td>3.00</td>
<td>4.00</td>
<td>1.50</td>
<td></td>
</tr>
<tr>
<td>Gap-fill H3</td>
<td>2.81</td>
<td>3.00</td>
<td>2.00</td>
<td></td>
</tr>
<tr>
<td>Gap-fill H4</td>
<td>2.25</td>
<td>1.50</td>
<td>1.67</td>
<td></td>
</tr>
<tr>
<td>Triadic H1</td>
<td>3.63</td>
<td>4.00</td>
<td>4.00</td>
<td></td>
</tr>
<tr>
<td></td>
<td>9.45</td>
<td>28.00</td>
<td>7.17</td>
<td></td>
</tr>
<tr>
<td>Triadic H2</td>
<td>2.19</td>
<td>3.00</td>
<td>1.50</td>
<td></td>
</tr>
<tr>
<td>Triadic H3</td>
<td>2.50</td>
<td>3.00</td>
<td>2.00</td>
<td></td>
</tr>
<tr>
<td>Triadic H4</td>
<td>1.69</td>
<td>1.00</td>
<td>1.33</td>
<td></td>
</tr>
</tbody>
</table>
The range of means and measures of expectedness of the age dataset were also examined in the same manner as the cultural background group. Two observations were made from the age by decade data; first, the means alignment for the four tonal endings within each NCSI set, and second, measures of expectedness. An examination of the range of means for the four tonal endings revealed that 10 NCSI sets means very closely approached their perfect alignment responses. In ages 20-29, it was changing-note and triadic. In ages 30-39, it was triadic. In ages 50-59, it was complementary, gap-fill, and triadic. In ages 40-59, created to include the single 43 year-old participant, it was changing-note, complementary, gap-fill, and triadic. The remaining 10 groupings less closely approached their perfect alignment responses.

Where the measurements of expectedness are greater than two, it suggests of the four level endings that “Completely expected” was significantly higher than “Completely unexpected.” Upon examination of the five expectedness measurements for each of the four age by decade groups, it appeared that in 19 out of 20 NCSI sets, participants perceived clearly expected endings, except ages 30-39. Statistical analysis supported that measurements of expectedness were significant within the variable of age. (See Table 4.8.)

*Music experience identifications.* Participants identified themselves with one of three music experience assessments. Choices were listed from greatest level of perceived experience to least. Participants chose among “Musician with much training,” “Musician with little or no training,” and “Non-musician.” (See Appendix A, *Internet test instrument*, Website Page Five: “Questionnaire.”) Five participants identified themselves as “Musician with much training,” nine as “Musician with little to no training,” and eight as “Non-musician.” Three test participants did not answer any items in the questionnaire.
The means alignment and measures of expectedness of the age dataset were also examined in the same manner as the variables for cultural background and age by decade. As before, two observations were made from the music experience data; first, the means alignment for the four tonal endings within each NCSI set, and second, measures of expectedness. An examination of the alignment of means for the four tonal endings more closely approached their perfect alignment responses than in cultural background and age by decade datasets. Eleven of 15 NCSI set means very closely approached their perfect alignment responses. In “Musician with much training,” it was axial, changing-note, gap-fill, and triadic. In “Musician with little to no training,” it was the same four NCSI sets as in “Musician with much training,” axial, changing-note, gap-fill, and triadic. In “Non-musician,” it was axial, changing-note, and triadic. The remaining three NCSI sets were only a little less closely aligned. (See Table 4.9.)

Where measurements of expectedness are greater than two, it suggests of the four level endings that “Completely expected” is significantly higher than “Completely unexpected.” Upon examination of the five expectedness measurements for each of the three music experience groups, 20 out of 20 NCSI sets had clearly expected endings. Statistical analysis supported that measurements of expectedness were significant within the variable of music experience. (See Table 4.9.)

Correlational comparisons of the measurements of expectedness between variables of cultural background, age, and music experience addressed the third research question, “Are relationships among participants’ responses attributable to cultural background, age, or musical experience?” Statistical analysis affirmatively supported that there are strong, moderate, and weak relationships in participants’ responses attributable to cultural background, age, and music experience.
Table 4.9: *Music experience expectedness measurements*

<table>
<thead>
<tr>
<th>Music Experience</th>
<th>Musician With Much Training</th>
<th>Musician With Little or No Training</th>
<th>Non-Musician</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n = 5</td>
<td>n = 9</td>
<td>n = 8</td>
</tr>
<tr>
<td></td>
<td>Mean (Max-Min)/Err</td>
<td>Mean (Max-Min)/Err</td>
<td>Mean (Max-Min)/Err</td>
</tr>
<tr>
<td>Axial H1</td>
<td>4.00 10.15</td>
<td>3.33 6.34</td>
<td>3.25 5.61</td>
</tr>
<tr>
<td>Axial H2</td>
<td>1.50 2.11</td>
<td>1.88</td>
<td></td>
</tr>
<tr>
<td>Axial H3</td>
<td>2.00 2.11</td>
<td>2.13</td>
<td></td>
</tr>
<tr>
<td>Axial H4</td>
<td>1.50 1.67</td>
<td>1.50</td>
<td></td>
</tr>
<tr>
<td>Change-n H1</td>
<td>3.75 6.02</td>
<td>4.00 10.97</td>
<td>3.50 6.88</td>
</tr>
<tr>
<td>Change-n H2</td>
<td>2.25 2.78</td>
<td>2.25</td>
<td></td>
</tr>
<tr>
<td>Change-n H3</td>
<td>1.75 1.89</td>
<td>2.00</td>
<td></td>
</tr>
<tr>
<td>Change-n H4</td>
<td>1.50 1.67</td>
<td>1.50</td>
<td></td>
</tr>
<tr>
<td>Comp H1</td>
<td>3.75 4.47</td>
<td>3.67 4.02</td>
<td>4.00 5.87</td>
</tr>
<tr>
<td>Comp H2</td>
<td>2.50 2.89</td>
<td>2.25</td>
<td></td>
</tr>
<tr>
<td>Comp H3</td>
<td>2.00 2.56</td>
<td>3.00</td>
<td></td>
</tr>
<tr>
<td>Comp H4</td>
<td>2.00 2.44</td>
<td>2.63</td>
<td></td>
</tr>
<tr>
<td>Gap-fill H1</td>
<td>3.75 5.73</td>
<td>3.78 8.53</td>
<td>3.75 4.02</td>
</tr>
<tr>
<td>Gap-fill H2</td>
<td>2.75 3.11</td>
<td>3.00</td>
<td></td>
</tr>
<tr>
<td>Gap-fill H3</td>
<td>2.50 2.78</td>
<td>2.88</td>
<td></td>
</tr>
<tr>
<td>Gap-fill H4</td>
<td>1.75 1.89</td>
<td>2.50</td>
<td></td>
</tr>
<tr>
<td>Triadic H1</td>
<td>4.00 10.59</td>
<td>4.00 9.84</td>
<td>3.25 5.88</td>
</tr>
<tr>
<td>Triadic H2</td>
<td>2.50 2.67</td>
<td>2.13</td>
<td></td>
</tr>
<tr>
<td>Triadic H3</td>
<td>2.50 2.11</td>
<td>3.00</td>
<td></td>
</tr>
<tr>
<td>Triadic H4</td>
<td>1.25 1.89</td>
<td>1.50</td>
<td></td>
</tr>
</tbody>
</table>
Researcher’s Hypothesis

The present researcher’s hypothesis was that newly composed schemata illustrations (NCSIs) composed to conform to Meyer’s schemata in an authentic setting (1) imply melodic answers (realizations) similar to existing melodies, (2) prompt melodic answer expectancies of participants consistent with Krumhansl’s (1979) four tonal levels, (3) replicate, on average, pitch space distances between the NCSIs’ melodic answer measurements of expectedness similar to the pitch space distances between the four tonal levels as reported by Krumhansl, and that (4) in reference to Gestalt principles, participants’ responses are similar regardless of cultural background, age, or musical experience.

Parts two and three of the researcher’s hypothesis stated that NCSIs would prompt melodic answer expectancies consistent with Krumhansl’s (1979) four tonal levels, and replicate, on average, pitch space distances between the NCSIs’ melodic answer expectancies similar to the pitch space distances between the four tonal levels as reported by Krumhansl. Statistical analysis (RUMMFOLDss) of the responses of expectedness between the hierarchical levels of the “Note”able Endings Test (NET) revealed cluster groupings of the various level endings very similar to Krumhansl’s reported levels. Table 4.10 featured two comparative graphs of the hierarchical levels of Krumhansl’s investigation and this study. The four levels in both charts are somewhat similar in pitch space order, even though levels two and three in the NET Hierarchy reveal some crossover. (See Table 4.10.)
Table 4.10: Krumhansl’s hierarchy and NET’s hierarchy compared

Comparative Pitch Spaces Between Krumhansl’s Hierarchy and the NET

NET Hierarchy:

NET Level 4

NET Level 3

NET Level 2

NET Level 1

Krumhansl’s Hierarchy:

Level 4

Level 3

Levels 1 and 2

Researcher’s hypothesis conclusions. The researcher’s hypothesis conclusions are noted following in order of the hypothesis’ four parts. (1) Since the measures of expectedness were
clearly significant for the five NCSI sets (axial, changing-note, gap-fill, complementary, and triadic), based on one-dimensional statistical evidence from the examination of research question one, statistical evidence rejected the Null hypothesis and supported the alternative that the newly composed schemata illustrations (NCSIs) in an authentic setting imply melodic answers (realizations) similar to existing melodies. (2) Since the individual means (H1 to H4) within a majority three of five NCSI sets (axial, changing-note, and triadic) closely approached each tonal level’s perfect alignment response, statistical evidence rejected the Null hypothesis and supported the alternative that the NCSI endings chosen by participants were consistent in the same order as Krumhansl’s (1979) four tonal levels for three of five NCSI sets, and (3) replicated, on average, pitch space distances between the NCSIs’ melodic answer expectancies similar to the pitch space distances between the four tonal levels as reported by Krumhansl. (4) In reference to Gestalt principles that participants’ responses are similar regardless of cultural background, age, or musical experience, statistical analysis instead affirmatively supported that there are strong, moderate, and weak relationships among participants’ responses attributable to cultural background, age, and music experience.

Chapter Four Summary

This present study began with the intent of investigating Krumhansl’s (1979) tonal hierarchy of four levels with Meyer’s (1973) five melodic schemata in an authentic setting. Until this study, Meyer’s melodic schemata theory had not been investigated in the context of all five melodic schemata in an authentic setting closely approximating how music may be heard in real life, instigating melodic implications (melodic questions) and realizations (melodic answers). Statistical analysis affirmatively supported Krumhansl’s tonal hierarchy of four levels, supported Meyer’s melodic schemata being illustrated into new-composed schematic illustrations (NCSIs)
that imply implications and realizations, and supported the authentic setting of holistic melodies rather than synthetically-derived melodic motives and prime tones.
CHAPTER FIVE

SUMMARY, DISCUSSION, RECOMMENDATIONS, CONCLUSION

Chapter five is organized into six major sections. Section one, *Purpose, Hypothesis, Research Questions, and Review of Statistical Findings*, is a review of the study’s purpose, three research questions aligned with the researcher’s hypothesis, and statistical evidence concerning the four parts of the hypothesis. Section two, *Discussion and Recommendations*, considers additional areas of investigation revealed by the statistical analysis of measures of fit, and possible restructuring of the “Note”able Endings Test (NET). Section three, *Considering Past Melodic Perception Theories and Recommendations for Future Research*, considers how this study raises reflective questions about previous melodic perception studies. Section four, *Considering a Present Melodic Perception Theory and Recommendations for Future Research*, discusses a recently new melodic perception theory and a renewed appeal for authentic investigations over synthetic. Section five, *Considering Futuristic Melodic Perception Possibilities Beyond Melodic Perception Theories*, proposes futuristic, imaginative melodic expectedness possibilities, and a philosophical reexamination of one-dimensionality versus multi-dimensionality within measures of melodic expectedness. Section six, is the *Conclusion* to this study.

**Purpose, Hypothesis, Research Questions, Review of Statistical Analyses**

**Purpose**

The purpose of the current study was to investigate if expectancies for melodic answers are consistent with Krumhansl’s (1979) tonal hierarchy when melodic questions are based on Meyer’s (1973) five theoretical melodic schemata.
Researcher’s Hypothesis

The present researcher’s hypothesis was that new melodies could be composed based on Meyer’s schemata and these melodies would also perceptually reflect Krumhansl’s four tonal levels. Specifically, these newly composed schemata illustrations (NCSIs) would (1) imply melodic answers (realizations) similar to existing melodies, (2) prompt melodic answer expectancies of participants consistent with Krumhansl’s (1979) four tonal levels, (3) replicate, on average, pitch space distances between the NCSIs’ melodic answer expectancies similar to the pitch space distances between the four tonal levels as reported by Krumhansl, and that (4) in reference to Gestalt principles, participants’ responses would be similar regardless of cultural background, age, or musical experience.

Three Research Questions

Three research questions guided the investigation: (1) Are preferred melodic answers (realizations) to newly composed melodic questions (implications), composed to conform to Meyer’s (1973) melodic schemata, consistent with Krumhansl’s (1979) four tonal levels? (2) To what degree did participants anticipate the closing of melodic phrases individually comprised of the four Krumhansl tonal levels? (3) Are participants’ responses attributable to cultural background, age, or musical experience? The purpose of the current study was to investigate if expectancies for melodic answers are consistent with Krumhansl’s (1979) tonal hierarchy when melodic questions are based on Meyer’s (1973) five theoretical melodic schemata.

Review of Statistical Analyses

Statistical evidence supported parts one, two, and three of the researcher’s hypothesis, and did not support part four. Concerning part one, since the measures of expectedness were clearly significant for the five NCSI sets (axial, changing-note, gap-fill, complementary, and
triadic), based on one-dimensional statistical evidence from the examination of research question one, statistical evidence rejected the Null hypothesis and supported the alternative that the newly composed schemata illustrations (NCSIs) in an authentic setting imply melodic answers (realizations) similar to existing melodies. Concerning parts two and three, since the individual means (H1 to H4) within a majority three of five NCSI sets (axial, changing-note, and triadic) closely approached each tonal level’s dichotomous “correct” answer, statistical evidence rejected the Null hypothesis and supported the alternative that the NCSI endings chosen by participants were consistent in the same order as Krumhansl’s (1979) four tonal levels for three of five NCSI sets, and replicated, on average, pitch space distances between the NCSIs’ melodic answer measurements of expectedness similar to the pitch space distances between the four tonal levels as reported by Krumhansl. Concerning part four, in reference to whether participants’ responses are similar regardless of cultural background, age, or musical experience, statistical analysis instead affirmatively supported that there are strong, moderate, and weak relationships in participants’ responses attributable to cultural background, age, and music experience. Statistical analysis supported three of four parts of the researcher’s hypothesis.

Discussion and Recommendations

Statistical analysis revealed that measures of expectedness affirmatively supported four secondary considerations of this study: (1) Meyer’s (1973) five melodic schemata functioned as melodic questions (implications) as indicated by the significance of the expectedness measures. (2) Krumhansl’s (1979) tonal hierarchy of four levels functioned as melodic answers (realizations). (3) These melodic questions and answers together functioned as authentic, holistic melodies, rather than synthetically-derived tonal motifs and prime tones, as verified by the content validity determined by the collegiate music experts. (4) Participant’s responses among
Krumhansl’s (1979) four tonal levels on average indicated the same tonal spacing that Krumhansl originally reported, as indicated by the hierarchy of expectedness measures among the four tonal levels.

This researcher concluded that a major limitation to this study was the extremely small sample size, and was possibly the most concerning limitation. Although 25 respondents were less than Moulton’s (2010) suggested 30 to appropriately fit the NOUS statistical model, it was concluded 25 were acceptable for this analysis because the standard errors were consistently small and that the analytical pattern was stable (Andrich, 2010; Moulton, 2010). The response of only 25 persons necessitated the qualification, which remained constant for all groups and their measures of expectedness, that any comparisons of expectedness measures were limited due to extremely uneven group distributions. One can only conjecture what would have been the statistical results had the sample size been in the hundreds as was initially hoped for. In addition to conjectures relating to a larger sample size, the following explores a variety of ways of how this study may be extended.

Extending Moulton’s NOUS Analysis and Restructuring the NET

Further explorations were suggested as a result of this study, an examination of relationships between item fit and response fit measurements, exploring more of NOUS’ robustness, more cultural background and expectedness dimensions regarding race / culture / ethnicity, and restructuring the melodic stems and endings in the “Note”able Endings Test (NET).

*Item fit and individual response fit measurements.* Statistical analysis using Moulton’s (2010) NOUS revealed two sets of fit measurements that were opposite of each other. NOUS compared each individual item response (20 observed responses for each participant, of axial H1,
H2, H3, H4, and so on) to the estimate of what the model predicted, which determined an
Individual Response Fit measurement. Second, NOUS calculated the overall average fit of each
level ending (axial H1, H2, H3, H4, and so on), which determined an Item Fit measurement.
Third, NOUS calculated each participant’s 20 responses and determined a Person Fit
measurement. Item Fit measurements greater than “2” or less than “-2” indicate that the
participant’s observed response was significantly greater than, or significantly less than, what the
model predicted. Concerning the Item Fit and Individual Response Fit, an opposite set of
measurements were revealed. Item Fit measurements ranged from .99 to 1.02, indicated
significant fitness, while Individual Response Fit measurements ranged from -3.84 to 3.62,
indicated significant lack of fit. One may expect 5% of the dataset to misfit by chance, but
analysis indicated that 9.79% of the dataset did not fit. These opposite measurements suggested
further investigation of possible hidden interactions.

Reexamination of one-dimensionality and factorial analysis. The above significant lack
of fit of individual responses indicated definite rater and/or melodic questions (implication) and
answers (realization) interactions that violated the one-dimensional model (Moulton, 2010). A
further examination of this study’s one-dimensionality and factorial analysis was suggested to
explore possible hidden influences of fitness.

Exploring NOUS’ robustness. This investigation seemed to add another method for
measuring melodic perception to the statistical models cited in previous studies. Previously,
Larson (2004) used two algorithmic models to investigate computer-generated and participant-
generated responses of gravity, magnetism, and inertia. Margulis' (2005) model included
hierarchical expectancy formulas for pairs of pitches within existing authentic melodies as well
as sequences of pitches within various time-span reduction levels, with a weighted average of
different levels’ formula ratings to insure that expectations (implications with realizations or denials) from adjacent events play a greater role than distant hierarchical ones in the determination of overall expectancy ratings. The use of Moulton’s (2010) NOUS model for melodic perception purposes was a contribution of this study. Moulton’s NOUS multi-dimensional model was able to determine measures of expectedness across the melodic event of questions and answers. Perhaps the NOUS procedure for determining melodic expectedness measures could be retroactively applied to the Larson and Margulis studies for a contrast and comparison of their previous findings. Possibly this retroactive application could strengthen the robustness of NOUS and extend its possible use for future melodic perception studies of melodic expectedness.

*Restructuring the “Note”able Endings Test (NET).* In this present study using the NET, melodic expectedness measurements were derived from the structure of melodic questions (implications) serving as listening prompts and hierarchical level endings (realizations), similar to melodic answers. With these elements combined, the NET explored a perceptual expectedness musical sense in that it explored degrees of adherence to an “expectation hierarchy.” What correlational relationships to this study’s melodic expectedness scores would arise if participants were presented a melody with a part missing, for example, a blank measure, and they were asked to fill in the blank by choosing a “fill-in answer” among various choices? No previous melodic perception investigations have employed this method (Huron, 2007).
Considering Past Melodic Perception Theories and Recommendations for Future Research

Melodic Expectedness Compared to Melodic Perception Theories

Meyer’s melodic explicit schemata. Meyer (1973) outlined a theory of melodic implications (questions) and realizations (answers) within varying lengths of melodic events such as intervals, motives, and phrases, as well as entire melodies. Using Western melodies as supporting evidence, Meyer proposed melodies are organized into five basic patterns (or melodic schemata). Meyer noted that implications and realizations occurring within intervals, motives, phrases, and entire schemata create hierarchical levels of melodic structure. Implications-realizations at the schematic hierarchical level (schematic realizations comprised of multiple notes) later became identified as schematic completeness (Larson, 2004). This study investigated entire melodies, known as schematic completeness. As suggested following, three general melodic schemata considerations may be made concerning melodic schemata.

Previous investigations have identified three broad categories of melodic schemata. (1) Meyer’s (1973) five schemata, (2) embellished or implicit schemata, later referred to as time-span reductions (Lerdahl & Jackendoff, 1983a, 1983b; Lerdahl, 2001; Margulis, 2005), and (3) children’s schemata (Mitroudot, 2001), identified as particular to children yet perfectly fitting Meyer’s schematic theory. A researcher may wonder, are more schemata yet to be discovered? General research questions could be, what are the yet-to-be-discovered schematic measures of implication and realization strengths across them? How do these measures of expectedness compare or contrast to the ones found between Meyer’s (1973) basic schemata and Krumhansl’s (1979) hierarchical tonal levels?
This present study was concerned with Meyer’s (1973) five basic (explicit) schemata. This study identified melodic expectedness measurements between melodic implications (questions) and realizations (answers) comprised of four specific tonal levels (Krumhansl’s hierarchy) at the schematic completeness level identified by Larson (2004). In the same manner that measurements of melodic expectedness were revealed in this study’s melodic questions and answers among the five schemata and four tonal levels (NCSIs), measurements of melodic expectedness possibly may be found in this study’s NCSIs among smaller melodic units such as phrases, motives, and intervals. Specifically, if expectedness measurements were revealed between the three smaller melodic units, how might these compare and contrast to the measurements found in this study at the schematic completeness level? Would a NET test melodic structure of “fill-in-the-blank” provide this data, or a similar question and answer format used in this study?

This present study did not address Meyer’s (1973) more complex embellished (implicit) schemata. Embellished or implicit schemata, later referred to as time-span reductions (Lerdahl & Jackendoff, 1983a, 1983b; Lerdahl, 2001; Margulis, 2005), were not investigated in this study since they may involve a more complex level of melodic perception than deemed appropriate for this study. Implicit schemata are melodies elaborately embellished and adorned, for which a melodic reduction is required to visualize the otherwise hidden explicit melodic schema (Meyer, 1973). The newly composed schematic illustrations (NCSIs) in this present study were structurally based on Meyer’s basic (explicit) schemata. Since measures of expectedness in this study were found for explicit schemata, might melodic questions and answers (NCSIs) comprised of Meyer’s embellished or implicit schemata reveal comparable expectedness measurements? A general research question could be, how do each of the five categories of
explicit (basic) schemata compare or contract with its companion category of implicit
(embellished or adorned) schemata?

Rosner and Meyer’s studies. As discussed in chapter one, it appears only two studies,
First, Rosner and Meyer (1982) investigated whether or not participants could identify existing
melodies as belonging to Meyer’s melodic schema categories of gap-fill versus non-gap-fill,
changing-note versus non-changing-note, and gap-fill versus changing-note. Second, Rosner and
Meyer (1986) investigated the role of melodic schemata in melodic perception. Rosner and
Meyer (1982) concluded that participants were significantly better at identifying gap-fill than
melodies not gap-fill, significantly more successful identifying changing-note than not changing-
note, but found no significant relationship between recognition of gap-fill versus changing-note,
or changing-note versus gap-fill.

Rosner and Meyer’s (1982, 1986) conclusions gap-fill and changing-note schemata led
this researcher to consider that gap-fill and changing-note NCSIs may reveal greater significant
measures of expectedness than axial, triadic, and complementary. However, upon examination of
the various expectedness measures, there appears to be no parallel order among NCSI sets,
cultural background, age, or music experience. In general, this study’s expectedness
measurements, in order of greatest to least significant, seemed to be opposite from what was
implied in earlier studies (Rosner & Meyer, 1982, 1986). In this study, changing-note and triadic,
in priority positions one, two, and three, indicated greater significance than gap-fill and
complementary in positions three, four, and five (see Table 5.1). These dissimilar orders among
NCSI sets, cultural background, age, or music experience certainly suggests areas for further
research. Factors may be explored to explain these seeming radical relationships. Rosner and
Meyer used existing, historic melodies in their research, while this study used newly-composed melodies illustrating the five schemata. Possibly this difference may explain the apparent opposite findings between the two studies.

Melodic expectedness measures were extracted from various tables in chapter four and collated into Table 5.1. Featured in this table are expectedness measurements for the NCSI sets, and expectedness measurements for the individual variables of cultural background, age, and music experience. From top to bottom, these indicate highest to lowest measurements of expectedness, and seem to be opposite from Rosner and Meyer’s studies (1982, 1986).

Table 5.1: Melodic expectedness measures compared

| Melodic Expectedness Measures of NCSI Sets, Cultural Background, Age, & Music Experience |
|-----------------------------------------------|-------------------------------|-----------------|-----------------|
| NCSI Sets                              | Cultural Background | Age              | Music Experience |
| 32.43—Changing-note        | 7.38—Changing-note      | 13.16—Triadic    | 8.77—Triadic    |
| 32.02—Triadic                 | 6.16—Axial             | 9.59—Gap-fill    | 7.96—Changing-note|
| 31.24—Axial                   | 5.75—Triadic           | 9.09—Changing-note| 7.36—Axial     |
| 18.07—Complementary           | 3.28—Complementary     | 5.42—Axial       | 4.76—Complementary|

Meyer’s (1973) theory of five schemata is a theory based on historic melodies, followed by very little research, while this study is a practical application of the theoretical. This researcher postulated that had Meyer followed up his theory with practical applications, he may have discovered a large difference between the structures that melodies appear on the visual page, as compared to how they are aurally perceived. Though unsupported by research, this
researcher speculated that Meyer may have structured his theory differently had it been based on aural perceptions, as in the present study, instead of visual perception.

*Narmour’s implications and realizations.* Narmour (1983, 1989, 1990, 1992) developed Meyer’s general theory of melodic implications (questions) and melodic realizations (answers), focusing on whether or not the uniqueness of any perceptual melodic event (implication-realization) can be captured in a specific analytical symbol. One such analytical symbol is [P] for *Process* consisting of small intervals in the same direction, that may imply a “need” (realization) for more small intervals in the same direction. As Narmour argued implication-realization events (1) are universally built on Gestalt principles, (2) are therefore free of all cultural or era contexts, and (3) applicable to all styles of melody, he contended the analytical symbols therefore were also universal to all melodies, cultural, tonal, and atonal. Narmour (1990, 1992) agreed with Meyer in proposing that implications (questions) and realizations (answers) are inherent not only between singular pairs of pitches, but at all hierarchical levels and various sizes of melodic events. Thus, the main contributions of Narmour’s theory are the determining and symbolizing of individual events (implications-realizations) and how individual events may be sequenced together comprising larger hierarchical events.

Since Narmour (1983, 1989, 1990, 1992) argued implication-realization events are (1) universally built on Gestalt principles, (2) therefore free of all cultural or era contexts, and (3) applicable to all styles of melody, he contended the analytical symbols therefore were also universal to all melodies, cultural, tonal, and atonal. What association does Narmour’s three arguments have with this present study’s findings that there are relationships among participants’ cultural backgrounds, ages, and music abilities? Since statistical analysis in this study revealed three strengths of correlations (strong, moderate, and weak) among cultural background, age, and
music experience, perhaps this study may be an instance of refutation of Narmour’s theoretical points one and two. Perhaps the dataset from this sample (n=25) may be too narrow to be considered a valid negation. Or might a greater similarity be revealed to these questions from a dataset of greater than 100, and perhaps from a more global population, rather than the smaller representative convenience graduate population at a large central Pennsylvania university?

As was noted previously with Meyer’s (1973) schemata theory that it seemed to be more visually based than aurally perceptive, so too Narmour’s (1983, 1989, 1990, 1992) theory, which follows in the steps of Meyer’s, seems to be visually based rather than aurally based. It seemed that Narmour concluded all implication-realization events are universally built on Gestalt principles from the visual only. This researcher speculates that Narmour, like Meyer, may have discovered hidden complexities in his simplistic Gestalt conclusion had he included in his theory a wealth of aurally perceptive research from a truly world-wide population.

*Krumhansl’s tonal hierarchy.* Krumhansl (1979) theorized that Narmour’s uniquely individual implications and realizations may also involve perceived distances between pitches, known as pitch spaces. Krumhansl used tonal and atonal sequences as implicative stimuli and various pairs of notes as realizations, and conducted experiments in which participants were asked to judge how similar the first tone was to the second after listening to the tonal or atonal sequence. Krumhansl concluded listeners extracted a pattern of pitch space (distances) among tones that not only revealed pitch height measurements, but also measurements from membership in the major triad chord and within the diatonic scale. Krumhansl’s findings seem to be the first to indicate possible strength differences within Narmour’s (1983, 1989, 1990, 1992) implication-realization events.
Since Krumhansl (1979) seemed to be the first to explore strength measurements within Narmour’s implication-realization events, how might this study’s unique measurements of expectedness relate to Krumhansl’s implicative strength measurements? The answer to this question may be found in contrasting and comparing the mathematical philosophies underlying the multi-dimensional analytical principles of Krumhansl’s statistical analysis and the one-dimensional analytical principles of Moulton’s NOUS statistical analysis.

As discussed in chapter two, various investigations have explored elements of Gestalt-based and universal principles (Eerola, 2003; Krumhansl, 1995; Krumhansl, et al, 2000; Narmour, 1990, 1002; Schellenberg, Adachi, Purdy, & McKinnon, 2002). These studies spanning various cultures, musical training levels, and ages seem to support Narmour’s (1990) claim that his implication-realization principles are Gestalt-based and are therefore universal. One study in particular (Schellenberg, Adachi, Purdy, & McKinnon, 2002) asked 8- and 11-year-old children and adult participants to rate how well individual test tones continued melodic fragments. These different ages experienced similar melodic implications by expecting a forthcoming tone to be in closest proximity to the last tone heard. Schellenberg, et al. denoted the use of melodic fragments rather than entire melodies (schematic completeness), and a wide range of ages. Compared to this present study wherein implications were measured within entire melodies, what relationships among expectedness measurements may be explored among Schellenberg’s melodic fragments and this study’s entire-completeness melodies? How do Schellenberg’s individual test tones as melodic realizations (answers) compare to Krumhansl’s (1979) tonal levels as melodic answers? Why does this present study find strong, moderate, and weak relationships among responses by ages, whereas strong relationships are reported in the
above previous studies? Would different relationships been present in participants’ responses with a population of several hundred instead of 25?

*Lerdahl and Jackendoff’s generative theory of tonal music.* Lerdahl and Jackendoff (1983a, 1983b; Lerdahl, 2001) detailed a generative theory of tonal music (GTTM) based on the premise that distances between pitches (pitch space), as described by Krumhansl (1979), and stability and instability conditions (Meyer’s and Narmour’s implications-realizations) are in principle the same. GTTM describes specific conditions of stability and instability of events within a piece’s temporal regions through four hierarchical structures in music: grouping structure, metrical structure, time-span structure, and prolongational reduction. Lerdahl proposed GTTM’s process may help explain a listener’s perceived relative stability and instability of events within a piece’s embedded temporal regions as the music dynamically flows from one part to another. Lerdahl and Jackendoff cited notable support for their GTTM pitch space model was Krumhansl’s experimental research (Krumhansl, 1979; Krumhansl & Shepherd, 1979) and theories of melodic implication and melodic completeness at the schemata level (Meyer, 1973; Narmour, 1990, 1992).

In this present study, measures of melodic expectedness were found to exist between NCSI stems (implications) and tonal level hierarchical endings (realizations). A closer examination of the GTTM theory may include an exploration of not only melodic measurements of expectedness but also rhythmic and metric measurements of expectedness within each of the theory’s four main considerations (grouping structure, metrical structure, time-span structure, and prolongational reduction). This may lead to specific research questions such as, what various types of expectedness measurements are to be found within GTTM’s four main considerations? How do GTTM’s conditions of stability and instability relate to this study’s expectedness
measurements between Meyer’s (1973) melodic schemata and Krumhansl’s (1979) tonal levels? A well-developed, multi-layered listening test may yield a dataset to explore these questions.

Larson’s theory of gravity, magnetism, and inertia. Larson (2004) expanded Meyer’s (1973) and Narmour’s (1990, 1992) theories of melodic expectations (implications) and melodic completions (realizations) in terms of physical motions that relate to gravity, magnetism, and inertia. Larson defined gravity as the tendency of an unstable note to descend; magnetism as the tendency of an unstable note to move to the nearest stable pitch, which tendency grows stronger the closer an implication progresses to its goal; and inertia as the tendency of a pattern of musical motion to continue in the same fashion as what the listener perceives to be heard. Larson found strong support between two algorithmic computer models and the experimental behavior of participants in several experiments as the theory successfully predicted completions identical to those performed by the participants. Larson concluded the striking agreement between computer-generated and participant-generated responses suggests that the theory captures gravity, magnetism, and inertia as critical aspects of melodic expectation (implication). Larson also concluded that listeners’ melodic expectations of entire completions of multiple notes rather than single notes (as in Krumhansl, 1979) should be regarded as schematic realizations, which conclusion seems to be a reiteration of Lerdahl and Jackendoff’s (1983a, 1983b; Lerdahl, 2001) and Meyer’s (1973) emphasis on schematic completeness.

How might this study’s measurements of melodic expectedness relate or correspond with Larson’s (2004) computer-generated and participant-generated responses of gravity, magnetism, and inertia? Since implications and realizations have been concluded to exist within Larson’s elements of gravity, magnetism, and inertia, have these implications been measured as expectedness? How might these measurements be the same or different from this study’s
measurements of expectedness? Are this study’s measurements of expectedness between schemata’s implications (questions) and realizations (answers) in any way related to Larson’s multiple-note schematic realizations? Lastly, a fascinating, creative question arises from Larson’s theory. If the same 25 participants who took the NET listening test were asked to provide Larson-styled participant-generated responses to each of the NET melodic questions, how might Larson generated responses compare to this study’s four melodic answers comprised of Krumhansl’s (1979) tonal levels? This researcher speculated these responses would closely approximate Krumhansl’s tonal level one centered on the tonic. With this study’s first-time use of Moulton’s (2010) NOUS software, NOUS analysis of Larson’s computer generated responses may make a fascinating analytical comparison to this study’s participant-response measures of expectedness. This researcher speculated that NOUS may be able to explore expectedness measures within Larson’s gravity, magnetism, and inertia, and may further define measurements of gravity, magnetism, and inertia.

*Margulis’ model of melodic expectancy.* Margulis (2005) proposed a model of schematic melodic expectations (implications) that assigns composite ratings to the listener’s intuitive expectedness of various levels of melodic events across the course of a melody. The ratings depend on the hierarchical existence of four basic factors: stability governed by chord and key contexts (atonal and non-Western contexts may possibly not apply), proximity (pitch spaces), direction, and mobility (natural inclination that a melody will move). Margulis’ model includes hierarchical expectancy formulas for pairs of pitches within existing authentic melodies as well as sequences of pitches within various time-span reduction levels. A weighted average of different levels’ formula ratings insures that expectations (implications with realizations or
denials) from adjacent events play a greater role than distant hierarchical ones in the
determination of overall expectancy ratings.

This study’s measurements of expectedness were derived from adjacent events of
melodic questions and answers using Moulton’s (2010) NOUS analysis. How might NOUS’
expectedness measures compare to Margulis’ (2005) weighted averages across different
hierarchical levels? In what ways could this study’s NCSIs and/or NET test be reconfigured to
explore distant hierarchical events similar to Margulis’ model? Are Margulis’ distant hierarchical
events in any way related to Meyer’s (1973) embellished or implicit schemata and Larson’s
(2004) time span reductions? Perhaps a NET listening test could be developed to explore
measurements of expectedness among adjacent events (as in explicit schemata) and distant
hierarchical ones (as in implicit schemata).

Theory of children’s schemata. Two more recent schemata, known as children’s
schemata (Mitroudot, 2001), identified as particular to children yet perfectly fitting Meyer’s
(1973) theory, were not investigated because of their claimed exclusivity to children, and not
appropriate for this study’s population of adults. Do Narmour’s three arguments about
implication-realization events, (1) universally built on Gestalt principles, (2) free of all cultural
or era contexts, and (3) applicable to all styles of melody, apply to children’s schemata? Possibly
measurements of expectedness may be found within implications (questions) and realizations
(answers) of children’s schemata. Are measurements of expectedness between melodic questions
and answers within children’s schemata in any ways similar or different from this study’s
measurements of expectedness? This entertains an interesting and yet unexplored area
concerning children’s melodic perception. Would participant responses be the same or different
among children and this study’s older university graduate population?
Audiation. Gordon (2003, 2007) refined theories of music perception and the mind’s organizational processes with his theory of audiation. Part of the theory of audiation is defined as the assimilation and comprehension in our minds music that we have just heard performed or have heard performed sometime in the past. It may seem to a melodic perception theorist, that to replay music in one’s mind, one may also re-experience implications and realizations that were present during the initial hearing. On this singular point, in regard to this study, the theory of audiation raises some speculative questions, such as, since melodic implications and realizations seem to involve the memory, which seems by the definition of audiation to embrace both short- and long-term memories, then might these recalled memories have within them measurable elements of expectedness? In reference to different strengths of implications and realizations, proposed by various past melodic perception theories, heard in the initial melodies, would these strengths be also present in the afterward events of audiation? It seems Gordon would say that one’s ability to audiate is, in fact, based on the ability to retain, compare, and predict what should come next; that is, one’s expectation. Possibly audiation could be measured in the NET test by having participants listen to each melody, asking participants to mentally recall or “audiate” each melody for the same length of time it was heard, and then after a length of silence, participants record their responses of expectedness.

Considering a Present Melodic Perception Theory and Recommendations and Considerations for Future Research

Most Recent Melodic Expectedness Theory

Huron’s ITPRA theory. While this present study was in progress, a new theory of expectedness was proposed. Huron’s (2007) theory of expectedness is a psychological account of expectation called the ITPRA theory. Each letter of ITPRA stands for one of five proposed
categories of expectation responses: Imagination, Tension, Prediction, Reaction and Appraisal. These five response systems (ITPRA) were grouped into two periods or epochs: pre-outcome responses (feelings that occur prior to an expected/unexpected event) included the imagination and tension responses; and post-outcome responses included the prediction, reaction, and appraisal responses.

Most notable in Huron’s ITPRA theory are the proposed connections between emotion and expectedness. Thompson (2007) stated, and Aiello (2007) concurred, that Huron’s discussions of the relation between emotion and expectedness have the potential to advance our understanding of music and emotion in at least three ways. First, previously unexamined emotional responses to music, such as humor, frisson and awe, were discussed at length and grounded in plausible psychological and evolutionary explanations. Second, although researchers have identified associations between structural attributes of music and emotional connotations, these associations were often left unexplained. The ITPRA theory has the potential to account for many of these associations through an analysis of the expectancy responses triggered by such features. Third, the distinction between perceived and felt emotion, which has received considerable attention in recent years, was readily explained by the operation of different expectancy responses.

Three ITPRA theory questions. Regarding previously unexamined emotional responses to music, perhaps future research will investigate possible associations between emotions in music (begun by Meyer, 1956) and melodic expectedness. Regarding unexplained associations between structural attributes of music and emotional connotations, possibly researchers will explore measures of expectedness between different musical structures. Regarding the distinction between perceived and felt emotion, if significant association is found between emotion and
expectation in music, what are the relationships among measures of expectedness between perceived and felt emotions in music? With a speculated significant association, it may be possible that relationships among participants’ responses regarding cultural background, age, and music experience were due to differently perceived emotional contents within the music. Perhaps participants were focusing on a feelingful response rather than a purely melodic structural-implicative response.

*Theoretical connections include ITPRA.* With ITPRA’s proposed connections between emotion and expectedness, melodic perceptual theories seem to have made a notable cycle. Meyer’s (1956) *Emotion and Meaning in Music* seems to be the seminal theory of melodic perception, and as discussed previously in chapter one, the basis of this study comprised the older theories of Meyer’s (1973) schemata and Krumhansl’s (1979) tonal hierarchy. This study explored a gap in research by investigating implicative strengths (measures of expectedness) in Meyer’s schemata as melodic questions and Krumhansl’s tonal levels as melodic answers. The Krumhansl (1979), Narmour (1990, 1992), and Lerdahl and Jackendoff (1983a, 1983b; Lerdahl, 2001) theories were seemingly connected when Lerdahl and Jackendoff maintained that pitch spaces are in principle the same as implications-realizations. Larson’s (2004) and Margulis’ (2005) multiple-note melodic realizations (entire completions) as predictable schematic realizations, seemingly connects to question and answer melodic events in the Meyer and Narmour theories. Meyer, Margulis, and Lerdahl and Jackendoff theories collectively consider perceived melodic stability and instability in time-span reductions as actual music dynamically flows from one part to another. Now with Huron’s (2007) ITPRA theory seemingly connecting melodic expectedness and emotion in music, melodic perceptual theories appear to have connected a cycle back to Meyer’s (1956) seminal *Emotion and Meaning in Music.*
This study’s findings connect several of the major melodic perception theories. The Meyer and Krumhansl theories were seemingly connected in that melodic implications (questions) were derived from Meyer’s schemata, and melodic realizations (answers) were comprised of Krumhansl’s tonal levels. The Krumhansl, Narmour, and Lerdahl and Jackendoff theories were seemingly connected once again when this study determined that implication-realization measurements of expectedness showed the same relative pitch spaces as in Krumhansl’s hierarchy of tonal levels. The four tonal level measurements of expectedness in this study simulated the Larson and Margulis theories of multiple-note melodic realizations (entire completions) as predictable schematic realizations. The Meyer, Margulis, and Lerdahl and Jackendoff theories were seemingly collectively connected in this study’s setting of authentic melodies presented in an authentic setting and their expectedness measurements perceived within actual music dynamically flowing from one part to another. No apparent connection was yet made with Huron’s theory as it is unknown at this time if this study’s participants were focusing on feelingful responses rather than melodic implication perceptions.

**Renewed Considerations of Authentic Over Synthetic**

An important element in this study, as previously discussed in chapter two, *Authentic (Dynamic Flow) and Synthetic Contexts*, was the creation and presentation of NCSIs as naturally as possible. Since melodies are usually heard as natural, holistic events in a dynamic flow, some researchers feel, they should be investigated, not in the synthetic (melodic fragments), but in the authentic (entire completions) (Aiello, 1994a; Larson, 2004; Lerdahl, 2001; Lerdahl & Jackendoff, 1983a, 1983b; Margulis, 2005). Huron (2007) again made the case for more melodic perception investigations in an authentic context rather than the more frequently-employed synthetic by citing previously used experimental methods and sub-methods to investigate
melodic perception and characterize a listener’s expectations. Of the 10 general research methods described, seven appeared to be contextually synthetic, while only three appeared to be authentic. Herein is a renewed appeal for authentic expectedness investigations, rather than synthetic.

Curiosity about the synthetic and authentic may prompt a melodic perception researcher to ask if relationships among measures of expectedness between the synthetic (melodic fragments) and the authentic (entire completions) exist. Between the synthetic and authentic, which context may reveal stronger measures of expectedness? Can a strong case be made for naturalness? The findings from this study’s authentic melodies and authentic presentation setting seemed to indicate such.

**Further Cultural Background Explorations**

As noted previously, this study’s 25 participants were a very narrow cross section of the university’s graduate ethnicity population. Represented in the study were White Caucasian, Latino, Korean, Other Asian, Indian Pakistani, and Chinese, and missing were Hispanic/Latino, American Indian/Alaska Native, Black/African American, and Native Hawaiian/Pacific from the university’s graduate population. An interesting observation about this study’s population was that it may appear more to misrepresent than represent United States culture in general, in that four notable cultural categories were missing. In relation to Gestalt principles of universality and the researcher’s hypothesis and had the dataset been from a culturally broader population many times larger than 25, one can only imagine if participants’ responses would have been similar regardless of cultural background, as well as age or musical experience. Allowing the “Note”able Endings Test (NET) URL (www.classroom-music.info/test) to continue on the Internet and be
published among leading Internet research organizations and collecting data longitudinally may provide insight into cultural background responses.

Considering Futuristic Melodic Perception Possibilities

Beyond Melodic Perception Theories

Futuristic Research Possibilities

Various melodic expectedness questions addressing music intelligence, electronic software, and dimensionality may be considered from this study.

Melodic expectedness intelligence test. Moulton (2010) concluded that the “Note”able Endings Test (NET) was not necessarily evaluating listeners and their measurements of expectedness, but rather evaluating the NCSI melodic stems and their four tonal level endings. Then perhaps the NET test of implications and realizations could be recreated into a test of melodic intelligence for more explicitly verifying one’s musical sense of the “correct” ending. The present NET may be said to somewhat approach this perceptual expectedness musical sense in that it explored degrees of adherence to an “expectation hierarchy;” that is, Krumhansl’s (1979) four tonal levels.

Melodic expectedness software. Various questions of a futuristic nature may be asked regarding melodic expectedness. When, sometime in the future, a more complete set of expectedness measures are established among all the various settings of implications and realizations discussed by Meyer (1973) and Narmour (1983, 1989, 1990, 1992), perhaps software could be created to automatically complete a melody? Perhaps software could be created for assessing the implications and realizations (musicality) of existing melodies, and Larson’s (2004) computer-generated and participant-generated responses of gravity, magnetism, and inertia could be the seminal foundation for this type of software.
One-dimensionality versus multi-dimensionality. Philosophically speaking, if melodic expectedness truly is multi-dimensional rather than one-dimensional, then in a sense, no “correct” ending to a melody can be determined. In which case, multiple endings for a given stem that sound “right” indicate that expectedness might be primarily a function of the listener’s individualistic musical tastes and background, rather than an intrinsic property of the ending’s tonal relations to the melodic stem. Is melodic expectedness largely one-dimensional within each narrowly-defined musical domain of genre, while taking into consideration an important body of exceptions to the rule within each genre?

Conclusion

This study began as an exploration into “Note”able endings through the “Note”able Endings Test (NET), investigating tonal hierarchical implication and realization perceptions in newly composed melodic schemata illustrations (NCSIs). The main purpose of this study was to investigate the strength of implication and realization perceptions between Meyer’s (1973) five schemata as melodic questions and Krumhansl’s (1979) four tonal levels as melodic answers. Overall, among the NCSIs and the variables of cultural background, age, and music experience, on average, participants perceived similar pitch space relationships as Krumhansl reported in a hierarchy of four tonal levels within the scale. As the literature review revealed, Meyer’s five schemata have been little explored, and in actuality, only two investigations in the 1980s have been enacted regarding them (Rosner & Meyer, 1982, 1986). With this long-standing absence of melodic schemata investigations, one can only vaguely imagine in what directions research might have progressed had Meyer’s schemata been thoroughly investigated.

This study also explored schematic completeness (entire melodies) in authentic settings rather than synthetically-derived melodic fragments of various lengths (intervals, motives, and
phrases) and individual and paired test tones. Only recently, in melodic perception history, have investigations begun to explore participants’ melodic perceptions in the dynamic hearing of authentic music (Dibben, 1994; Janata, Birk, Tillmann, & Bharucha, 2003; Larson, 2004; Lerdahl, 2001; Lerdahl & Jackendoff, 1983a, 1983b; Margulis, 2005; Toiviainen & Krumhansl, 2003). As these researchers have contended, investigations into melodic perception measurements across melodic events, such as schematic completeness, in real life situations are to be desired over synthetic ones. The outcome of this study’s statistical analysis provided insight into measurements of melodic expectedness between authentic, melodically complete implications (questions) and melodic realizations (answers) in an authentic setting. Statistical analysis revealed that significant expectedness measures among Krumhansl’s four levels in the authentic were very similar to Krumhansl’s original findings derived from a synthetic setting.

This investigation both extended backwards in completing a gap in past research and forwards in broadening recent research. In a backwards manner, from 1970s research, Meyer’s (1973) five melodic schemata in this study have been explored as melodic questions and Krumhansl’s (1979) hierarchy of four tonal levels have been utilized as melodic answers. In a forwards manner, combining these two older investigations enabled exploration of implications and realizations within melodic (schematic) completeness in an authentic setting. Both directions were successful in that this is the first study to explore melodic perception involving all five of Meyer’s schemata and the first study to explore measurements of melodic expectedness between melodic questions and answers utilizing Krumhansl’s four tonal levels.

This investigation seemed to add to the limited existing methods for measuring melodic perception. Previously, Larson’s (2004) two algorithmic models were employed to investigate computer-generated and participant-generated responses of gravity, magnetism, and inertia.
Also, Margulis’ (2005) model included hierarchical expectancy formulas for pairs of pitches within existing authentic melodies as well as sequences of pitches within various time-span reduction levels, with a weighted average of different levels’ formula ratings to insure that expectations (implications with realizations or denials) from adjacent events play a greater role than distant hierarchical ones in the determination of overall expectancy ratings. The use of Moulton’s (2010) NOUS model for melodic perception purposes was a contribution of this study, in that NOUS multi-dimensional model was able to determine measures of expectedness across the melodic event of questions and answers. Further, NOUS was statistically robust to be able to determine not only measures of one-dimensional expectedness across individual melodic events of questions and answers, but also one-dimensional measures of expectedness among datasets of axial, changing-note, complementary, gap-fill, and triadic, among the three variables of cultural background, age, and music experience that would normally require multi-dimensional analysis.

Additionally, the present study shed new light on a different method of collecting melodic perception data than had been used in previous studies. The “Note”able Endings Test (NET) began as a single curiosity while considering hierarchical perceptual data and multi-dimensional analyses. “Can melodic questions and melodic answers be configured to act like multiple choice questions with stems, answer choices, and distracters?” From this curiosity, the NET took a slightly different direction. The NET became an exploration format between melodic questions and answers using Meyer’s (1973) five melodic schemata as melodic questions and Krumhansl’s (1979) hierarchy of tonal levels as melodic answers. With these characteristics combined, the NET may have become somewhat of a test of melodic intelligence for exploring one’s musical sense of the “correct” ending. The NET may be said to approach this perceptual
expectedness musical sense in that it explored degrees of adherence and alignment to an “expectation hierarchy.” Statistical consistency of participants’ responses proved that this format was credible.

But uncertain at this time is whether the investigation explored melodic expectedness interactions in NCSIs between melodic implications (questions) and realizations (answers), or purely personal ending preferences of individuals (Moulton, 2010). The answer to this larger philosophical consideration has yet to be determined.

Also uncertain at this time, in regard to Huron’s theory, is whether the strong, moderate, and weak strengths of correlations among melodic expectedness measures among participants’ cultural backgrounds, ages, and music abilities were due to purely melodic perception responses or due to emotionality of the music and participants’ focus on feelingful responses.

Among the interconnections of the six foremost melodic perception theories, this study seemed to verify some previous connections and suggested new ones. This researcher proposed that this study (1) for the first time connected Meyer’s and Krumhansl’s two theories to create melodic questions (schemata) and melodic answers (tonal levels), (2) for the first time investigated authentic implication-realization strengths across these melodic questions and answers, (3) verified the Krumhansl and Lerdahl and Jackendoff theories that pitch space perceptions are in principle the same as implications-realizations, and (4) verified the connection between Larson’s and Margulis’ multiple-note melodic realizations (entire completions) as predictable schematic realizations. To expand the theoretic cycle of the six perception theories, future investigations may consider Huron’s ITPRA theory by exploring measures of emotional content within melodic expectedness, which is a compelling connection back to Meyer’s (1956) theory and publication of *Emotion and Meaning in Music.*
The notions that melody exists uniquely as a human perception (Davis, 1978), and that a sequence of simple frequencies can evoke such perception is a definitive fascination with this researcher. As a result of melodic perception developments that have emerged in this study and others that may come, may this study stimulate many more explorations into melodic perception, that is so uniquely human (Davies).
REFERENCES


Andrich, D. (personal email communication, October 4, 2010).


Mathieu, J. L. (personal email communication, April 26, 2007).


Moulton, M. H. (personal email communication, October 19, 2010).


APPENDIX A

Appendix A: Internet test instrument

Website Page One: “Introductory Welcome and Informed Consent Form”

"Note"able Endings!

How Should A Melody End?

What are your favorite and least favorite ways you expect melodies to end? Take this 10-minute melodic test of 20 short melodies and find out! At the end of the test, an explanation and results of your responses will be reported to you.

Please read the following Informed Consent Information and click "I Agree" or "I Disagree." If you click "I Disagree" you will be exited from the website. You may exit from this survey at any time simply by exiting the website.

INFORMED CONSENT FORM FOR SOCIAL SCIENCE RESEARCH
The Pennsylvania State University

Title of Project: "Note"able endings: An investigation of tonal hierarchical implication and realization perceptions in newly composed melodic schemata illustrations
1. Purpose of the Study: This study is being conducted for research, and its purpose is to explore preferences for various endings of melodies.

2. Procedures to be followed: Please listen to twenty short melodies. The twenty melodies, presented in random order, are featured with various endings. Please record a rating preference of “Expected Ending 4 3 2 1 Unexpected Ending” for each ending. Please complete a short survey about yourself.

3. Discomforts and Risks: There are no risks in participating in this research beyond those experienced in everyday life.

Website Page Two-A: “Thank You Exit” (If submitted “I Disagree”)

"Note"able Endings!

How Should A Melody End?

Thank you for your time!
Website Page Two-B: “Test Retaker” (If submitted “I Agree” and participant is flagged by the computer programming as a possible test retaker)

"Note"able Endings!

How Should A Melody End?

Have you taken this test before?

If you have reached this page, the computer may be thinking you have taken this test before. Different participants using the same computer may initiate this message.

If you feel you have reached this message in error, please click below to continue the test.

Website Page Two-C: “Practice Melodies” (If submitted “I Agree” and/or participant is a legitimate first-time test taker)

"Note"able Endings Test (NET)

Practice Melodies

"Note"able Endings Test (NET) General Procedure

You will be asked to click on melodies to listen. You will hear the beginning of each melody, a slight pause, and then the ending of the melody, as indicated in the melodic diagrams below.

Endings of the melodies will be various lengths from a single note, to two, three, five, or even as many as seven notes. Listen carefully to both the melody's beginning and ending, and consider the questions:

"Does how a melody starts influence how you think it will end?"
or asked another way, "Does the beginning of a melody create expectations for its ending?"
Please rate each ending from "Expected Ending 4-3-2-1 Unexpected Ending" by clicking the button below your rating. For practice, please click on each Practice Melody. Listen to the beginning, a slight pause, and the ending.

For the Practice Melodies, you may listen as many times as desired. If the ending was something you completely expected, you choose "4." If the ending was completely unexpected, you choose "1." The ratings generally indicate the following:

"4" = Completely Expected  
"3" = Somewhat Expected  
"2" = Somewhat Unexpected  
"1" = Completely Unexpected

Practice Melody 1  
Expected Ending 4 3 2 1  Unexpected Ending

Practice Melody 2  
Expected Ending 4 3 2 1  Unexpected Ending

Continue to the "Noteable Endings Test (NET)"
"Note"able Endings Test (NET)

Melodies 1-10

"Note"able Endings Test (NET) Directions

You will be asked to click on melodies to listen. You will hear the beginning of each melody, a slight pause, and then the ending of the melody.

Endings of the melodies will be various lengths from a single note, to two, three, five, or even as many as seven notes. Listen carefully to both the melody's beginning and ending, and consider the questions:

"Does how a melody starts influence how you think it will end?"

or asked another way,

"Does the beginning of a melody create expectations for its ending?"

Please rate each ending from "Expected Ending 4-3-2-1 Unexpected Ending" by clicking the button below your rating.

* * * Please note, you will be able to listen to each test melody only once before entering a rating. * * *

"4" = Completely Expected
"3" = Somewhat Expected
"2" = Somewhat Unexpected
"1" = Completely Unexpected

<table>
<thead>
<tr>
<th>Melody 1</th>
<th>Expected Ending</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
<th>Unexpected Ending</th>
</tr>
</thead>
<tbody>
<tr>
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<td>Expected Ending</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>Unexpected Ending</td>
</tr>
<tr>
<td>Melody 3</td>
<td>Expected Ending</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>Unexpected Ending</td>
</tr>
<tr>
<td>Melody 4</td>
<td>Expected Ending</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
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<tr>
<td>Melody 5</td>
<td>Expected Ending</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>Unexpected Ending</td>
</tr>
<tr>
<td>Melody 6</td>
<td>Expected Ending</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>Unexpected Ending</td>
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</table>
Website Page Three: “NET Test Melodies 1-10” continued

<table>
<thead>
<tr>
<th>Melody 7</th>
<th>Expected Ending</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
<th>Unexpected Ending</th>
</tr>
</thead>
<tbody>
<tr>
<td>Melody 8</td>
<td>Expected Ending</td>
<td>4</td>
<td>3</td>
<td>2</td>
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<tr>
<td>Melody 9</td>
<td>Expected Ending</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>Unexpected Ending</td>
</tr>
<tr>
<td>Melody 10</td>
<td>Expected Ending</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>Unexpected Ending</td>
</tr>
</tbody>
</table>

If you click the Continue button and you are not forwarded to Melodies 11-20, then please go back and fill in any listening responses you are missing.

Website Page Four: “NET Test Melodies 11-20”

"Note"able Endings Test (NET)

Melodies 11–20

"Note"able Endings Test (NET) Directions

Please complete the test with melodies 11-20. Again, the instructions are the same as before. Click on each melody to listen. Listen to the beginning of each melody, a slight pause, and then the ending.

Endings of the melodies will be various lengths from a single note, to two, three, five, or even as many as seven notes. Listen carefully to both the beginning and the ending, and consider the questions:

"Does how a melody starts influence how you think it will end?"

or asked another way,

"Does the beginning of a melody create expectations for its ending?"

Please rate each ending from "Expected Ending 4-3-2-1 Unexpected Ending" by clicking the button below your rating.
* * * Please note, you will be able to listen to each test melody only *once* before entering a *rating*. * * *

"4" = Completely Expected  
"3" = Somewhat Expected  
"2" = Somewhat Unexpected  
"1" = Completely Unexpected

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<thead>
<tr>
<th>Melody</th>
<th>Expected Ending</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
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</tbody>
</table>

If you click the Continue button and you are not forwarded to the Questionnaire, then please go back and fill in any listening responses you are missing.
"Note"able Endings Test (NET)

Questionnaire

Please complete the following 4 questions:

1. Have you ever previously filled out this particular test on this site?
   - No, this is my first time.
   - Yes, I’ve taken this particular test before.

2. What is your age? (in years) [ ]

3. What is your primary cultural or racial identification? (click for choices)
   - [ ]

4. How do you rate your own music ability?
   - Musician with much training
   - Musician with little or no training
   - Non-musician

There are no foreseeable risks to you from participating in this research. By clicking “Submit” you acknowledge that your answers will be recorded. Your participation in this research is completely voluntary, and all responses to this survey will be kept confidential. You may refuse to answer any of the questions, and you may withdraw your consent and discontinue participation in this study by leaving the site. The Informed Consent Form states more information about how data is collected and contains contact information should you have questions.

Click to Submit and Receive Your Results
Website Page Five: “Drop-Down Menu for Questionnaire Question Three”

-Please select an option-
Black
Chicano
Chinese
Filipino
Indian/Pakistani
Japanese
Korean
Other Asian
Latino
Native American
Pacific Islander
Puerto Rican
White/Caucasian
Other
"Note"able Endings Test (NET)

Your Results

Congratulations you have completed the "Note"able Endings Test (NET).

The "Note"able Endings Test (NET) is comprised of five different types of melody, each with four different endings. The five types of melodies are: (1) gap-fill, (2) triadic, (3) complementary, (4) axial, and (5) changing-note.

1. **Gap-fill melody** begins with notes that make a large leap upward and then come back down with steps to fill in the leap.

2. **Triadic melody** is a series of notes that are mostly in intervals of thirds or fourths from each other, somewhat like playing up and down a chord.

3. **Complementary** is a melody in which the second half is mostly a mirror-image inversion of the first half.

4. **Axial melody** has two halves that are mirror-image inversions like complementary, but the beginnings and endings of both halves must be the same note (the root).

5. **Changing note** is a melody in which notes change on strongest beat and harmony points, while the first and last notes of the melody must be the same.

The four different endings are from notes in major or minor scales ("do-re-mi-fa-so-la-ti-do"). This researcher's hypothesis is that listeners will expect melodies to end in the following preference order:

1. **First ending** uses the first or eighth note in the scale (known as the tonic center, beginning and ending "do"). This single-note ending usually sounds completely finished and completely expected (rating of 4).

2. **Second ending** uses the third and fifth degrees of the scale ("re-sol" which are closely related to "do"). This ending usually sounds somewhat finished but leaves the listener "a little up in the air," somewhat expected (rating of 3).

3. **Third ending** uses the second, fourth, sixth, and seventh notes of the scale ("fa-la-la-la"). These notes sound distinctly related to "do" and the beginning of the melody, somewhat unexpected (rating of 2).
(4) Fourth ending uses the five sharped notes in between the eight notes of the major or minor scale (raised first, raised second, raised fourth, raised fifth, and raised sixth, which are "di-ni-fi- fi-6"). This ending usually sounds totally unrelated to the beginning of the melody, completely unexpected (rating of 1).

Based on the preference ratings of
4 = completely expected,
3 = somewhat expected,
2 = somewhat unexpected,
1 = completely unexpected,

Your responses for melodic endings indicated:

(1) You rated the endings for Gap-fill melodies as no preference.

(2) You rated the endings for Triadic melodies as somewhat unexpected.

(3) You rated the endings for Complementary melodies as somewhat expected.

(4) You rated the endings for Axial melodies as completely unexpected.

(5) You rated the endings for Changing-note melodies as completely expected.

No preference indicates that your expectations for that melody type are perfectly aligned with the researcher's hypothesis.

Click Here To Print Your Results

Thank you, your participation is very much appreciated. If you have questions, please contact David Knauss at dek140@psu.edu.
Appendix B: Informed consent form

INFORMED CONSENT FORM FOR SOCIAL SCIENCE RESEARCH
The Pennsylvania State University

Title of Project: “Note”able endings: An investigation of tonal hierarchical implication and realization perceptions in newly composed melodic schemata illustrations

Principal researcher: David E. Knauss, 1368 Tears Road, Columbia Cross Roads, PA 19614, 570-404-0055, dek140@psu.edu

Faculty Advisor: Dr. Joanne Rutkowski, 206 Music Bldg #1, University Park, PA 16802, 814-863-0419, rvi@psu.edu

Dissertation Chair: Dr. Linda Thornton, 208 Music Bldg #1, University Park, PA 16802, 814-863-5723, lct12@psu.edu

1. Purpose of the Study: This study is being conducted for research, and its purpose is to explore preferences for various endings of melodies.

2. Procedures to be Followed: Please listen to twenty short, one-line melodies. The twenty melodies, presented in random order, are featured with various endings. Please record a rating of “Expected Ending 4 3 2 1 Unexpected Ending” for each ending. Please complete a short survey about yourself.

3. Discomforts and Risks: There are no risks in participating in this research beyond those experienced in everyday life.

4. Benefits: Individually, you may gain insight into what basic types of melodies and their endings you prefer. This information may help you make informed music listening choices for your personal enjoyment. Societally, musicians may purposefully create melodies with various melodic structures.

5. Duration: The listening test should not take longer than 10 minutes maximum, after which are a few brief questions to answer.

6. Statement of Confidentiality: Each test report will have an online ID# and the date submitted. In the research report, no individual responses will be reported nor any person identified. Computer IP addresses will be recorded solely for the purpose of tracking repeat test takers. No personal identifying information can be ascertained from a computer’s IP address. IP addresses will be deleted once data collection is complete. Your confidentiality will be kept to the degree permitted by the technology used. No guarantees can be made regarding the interception of data sent via the Internet by any third parties. Penn State’s Office for Research Protections, the Social Science Institutional Review Board, and the Office for Human Research Protections in the Department of Health and Human Services may review records related to this research.

7. Right to Ask Questions: You may ask questions about the research. The person in charge will answer your questions. Contact David Knauss at 570-404-0055. If you have questions about your rights as a research participant, contact Penn State’s Office for Research Protections at 814-865-1775. You can also call this number if you feel this study has harmed you.

8. Compensation: None

9. Voluntary Participation: You do not have to participate in this research. You may refuse to answer the questions and end your participation at any time by exiting the online website. You do not have to answer any questions you do not want to answer. Refusing to participate or withdrawing early from the research will involve no penalty or loss of benefits you would be entitled to otherwise.
If you consent to participate in this research study and to the terms above, please click the “I Agree” button. There are no foreseeable risks to you from participating in this research. By clicking “I Agree” you acknowledge that your answers will be recorded. Your participation in this research is completely voluntary, and all responses to this survey are confidential and will be kept confidential. You may decline consent by clicking “I Disagree.” You may refuse to answer any of the questions, or discontinue participation in this study at any time by exiting the website.

Please print this form to keep for your records.

Investigator e-Signature: David E. Knauss
Appendix C: “Note”able Endings Test or NET items

Two melodies were selected as Practice Melodies One and Two for the participant’s practice before entering the “Note”able Endings Test (NET).

1. Practice Melody 1: Triadic (slightly embellished) (after Handel’s “Hallelujah Chorus” from The Messiah) (Meyer, 1973, p. 165) (Tonal hierarchy 1)

2. Practice Melody 2: Gap-fill triadic (slightly embellished) (after Bach’s F Major Two-Part Invention) (Tonal hierarchy 4)

Twenty melodies, comprising the “Note”able Endings Test (NET), were randomly chosen from among 20 primary NSCIs and 60 altered NSCIs. These primary and altered NCSIs
comprise an equal representation of Meyer’s (1973) five melodic schemata and Krumhansl’s (1979) four tonal levels. The following list is a non-randomized schematic order:

---

**Gap-fill**


2. Gap-fill triadic (slightly embellished) (after Mozart’s “Minuetto” from Flute Quartet in A Major, K. 298) (p. 103) (Tonal hierarchy 4)
3. Gap-fill triadic (slightly embellished) (after Bach’s D Minor Fugue from Book II, Well-Tempered Clavier) (p. 149) (Tonal hierarchy 1)

4. Gap-fill nontraidic (slightly embellished) (after Schubert’s “Das Wandern” from Die schöne Müllerin) (pp. 153-4) (Tonal hierarchy 2)

Triadic

2. Triadic linked (slightly embellished) (after Beethoven’s Piano Sonata in F Minor, Opus 2, No. 1) (Tonal hierarchy 3)

3. Triadic linked (slightly embellished) (after Haydn’s Symphony No. 97, Movement II, Adagio (p. 164) (Tonal hierarchy 2)

4. Triadic linked (slightly embellished) (after Mozart’s “Tuba Mirum,” No. 3, from the Requiem, K. 626) (Tonal hierarchy 4)
Complementary


2. Complementary convergent (slightly embellished) (after Haydn’s String Quartet in B♭ Major, Opus 55, No. 3 (p. 182) (Tonal hierarchy 1)

3. Complementary convergent (slightly embellished) (after Mozart’s “Linz” Symphony, Movement I, K. 425) (p. 177) (Tonal hierarchy 4)
4. Complementary convergent (slightly embellished) (after Mozart’s “Menuetto” of the String Quartet in A Major, K. 464) (p. 96) (Tonal hierarchy 3)

Axial

1. Axial (unadorned) (axial note is E) (after Dvorak’s “New World” Symphony) (Meyer, 1973, p. 185) (Tonal hierarchy 4)

2. Axial (slightly embellished) (axial note is E) (Tonal hierarchy 2)
3. Axial (slightly embellished) (axial note is F) (Tonal hierarchy 3)

4. Axial (slightly embellished) (axial note is F) (Tonal hierarchy 1)

Changing-note

2. Changing-note (slightly embellished) (centered on the third degree of the scale G)

(Tonal hierarchy 3)

3. Changing-note (slightly embellished) (centered on the third degree of the scale A)

(Tonal hierarchy 1)

4. Changing-note (slightly embellished) (centered on the tonic note B) (Tonal hierarchy 4)
Appendix D: Melodic schemata survey instrument

Twenty single-phrase melodies are proposed to be used in a research project. Please evaluate the melodies for compliancy with Meyer’s (1973) schematic definitions. Meyer’s five schematic definitions are taken from his 1973 book: Explaining music: Essays and explorations. Chicago, IL: The University of Chicago Press, pp. 145-196.

Please read Meyer’s definition of each melodic schema followed by melodic renderings of that definition. Are the melodic renderings compliant with the schema definition? (Each schema is presented first as straightforward and unadorned, following by three others that are slightly embellished.)

1. Gap-fill schema consists of two characteristics: disjunct intervals in a certain direction, which comprise the gap, and a series of conjunct intervals in an opposite direction, which fill in the gap.

Figure 1: Gap-fill melody #1 (unadorned)

Please rate by circling a number.

Compliant  4  3  2  1  Non-compliant

Figure 2: Gap-fill melody #2 (slightly embellished)

Compliant  4  3  2  1  Non-compliant
2. **Triadic schema** consists of disjunct intervals such as thirds, fourths, or fifths as these are syntactically understood as parts of normative patterning, namely triads.
3. **Complimentary schema** is one in which two successive melodic events are similar inversions of each other.
4. **Axial schema** consists of a main or axis-tone balanced by upper and lower neighboring tones. An axis melody exhibits two parts similar to a complementary melody with one part being a similar inversion of the other, also described as a model and its mirror. Both the model and its mirror move from the axis tone to neighboring tones and back.
Figure 14: Axial melody #2 (axial note is the tonic note E)

![Axial melody #2](image)

Compliant 4 3 2 1 Non-compliant

Figure 15: Axial melody #3 (axial note is the tonic note F)

![Axial melody #3](image)

Compliant 4 3 2 1 Non-compliant

Figure 16: Axial melody #4 (axial note is the tonic F)

![Axial melody #4](image)

Compliant 4 3 2 1 Non-compliant

5. **Changing-note schema** begins and ends on the same pitch similar to an axial melody, but the upper and lower neighboring tones are relatively high-level, harmonic and metric structural tones located on strong beats. The changing-note pattern typically is found around the tonic and may also sometimes begin on the third degree of the scale.
Figure 17: *Changing-note melody #1 (unadorned and on the first degree of the scale)*

![Music notation for Changing-note melody #1.](image)

Please rate by circling a number.

- Compliant: 4 3 2 1
- Non-compliant

Figure 18: *Changing melody #2 (slightly embellished and on the third degree of the scale)*

![Music notation for Changing melody #2.](image)

- Compliant: 4 3 2 1
- Non-compliant

Figure 19: *Changing melody #3 (slightly embellished and on the third degree of the scale)*

![Music notation for Changing melody #3.](image)

- Compliant: 4 3 2 1
- Non-compliant

Figure 20: *Changing melody #4 (slightly embellished and on the first degree of the scale)*

![Music notation for Changing melody #4.](image)

- Compliant: 4 3 2 1
- Non-compliant
APPENDIX E

Appendix E: Invitational email to The Pennsylvania State University programs’, colleges’, schools’, and departments’ deans, heads, and chairs

RE: Dissemination of “Note”able Endings Test (NET)

I am David E. Knauss, a Ph.D. Candidate in Music Education, and am conducting this study for research, under the auspices of the School of Music, College of Arts and Architecture, The Pennsylvania State University. With your approval, please disseminate this message and the following invitation and URL to all graduate students, ages 18 and older, in your department for an online melodic preference test.

If you have any questions, please feel free to contact me, David E. Knauss, at dek140@psu.edu or my cell phone 570-404-0055.

Thank you for your consideration, David Knauss

“How Should a Melody End?“

What are your favorite and least favorite ways you expect melodies to end? Take this 10-minute melodic test of 20 short melodies and find out! At the end of the test, an explanation and results of your responses will be reported to you.

Please visit the following URL for the melodic preference test:

http://classroom-music.info/test
DAVID E. KNAUSS VITAE

Home: 1368 Tears Road  
Columbia Cross Roads, PA 16914  
H: 570-549-2514  
music@classroom-music.info  
www.classroom-music.info

“In a lifelong search for my students’ learning limits, I only ever found my teaching limits!”

PROFESSIONAL PREPARATION

<table>
<thead>
<tr>
<th>Year</th>
<th>Degree</th>
<th>Institution</th>
<th>Location</th>
<th>Notes</th>
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<tr>
<td>2011</td>
<td>Doctor of Philosophy</td>
<td>The Pennsylvania State University, University Park, PA 16802</td>
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<tr>
<td>1981</td>
<td>Master of Education in Music (summa cum laude)</td>
<td>Mansfield University, Mansfield, PA 19633</td>
<td></td>
<td>Research Paper: William Clifford Heilman; Academic Advisor: Dr. William M. Goode</td>
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<tr>
<td>1973</td>
<td>Bachelor of Science in Music Education</td>
<td>West Chester University, West Chester, PA 19380</td>
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<td>Major Instrument: Piano</td>
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PROFESSIONAL EXPERIENCE

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<th>Year</th>
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<tr>
<td>2006-11</td>
<td>Baptist Bible College, Clarks Summit, PA</td>
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<tr>
<td>2003-06</td>
<td>Graduate Assistantships, Internships, and Instructor, The Pennsylvania State University, University Park, PA</td>
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<tr>
<td>2001-03</td>
<td>Williamson Jr./Sr. High School and R.B. Walter Elementary, Tioga, PA</td>
<td>Liberty Jr./Sr. High School and Liberty Elementary, Liberty, PA</td>
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<tr>
<td>1999-01</td>
<td>Interim Music Education Instructor, Mansfield University, Mansfield, PA</td>
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<tr>
<td>1973-99</td>
<td>Williamsport Area School District, Williamsport, PA</td>
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SELF-PUBLISHED BOOKS


SCHOLARLY PRESENTATIONS

Knauss, D. The reported influence of multiple variables on memorableness of a musical selection.  
(April, 2005). Poster session at the Pennsylvania Music Educators Association (PMEA) State Conference, Hershey, PA  
(March, 2005). Poster Option of the Twentieth Annual Graduate Exhibition, HUB Alumni Hall, The Pennsylvania State University: University Park, PA  
(March, 2005). Poster session at the National Association for Music Education (MENC)