THE OBJECTIVE IDENTIFICATION OF A HIERARCHY OF DIFFICULTY OF RHYTHM PATTERNS IN THE CONTEXT OF HIGH SCHOOL BAND STUDENTS

by

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(Under the Direction of Brian C. Wesolowski)

ABSTRACT

The overreaching purpose of this study was to explore and establish a hierarchy of difficulty in the performance of rhythm patterns in the context of high school band students. The study was guided by the research questions: (a) Can a hierarchy of difficulty be objectively identified; (b) How should the items be analyzed to best achieve accuracy of scoring; (c) Does the instrument one plays (primarily) have an impact on the level of the student performance of rhythm patterns; and (d) Do students generally have different achievement levels of reading rhythm patterns based upon years of study in band? A total of 146 band students participated in this study from as many as eight suburban eastern Georgia high schools. Implications for teaching and learning, curriculum development, and understanding of cognitive processing may allow for teachers in the field to more effectively sequence the instruction of rhythm pattern reading according to best practices of instruction of simple to complex and known the unknown based on this and other research and may be a step toward more objective and reliable assessments and evaluations.

INDEX WORDS: Rhythm; difficulty; curriculum development; Rasch measurement; lesson sequencing

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A Dissertation Submitted to the Graduate Faculty of The University of Georgia in Partial Fulfillment of the Requirements for the Degree

DOCTOR OF EDUCATION

ATHENS, GEORGIA

2017

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August 2017

DEDICATION

I dedicate this study and my studies to my bride Amy Toney, who has not only been my wife, confident, friend, and partner, but also my colleague as a music educator. Special recognition also goes to our parents who gave up their homes to bring our families closer together and our sons Simon and Nolan for their inspiration. My maternal grandparents and great aunt instilled a love of learning and a quest for knowledge. I found a calling through their example as pioneers and teachers.

ACKNOWLEDGEMENTS

Throughout my time as a post-secondary scholar, I have had many wonderful professors and mentors. Dr. Edwin P. Arnold taught me "adminstrivia", prioritization, and the value of good people around you. Dr. Mary Lemons taught me a larger view of music education, one well beyond performance and stature. Dr. Mary Leglar challenged my thinking and unlocked aspects of philosophy never considered before. Dr. Brian Wesolowski helped shape my vision and inspired though his tremendous accomplishments. Dr. Stephen Valdez rekindled a love of history—not just music history—and helped connect many dots. Dr. Michael Robinson inspired from afar with his tremendous work with the Redcoats and the UGA Bands. The cooperation and support of my school administrators, band director friends, and colleagues helped me through times where the impossible had to happen.

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INTRODUCTION

Explanation of the Problem

Many band directors have experienced frustration over pieces of music which, to the eye, do not seem to pose a significant challenge, but in practice prove to be quite difficult for their students. One example may be in a traditional horn in F part of a concert march. Students and directors might acknowledge that the often-used playing on the upbeat is not technically complex, yet in performance proves to be a trial to play accurately. Difficulty level is not specifically understood nor is it always related to complexity. In fact, the identification or definition of what difficulty is may be uncertain. For the purposes of this study, difficulty was defined as: the intrinsic, cognitive load of a task and its symbolic and informational complexity which involves length, speed, familiarity, information density, and symbolic organization (Mohamadi, 2013).

Rhythmic notation is just a symbolic system representing time (Johnson, 2003, p. 30). In rhythmic performance, the accurate playing of music notation is related to duration in time (Upitis, 1987, p. 41). While this may be the case, rhythm is generally not performed with mathematical precision (Grieshaber, 1993, p. 129). In music performance analysis, rhythm may be seen on the microstructural level with some allowance for the nuances of musical style and expression; however, the evaluation of rhythms from a difficulty level is deficient, especially from a pedagogical/task-orientation point of view (Gordon, 1974, p. 41). At times, estimating task or item difficulty is not successful. Many players, teachers, and/or experts seem to think they know what is hard or not (Impara & Plake, 1998). Generally, the process of attaching a difficulty level to musical performance pieces has been done by an informed, but subjective, assessment of teachers or judges. For instance, many state music literature lists were created by a committee who evaluated compositions and made determinations based upon their informed opinions (American Band College, 2014; Beecher, 2006; Berger, Jacobs, Philbrick, & Murphy, 2010; Grieshaber, 1993; Impara & Plake, 1998; Maryland Music Educators Association & Maryland Band Directors Association, 2014; McPherson & Thompson, 1998; National Coalition for Core Arts Standards, 2015; New Hampshire Department of Education, 2001; Norona, 2008; Rasmussen, 1962; Saville, 1991; Sebastien, Ralambondrainy, Sebastien, & Conruyt, 2012; Secolsky, 1987).

By nature, the subjectivity of opinions stands in the way of a true measurement of difficulty, which may or may not agree with an actual level of difficulty of repertoire. Some aptitude tests have indicated levels of difficulty of items, but without a justification or specific study for determination of those levels in rhythm patterns. While there have been previous studies done researching the difficulty level of rhythmic patterns, no research found has been related specifically to ascertain whether there is a hierarchy of difficulty in the performance of rhythmic patterns for the high school level instrumentalist (Beecher, 2006; Danahy, 2013; Gardner, 1971; Gordon, 1971, 1974, 1979; Grieshaber, 1993; Harding, 2010; Norona, 2008; Spohn, 1977; Wolf, 2004). Some of the difficulties noted in different studies may stem from a lack of a consistent definition of what a rhythm pattern is. For the purposes of this study—and for the construction of the assessments for this study—rhythm patterns were defined as: duration(s) of sound in a given meter that are sequential and exist as a result of the interaction among notes and rests; generally including at least two notes or rests and comprising up to six notes or rests (Gordon, 1971, 1997).

Whereas the estimation of the difficulty of items or pieces is generally a subjective process, judging the level of a student or group is also usually subjective in musical performance. Once again, the criteria for judging a performance are often based on subjective criteria, by the setting, and/or context of a performance (i.e. football game vs. a band competition). With subjective criteria, evaluators or adjudicators are left to their informed opinions rather than objective criteria. Subjective judging is very difficult to justify.

The element of rhythm is unquestionably vital to music. Its very definition dictates the movement in time of notes or sound. Beyond that, “Rhythm gives music a sense of organization and must be methodically taught” (Palkki, 2010, p. 101). This supposes that the constructivist ideas of making connections from previous knowledge and the practice of learning through a spiral curriculum as recorded by Jerome Bruner at the 1959 Woods Hole Conference are indeed correct. In this, one idea may relate and/or build on the idea of another more effectively than without a frame of reference. Over the years and for various reasons, it has been observed by some that music students are leaving the public schools with less and less rhythm reading ability (Hoffman, Pelto, & White, 1996). This study, which identifies a hierarchy of performance difficulty of rhythmic patterns for the general high school level band students, may help instructors of high school bands be better prepared to teach and inform instruction for a deeper knowledge and higher level of success.

Researchers and educational figures have discussed difficulty “…in a variety of pedagogic designs and learning constructs such as zone of proximal development, metacognition, problem solving, and constructivism” (McEnaney, 2006, p. 9). Understanding difficulty as it relates to motivation and the success of students and in determining achievement levels of students cannot be overlooked. Many educational thinkers, including Gagné, Pestalozzi, Bruner, Dewey, Gardner, and beyond, indicate the importance of difficulty in determining the sequencing of material. Sequencing is vital to the structuring of lessons and the learning process of students. Up to this point, music educators have not had an objective identifier of what is or is not difficult in terms of the performance of rhythm patterns. This study sought to identify a hierarchy of difficulty of rhythm patterns through the statistical evaluation of data using the Multifaceted Rasch (MFR) model, which is in the Item Response Theory category of statistical measurement.

The resulting researched based list of rhythmic patterns identified by difficulty level may be used for a much larger process of creating something for musicians similar in fashion to what English literature has in the Lexile framework—a research-based framework for the identification of leveling of literature and the corresponding reading level of an individual. The knowledge of a level of difficulty could greatly influence music education in much the same way that that the Lexile framework has influenced the teaching of reading and the English language. This is all the more likely as it is understood that the reading of rhythm is done in much the same way as the reading of words—through the identification and stimuli of groups or patterns.

Assessment of Rhythm and Interpretation in the Field

There have been a number of rhythm studies done in the past and a number of different methods or ideas on how to score and interpret the data of those studies. Several studies (Bergee & Antonetti, 2012; Colley, 1987; Farley, 2014) were scored dichotomously by measure as correct or incorrect. Two studies (C. Drake, 1993; Mclaughlin & Boals, 2010) were scored according to the percentage of notes played correctly in rhythm within a given margin of error.

Griesharber (1993) developed software to identify the accuracy of the performance of rhythm. Rhythm tests by Gardner (1971) and Wolf (2004) were not done to determine rhythm reading ability but only to determine the ability to duplicate a rhythm pattern. Harding's (2010) study was done with a section on the duplication of rhythm patterns and a section on an improvisational aspect based on a given rhythm. Gordon's (1971, 1974, 1976, 1979) studies were based on the identification of same, different, or in some cases, do not know statements or answers by the subjects.

With the different ways of scoring, assessing, and design, each of the different tests or studies that have been put forth have aspects within them that, in the opinion of this researcher, could be improved upon to yield clearer or more complete results. In addition, only the Bergee and Antonetti (2012) study had similar subject samples as the present study—ninth graders were used as well as third and fourth-year college students to make up different subject populations. While the Bergee and Antonetti (2012) and the Farley (2014) studies were similar in many ways to the present study, both scored items based upon large groups of rhythmic patterns rather than individual ones. In addition, both of these studies suspended their tests after students were lost in the music or performed items poorly. This did not allow for the possibility of the sequence of all rhythm patterns to be done in some cases. As a result, some rhythm patterns later in the test were scored as incorrect. This scoring may not have been accurate as some subjects may never have even attempted some items due to the assessments being halted before they got to them. Instead, any time a rhythmic pattern was not attempted it was scored as incorrect.

Role of the Researcher

The researcher in this study created three tests (Appendices A, B, and C) based upon previous research to assess the performance of rhythm patterns of high school band students. All previous research found on this topic was informative and useful, but still lacking in some manner is addressing the goals of this study. Therefore, the researcher took the result of the assessments and assembled a comprehensive, objective, statistically-based conclusion leading to a clear hierarchy of the difficulty of the performance of individual rhythm patterns for high school band students. The MFR model, in the Item Response Theory approach of test construction, was used for this task. It is understood that the context and tempo of rhythm patterns as they are used in repertoire could or would likely impact the performance difficulty of rhythm patterns and all music in general (Fraisse, 1982; Mclaughlin & Boals, 2010; Repp & Su, 2013; Repp, Windsor, & Desain, 2002; Sink, 1983; Spohn, 1977; Wolf, 2004).

Research Problem

This study sought to address a lack of literature in the field and specifically to objectively identify a hierarchy of difficulty in performing rhythm patterns for high school level band students. The methodology of this study was designed to meet that aim. It is acknowledged that studies by both Bergee and Antonetti (2012) and Farley (2014) used similar aspects in scoring the items and subjects in their research, though each had significant differences that allowed for the current study to address areas beyond or differently than those two studies. The differences from this study included addressing (a) each grade level of high school students—ninth, tenth, eleventh, and twelfth grade students, other studies do not include all of these grade levels as part of their subjects; (b) each rhythm pattern was scored independently of the others, rather than within a multi-measure grouping as in the other studies; and (c) the scoring of all rhythm patterns of this study—different from the other two studies as the tests in this study were not stopped once the students were off track or ended their participation.

The overreaching purpose of this study was to objectively identify a hierarchy of performance difficulty of rhythm patterns in the context of high school band students. Once data was scored dichotomously from the testing of the subjects, application of the MFR model was used to transform observed scores to logit measures (Rasch, 1960). These results show both the difficulty of the items, which are rhythm patterns, the level of the subjects, and the level of the category of what instrument each subject primarily played. Each was analyzed independently of each other. This allowed for the objective identification of a hierarchy of performance difficulty of rhythm patterns in the context of high school grade level band students.

This study was guided by the following research questions:

1. Can a hierarchy of difficulty be objectively identified?
2. How should the items be analyzed to best achieve accuracy of scoring?
3. Does the instrument one plays (primarily) have an impact on the level of the student performance of rhythm patterns?
4. Do students generally have different levels of rhythm reading skill based upon years of study in band?

CHAPTER 2

REVIEW OF RELATED LITERATURE

Introduction

The following review of related literature was undertaken with the goal of assimilating much of the literature on the idea of difficulty in the realm of education and in music. Some sources outside of education, music, and both music and education were also consulted. While many materials were identified through various database searches, much more was acquired by consulting the references in the works that were found. It became clear that Gordon is one of the most published and/or influential in the field of music assessment in rhythmic patterns. The works of Gordon (1971, 1974, 1976, 1979, 1997) and some of his students largely guided this research. The search for related literature included a variety of topics, including rhythm pattern reading, performance, and those that relate to the aspects of difficulty within rhythm pattern reading and performance.

The Importance of Rhythm

The research of music and specifically rhythm reading among neurologists and cognitive psychologists, both in task exploration and in actual music making, have shown many links and insight into what happens when humans make music. Results show how the brain is engaged or utilized and indicate the relatability of music to other disciplines and tasks or activities. This was elaborated on by Thaut (2005) as “Research suggests that music can uniquely engage the brain as a language of time, providing temporal structure to enhance learning and perception, especially in the fields of cognition, language, and motor learning” (p. 83). “Anatomical centers for reading musical notation and reading written language are in close proximity in temporal-occipital regions, but clearly separated, with notation reading mediated by specific activations in the angular gyrus region" (p. 72). Statements such as these support the growing evidence that "…language skills rely on rhythmic abilities that are not domain-specific and can therefore be assessed using non-linguistic stimuli" (Tierney & Kraus, 2015, p. 2).

Rhythm is extra-musical, reaching poetry, general speech, architectural, athletic, biological, and geographical aspects. Rhythm is found in nature itself. This diversity reinforces the importance of rhythm (Gabrielsson, 1993, p. 94). Thaut (2005) identified:

> Music unfolds only in time, and the physical basis of music is based on the time patterns of physical vibrations transduced in our hearing apparatus into electrochemical information that passes through the neutral relays of the auditory system to reach the brain. Within this temporal basis, two core dimensions emerge: sequentially and simultaneously. Music's particular nature permits it to express these at once. This is a unique feature among art forms and communication systems. Language is sequential but monophonic. Visual art has analogies of time dimensions expressed in its works within the physical essence of the special dimension, all of the observer and the creator in the visual arts experience to work in time. (p. 3)

Specifically to music, "Rhythm guides the ear and brain to make sense of critical patterns and shapes by directing focus on important moments in the unfolding of the music" (Thaut, 2005, p. 6). Gaberielsson (1993) elaborates that:

> Music takes place in time, and the temporal organization of the sound events achieved through rhythm simply *must* be a fundamental importance. In fact, there is no melody

> without rhythm; melody thus presupposes rhythm. But rhythm does not presuppose melody; you can clap a rhythm without any trace of melodic content. (pp. 93–94)

Thaut (2005) nicely surmises that "…in music the human brain creates and experiences a unique, highly complex, time-ordered, and integrated process of perception and action based on sensory events, as well as complex perceptual, cognitive, and affective operations" (p. 39).

Rhythm Within Music

Rhythm is not just an aspect of music. It is, in fact, vital to music: "Rhythm is music's central organizing structure. It orders the movement of musical patterns in time… Whereas rhythm can exist without melody or harmony, melody and harmony cannot exist without rhythm" (Thaut, Trimarchi, & Parsons, 2014, p. 429). This statement is supported by Sink (1983) as "Rhythm in music is the organization of sound and silence across time, and is an essential component of all music" (p. 102). Stetson (1923) goes further and explains that "Rhythm is so fundamental that it is perhaps the one element of a musical period that exists by itself when the other elements are eliminated" (p. 181). Gordon (1997) gives perspective on the depth of rhythm:

> Rhythm comes from the Greek word *rhythmos*. It means flow, as water in a river. In Latin, *mov* means movement and *mot* means motion. The Latin infinitive *movere* means to move. Rhythm, and possibly (e)motion, were associated with movement in the minds of early thinkers, and it is this flow and coordination of movement in audiation that seems to be the basis of rhythm aptitude. (p. 162)

Bowers (2007) would agree with the importance and depth of rhythm and how it relates to overall performance as a high level of skill in the performance of rhythm may, to a degree, compensate to an audience or listener when components of other musical elements are lacking (pp. 531-532).

The Importance and Teaching of Rhythm

Overall, music is made up of the combination of and the interplay between and within the elements of music. This may be intuitive but is also supported by research. Experts concur that "Behavioral studies demonstrate that rhythm and pitch can be perceived separately, but that they also interact in creating a musical percept" (Zatorre, Chen, & Penhune, 2007, p. 549). Stetson (1923) indicated that the uniqueness and importance of the element of rhythm could lead to the possibility and/or need to teach rhythm reading independently from the other elements in certain settings (p. 181).

When a musician performs while reading music they process multiple layers of visual information which occur simultaneously, but "research in cognitive psychology and attention has demonstrated perceptual independence and distinct processing between melodic and rhythmic information" (Farley, 2014, p. 2).This is often not the case in music instruction, as other authors explain, "While the rhythm and tonal vocabulary are typically limited, the novice's eye is flooded with information…" (Ester, Scheib, & Inks, 2006, p. 60). Furthermore, tempo often fluctuates in the initial stages of music learning, especially on an instrument (Duke, 1994, p. 33). To make matters even more difficult for young learners, "Rhythmic and melodic alternations often simultaneously occur" (Sink, 1983, p. 102).

It is also understood that playing in an ensemble is more complex than just melodic change. "Harmony is too dependent on rhythm for similar reasons. Whether there are chords or chord combinations resulting from different voices in polyphonic music, they perceived the change according to the rhythm organization, a process sometimes called 'harmonic rhythm'" (Gabrielsson, 1993, p. 94). All of these ways that music is constructed and experienced underline the complexity of music performance and the importance of a well thought-out and grounded practice of rhythm reading instruction.

Teaching rhythm to the highest level of performance should be a highly prioritized goal of music teachers (Drake, 1968, p. 329). Rhythm "…easily is an important factor in reading music" (Stetson, 1923, p. 181). The research of Johnson (2003) confirms that the teaching and learning of rhythm are at the heart of producing musically literate students (p. 30). However, "Research literature dealing with rhythm reading achievement per se is surprisingly scarce" (Bergee & Antonetti, 2012). In addition, Honing (2002) laments that "Rhythm and timing have been only sparingly addressed in music theory" (p. 232).

Some studies sought to identify rhythm as a semi-voluntary motor response rather than a mental activity consisting of the higher nervous centers that control muscles and movements—a process that can be trained and a concept that can be taught (Murphy, 1999, p. 45). This idea differs from work such as that of Waters, Townsend, and Underwood (1998) who state that "From a cognitive psychological perspective, sight reading can be most usefully characterized as a transcription task" (p. 124). Other research identifies rhythm reading as a specific cognitive process; in one study it was demonstrated that tempo, meter, and melody exercises and exercises that combined or intertwined melody, tempo, and meter exercises activated different parts of the brain and did so in different ways: "One striking feature of these exploratory findings is that pattern, tempo, and meter elicit different distributed neural mechanisms" (Thaut et al., 2014, p. 445). Each activates different parts of the brain. Hodges and Nolker (2011) also found that "… melody, harmony, and rhythm are processed independently, although there is also evidence for interactive processing of pitches and rhythms" (p. 67).

With rhythm being such an important aspect of music, it seems unfortunate that rhythm is apparently not given more focused instruction. “Instead, rhythm is very seldom directly attacked; its mastery is usually a by-product; and capable students are often weak in grasping even simple rhythmic figures without clumsy experiment” (Stetson, 1923, p. 181). In an unpublished study by the researcher, it was identified that, regardless of method or strategy, focused study of rhythm reading tended to improve rhythm reading skill, and tended to improve student skill level at roughly the same level (Toney, 2014). Other studies regarding methodology or strategies have yielded mixed results but generally have shown that rhythm reading focused instruction yields improvement at comparable levels as well (Bebeau, 1982; Boyle, 1970; Brittin, 2001; Colley, 1987; Dalby, 2005; Ester et al., 2006; Gage, 1994; Hoffman et al., 1996; Johnson, 2003; Richardson, 2008; Shehan, 1987; Sink, 1983; Winik, 1973). Even if rhythm reading is given focus, the various and unaligned strategies or methods for teaching rhythm may hinder the universal understanding of rhythm and how it is to be performed (Ester et al., 2006, p. 60). Hodges concurs, “… there is a decided lack of continuity among the approaches used and in the results obtained [in rhythm performance teaching]. It is not clear, for example, whether one particular approach has a distinct advantage, or whether the use of nearly any kind of syllabic or mnemonic device is sufficient” (Hodges, 1992, p. 467). The unevenness of how rhythm is taught may actually benefit students in some cases, as each individual may learn somewhat differently than others, but likely shows a lack of clear information on the teaching and learning of rhythm reading.

Pattern Grouping

Different symbol systems are used in many disciplines to include mathematics, music, and written language (Stenner, 1996, p. 10). In the instruction of the written word, “Beginning readers learn to attach specific sounds to graphemes and vice versa, and the research based on the importance of phonological activities is extensive" (Fitzgerald et al., 2015, p. 6). The many different elements of music—often connecting with a student's previous knowledge of both syntactic and structural qualities and through analysis, classification, and decision—all contribute to learning to read word and music (Bartel, 1994, p. 2). Through the study of the relatability and importance of rhythm, "There is reason to suspect that grouping may be a fruitful phenomenon for the investigation of processing relations between linguistic and musical rhythm" (Patel, Peretz, Tramo, & Labreque, 1998, p. 125).

It is identified that "There is a direct relationship between learning to read a spoken language and learning to read music" (Gordon, 1974, p. 39). In relating to music specifically, "To be musically literate, [potential musicians] must then be able to connect the sounds of music with the symbols of music" (Ester et al., 2006, p. 61). In Gordon's (1997) methodology, students must be able to hear a sound pattern in their heads before they can read or notate it. On this topic, Thaut (2005) posed that "Rhythm in music is the core element that binds simultaneously and sequentially of sound patterns of structural organizational forms underlined we consider musical language. In this function, rhythm assumes a critical syntactical role in communicating symbolic, as well as associative, meaning in music" (Thaut, 2005, p. 4). This further demonstrates the importance of rhythm patterns.

Process of Reading by Pattern

Sounds often bring about responses. According to a previous researcher, for humans "Rhythmic sounds are believed to act as sensory timers, and training regulating brain mechanisms that control the timing, sequencing, and coordination of movement" (Thaut, 2005, p. 115). Because of this, "Sensorimotor synchronization (SMS) is a form of referential behavior in which an action is temporarily coordinated with a predictable external event, the referent" (Repp, 2005, p. 969). This referent can be anything, but it must be a prompt of some sort to encourage a specific result or movement.

With a referent such as notation, perception, production, and synchronization are quite possible and remarkable. "When reading notation, a musician experiences three stages of perception: auditory processing, structural perception and structural cognition while simultaneously employing three basic motor functions: timing, sequencing and special organization of movement" (Farley, 2014, p. 11). While different in complexity from the written word or other symbolic representation, written work more specifically portrays text rather than musical elements. This process overall is not unlike the reading of words. "The development of reading efficiency might be the driving factor behind the development of multiple letter processing speed" (Lobier, Dubois, & Valdois, 2013, p. 9). In the same manner that readers, in general, are actually looking ahead of where they are truly processing, it is reasonable to surmise that there is a natural or learned structural strategy (Farley, 2014, pp. 18–19). Both multiple-letter processing and looking ahead are strategies for literacy of the symbolic nature of reading in the various disciplines, each of which involves a grouping aspect. "Less skilled readers often complain that they cannot 'take in' the information quickly enough because they are reading the notes individually, whereas the more skilled readers appear to process groups of notes rapidly" (Waters et al., 1998, p. 125). This discovery is not specifically groundbreaking, though the reason behind why this may be the case may give great insight into how and why some students read at a higher level or faster level than others in both the written word and in the reading and performing of music notation. According to Lobier et al. (2013), the answer may lie in visual attention span (VAS), visual attention capacity (VAC), visual short-term memory (VSTM), and visual processing capacity (VPC).

In the article, *The Role of Visual Processing Speed in Reading Speed Development*, Lobier et al. (2013), identify that readers have a limited VAS which is influenced by short-term VAC. An individual can only focus on what can be taken in and only for so long. The VAC may be filled or limited by VPC and VSTM—both finite in the number of items that may be focused on, however, the size of items that may be processed are expandable. As the size of items grow, larger chunks of information is gathered and processed. As patterns or items become familiar, they may be expanded on. As complex or larger patterns become familiar, they are accepted into VSTM in larger chunks rather than as separate small parts. This is done through the connection of a known pattern to an unknown, which makes the formerly unknown a new known grouping. Larger chunks are then able to make their way into VAC. Conversely, words/patterns/groupings that are not able to be identified as a whole must be handled by a reader in a much slower process, such as phonics, just as unknown rhythms may have to be subject to a counting system to figure out both where each note placement is supposed to be and the duration of each note in a pattern. In the most simplistic form, this process could indicate that as one practices or experiences symbols, a reinforcement and/or advancement of a skill occurs allowing what was not known/recognized in whole to be learned and more difficult patterns to be perceived as easier. VAC is expanded and the information is processed faster due to the increased comfort level or familiarity that one acquires. Generally, reading speed increases continually from elementary school up to college through this process. The work of Fitzgerald et al. (2015) seems to validate this point according to research in the Lexile format, “When word structure and word meanings were relatively difficult (as for informational text compared to narratives), more repetition and patterning at the discourse level likely modulated the impact of the difficult words to bring the overall text complexity to a relatively low level" (Fitzgerald et al., 2015, p. 22). The research of Lobier et al. (2013) indicates why this may be the case.

Grouping Patterns in Music

To Smith (2004), while it has been found that there is a correlation between students' ability to identify letters and learn words, learning letters does not have to come before learning words. Letters may be derived as features of the words rather than words as combinations of letters. As such, a working vocabulary is important in learning to read words. In music, it is no different. Learning about music and the performance of music are, in one's mind, "…a conscious construct dominated by registrations of the syntactic and structural qualities…by conscious analysis, classification, and judgment" (Bartel, 1994, p. 2). According to Gordon (1974):

> Education psychologists generally believe that fluent reading—reading with comprehension—is an outgrowth of viewing words through a semantic feature analytic approach. That is, it is the words and the organization of words on a page, and not necessarily the recognition of alphabetic characteristics which constitute the words, that most efficiently generate meaning in the mind of the reader. (p. 39)

When reading music, it may be to the performer's advantage to group the notes in rhythmic patterns rather than note-to-note. This is not unlike how students learn to read words. In fact, Gordon (1974) writes that "It should be recognized that the terms 'word' and 'pattern' function synonymously in language reading and in music reading" (p. 40). Upitis (1987) explains that "…by building on a child's figural knowledge, the teacher can help the child move to a metric embodiment of rhythm, in much the same way as formal notation evolved historically" (p. 59).

The questions of how humans order or make sense of what is experienced has a history of study. “Our natural tendency towards grouping is based on Gestalt principles which posit that the brain has tendencies toward self-organization” (Palkki, 2010, p. 105). This is reinforced in the writings of Deutsch (1999):

> The early Gestalt psychologist identify that we group elements and configurations on the basis of various simple rules. One is proximity: closer elements are grouped together in preference to those that are spaced apart…. Another is similarity…. A third, good condition, states that elements that follow each other in a given direction are perceptually linked together…. (p. 300)

Moreover, and specifically to music and rhythm, “Rhythm may enhance our brain operations through providing structure and anticipation in time. Rhythm may be one of the central processors to optimize our gestalt formation in the basic process of learning and perception” (Thaut, 2005, p. 17). “We actually tend to hear rhythm and timing in what one might call ‘clumps’…” (Honing, 2013, p. 380). The process of grouping or chunking in reading is vital to the understanding and teaching reading of word or music. This is especially relevant as “In Western music notation, rhythm is often notated proportionally” (Honing, 2013, p. 374). This clumping or grouping form what are known as rhythmic patterns (Gordon, 1974).

Reading Music by Pattern

It has been identified by multiple researchers that music readers grow to identify patterns or chunks rather than individual notes (Bengtsson & Gabrielsson, 1983; Bergee & Antonetti, 2012; Farley, 2014; Fraisse, 1982; Gordon, 1971, 1974, 1976, 1997; Gromko, 2004; Hodges, 1992; Hodges & Nolker, 2011; Honing, 2002, 2013; London, 2002; Repp et al., 2002; Thaut, 2005; Thaut et al., 2014; Waters et al., 1998). This is much like reading the written word. As competency in reading words grows, the size of the chunk or patterns able to be processed and read in whole rather than in parts also increases (Farley, 2014; Gromko, 2004; Hodges, 1992; Hodges & Nolker, 2011; Lobier et al., 2013; Waters et al., 1998). This increased capacity for the size of patterns allows for less eye movement for the performer as "Skilled sight-readers are able to read in larger units and actively compare stimuli while also demonstrating fewer fixations of the eye on any single point in the musical example" (Farley, 2014, p. 14). This allows the body and/or brain to move on from the work of the eyes and center on new aspects of processing information or performance—such as expression or pitch—as indicated by Hodges (1992) who explains "Experienced music readers read ahead of the point of performance in units or chunks. This 'previewing' allows the eyes to fixate on structurally important features, such as chords or melodic fragments, and to skip over less important details which may be filled in" (Hodges, 1992, p. 466). Drake (1993) agreed that "Many temporal organizations of events in the environment can be described parsimoniously by a hierarchical structure with lower order events recursively combining to form higher levels" (p. 25). Moreover,

> …the actual mechanics of reading involve the rapid series of stops (fixations) and starts as the eye focuses on pertinent information and then sweeps (saccade) to the next focal point. Information is brought into the visual system at a fixation, when the eye is not moving and is focused on a circular area about 1 inch in diameter. Fixations can last from less than 100 ms to 500 ms (half a second). (Hodges, 1992, p. 466)

Farley (2014) found that any deviation from this process, such as having to focus for longer periods on specific patterns or shifting of position, might hinder the fluency of a performance. This understanding may explain that "…better keyboard readers economize on eye movements, keeping their eyes focused on the music, while poorer readers engage in many needless shifts from the music to the hands" (Hodges, 1992, p. 466).

The impact of grouping on the performance of rhythm patterns. The way that students group and perceive rhythm has a direct impact upon performance (Mclaughlin & Boals, 2010, p. 400):

> Music can be understood in terms of its syntax and structure through conscious cognitive processes and in terms of its emotional-expressive content through a consciousness of emotions felt, subjective emotion-referenced association with the music, or perception of emotion-referenced expressivity located in the contours of the music. (Bartel, 1994, p. 2)

In a class setting, while group instruction may or may not be given on the same skills in rhythms, it may be adapted by the teacher or in the mind of each student according to their understanding of the concept to further their development in music performance and literacy (Gordon, 1997, p. 208). Each student sorts rhythm patterns in all aspects of music study to include reading, composing, and listening. "If the meaning perceived stems from conscious intellection, the response to music clearly registers as a mental construct" (Bartel, 1994, p. 2). As such, the students' perceptions of patterns are organized in their own mental constructs and may be built upon as further knowledge is introduced in a spiral curriculum where the instruction is adapted to offer further knowledge as a student is ready for it (Gordon, 1974, p. 62). As all students are individuals, a similar representation of musical stimulus may lead to different problem-solving strategies in music reading (Upitis, 1987, p. 59).

Students are likely to use different but similar strategies for making sense of rhythm and the different patterns or strategies that they use may be identified (Upitis, 1987, p. 59). Because of this, "…one would expect to find both inductive and deductive content sequences incorporated…but a review of selected aural perception textbooks indicates the exclusive use of inductive content sequences" (Alvarez, 1981, p. 135). This reveals an apparent disconnect between pedagogy and many research findings that give insight into how students actually do learn and how they learn to read music most efficiently (Gordon, 1974, p. 41). This disconnect is not just limited to music, as recent research identifies that "Educators and researchers tend to focus on word-level text characteristics as almost singularly critical for early reading, and the role of how texts are structured to facilitate ease of early-reading progress is often overlooked" (Fitzgerald et al., 2015, p. 24). Instead of this narrow focus, Gardner (1971) states that "Teachers might want to encourage students to respond to rhythmic patterns…of musical organization in a number of ways, so that flexibility and involvement with the music, rather than a single, rigid manner of assimilation, might be promoted" (p. 360).

> For at least two hundred years, 'sound before symbol' has been a fundamental component of music learning theories such as those promoted by educational theorists Johann Heinrich Pestalozzi, James Mursell, Jerome Bruner, Robert Gagné, and Edwin E. Gordon. In spite of this, published resources for music literacy instruction (e. g., sight-singing method books, beginning instrumental method books) often take a notation-first approach; it is the rare resource that mentions the need to develop an aural vocabulary before encountering notation. (Ester et al., 2006, p. 60)

It is apparent that by choice or because of lack of quality resources, "…teachers nevertheless expect students to grasp the formal representations, even if their internal structures are of a different nature to the formal structure" (Upitis, 1987, p. 59). The notation first (and only) approach may aid in uniformity of process and universality of a system, but teachers may be wise to structure learning opportunities in various ways that students learn—to include pattern teaching (Palkki, 2010, p. 105). For, "…when the implications [for diverse strategies] are viewed with wisdom, they can serve well in developing at least an appropriate initial course of study in music literacy" (Gordon, 1974, p. 63).

Variables that Affect Pattern Grouping in Music

It has been found that there are some variables that may influence the way that a music reader will group notes into patterns. Chief among these variables are expressive timing and tempo. As will be explained, expressive timing and tempo are often intertwined yet independent (Honing, 2002). The complexity or length of a pattern had an impact upon the student performance as well, though it was not as prevalent as expressive timing and tempo (Gardner, 1971; Wolf, 2004).

Expressive timing. In both the perception and the production of rhythmic patterns, timing and artistic understanding or intention are important factors because "…musical rhythms are rarely performed with the exact ratios specified in musical notation" (Repp et al., 2002, p. 588). The term 'expressive timing' usually identifies this concept (Farley, 2014, p. 10). Expressive timing is bound by factors related to melody, harmony and musical structure (Repp, 1998). Bengtsson and Gabrielsson (1983) identified that many different styles, tempo and tempo change, and structural considerations (such as meter, accents, and complexity) influence the accepted performance of rhythms significantly. In some cases, performances would be hindered if the notation was mechanically followed. Structurally, "In music, sound elements tend to be grouped into larger units (e. g. 'phrases'), and the ends of these units also tend to be marked by slowing, with the degree of slowing reflecting the structural importance of the boundary" (Patel et al., 1998, p. 125). Musicians may make choices that alter the timing but does not make the performance inaccurate within parameters of good musical taste or stylistic concerns. According to Honing (2002), "…it could be argued that expressive timing is only perceptible *because* there is categorization, the rhythmic category functioning as a reference relative to which timing deviations are perceived and appreciated" (p. 228). Farley (2014) gives a little less freedom by stating, "The nature of rhythm performance is not required to be exact, but maintenance of temporal ratios is necessary for rhythmic accuracy to be perceived by the listener" (p. 10). This seems to be conceded by Honing (2013) in some cases as "Some rhythms allow for considerable time and variation, without the risk of being perceived as another rhythm. Other rhythms allow for little variation in the timing. If timing variation is applied to these rhythms, they are quickly perceived as an altogether different rhythm" (p. 377).

Timing is a fundamental combination of perception, referent, coordination, tempo, and resulting synchronization. Thus, "Timing plays an important role in the performance, perception, and appreciation of almost all types of music" (Honing, 2013, p. 383), for "Musicians playing in an ensemble must synchronize their actions with the audible and visible actions produced by other members of the ensemble" (Repp, 2005, p. 969). This synchronization of all aspects involved in performing in an ensemble is undeniably complex and influenced by many factors.

Tempo. In the study of rhythm at this depth, there is value in identifying a possible origin of rhythm. On this subject, Fraisse (1982) proclaims that "All of the rhythms that we perceive are rhythms which originally resulted from human activity" (p. 150). Fraisse (1982) commented that it is "…striking that the rhythm of the heart, of walking, of spontaneous tempo, and preferred tempo are of the same order of magnitude (intervals from 500 to 700 and msec) [as one another]" (p. 162). Tempo varies in different studies but ranges from 72-112 beats per minute (bpm) (Fraisse, 1982; London, 2002; Repp, 2011). Furthermore, the body's natural rhythm trickles down into ratios and tempi with which humans are most comfortable. The body's natural movement is usually symmetric—moving in the same direction, or opposite—as in arms swinging in opposite directions, as isochronous or perpendicular motion (Clarke, 1999, p. 474). It is not so with other living species as, “In contrast to humans, animals do not spontaneously move in synchrony with rhythmic auditory or visual stimuli, and there seem to have been no successful attempts to train them to do so” (Repp, 2005, p. 969).

The findings of multiple studies of difficulty in music performance indicated that tempo was a significant factor in playing accuracy (Bradford, 1995; Gardner, 1971; Lai, 1999; Mclaughlin & Boals, 2010; Sink, 1983; Wolf, 2004). Some tempi have been found to be most reliable to facilitate grouping of notes into rhythmic patterns. The research on this phenomenon is not completely in agreement. London (2002) found that beats and rhythmic grouping of patterns “…are most strongly felt at a moderate tempo, around 80-90 beats/minute (bpm) (600-700 ms) (p. 536). In Farley’s study (2014), a rhythmic performance test was utilized where “The introduction consisted of four clicks from a metronome at 80 bpm. This tempo has been identified as having the strongest beat salience in spontaneous tapping studies” (p. 31). Bergee and Antonetti (2012) discovered that 72 bpm was exceedingly prevalent in rhythm studies and therefore used in their research. Other researchers found that the tempo of 100-120 bpm was an ideal range for identifying rhythmic patterns and their performance (Repp, 2011). The work of Fraisse (1982) and Clarke (1999) have shown that the body’s natural tempi of movement are the ones with which humans are generally most comfortable. Each of the listed tempi have been identified as a natural tempo of some aspect of the body’s natural movements or a subdivision of it, whether it be a heartbeat, the pace of walking, or other human activity (Fraisse, 1982).

Tempo is one of the most significant variables as “A musical rhythm is an acoustic sequence invoking a sensation of pulse” (Parncutt, 1994, p. 453). At the same time, “Tempo of music – unlike the concept of felt pulse – is never completely stable and regular in reference to equidistant pulse repetition rates. However, fluctuating tempi do not seem to undermine a sense of stability in an underlying pulse" (Thaut, 2005, p. 9). Fraisse (1982) put forth that "The possibility of rhythmic perception depends upon tempo, because the organization of succession into perceptible patterns is largely determined by the law of proximity. When the tempo slows down too much the rhythm and also the melody disappeared" (p. 151). Furthermore, "…people tend to hear the sounds in groups of two, three, or four or even larger units. How many members are grouped together depends on the rate: the faster the rate, the more members in the perceived group, and vice versa" (Gabrielsson, 1993, p. 95). Repp et al. (2002) summarizes:

> When the tempo of a rhythm is changed, perceptual reorganization (regrouping) may occur, which makes it difficult to recognize the same rhythm at different tempi. Similarly, in music performance, the events in notationally identical rhythms may be grouped in different ways and timed differently at different tempi. (Repp et al., 2002, p. 570)

It is clear from research that tempo has a strong effect on rhythmic perception and grouping (Honing, 2013; Repp, 2011; Repp et al., 2002).

The Importance of Difficulty in Education

The understanding and incorporation of difficulty is embedded in education and educational research. According to McEnaney (2006), "Difficulty has been used as a descriptor in, and a component of, educational research and critique. Difficulty has been considered as an element of or independent variable in experimental research" (p. 13). Dewey (1934) writes of difficulty in relation to educational pedagogy and as a developmental tool as one goes from becoming an artisan to an artist. Others have discussed difficulty "…in a variety of pedagogic designs and learning constructs such as zone of proximal development, metacognition, problem solving, and constructivism." (McEnaney, 2006, p. 9) These writings reiterate how important understanding difficulty is in motivation and success of students in the completion and ownership of a presented task.

In the modern educational climate, teacher accountability is continually at the forefront. Teachers are now being judged in many states based on the competence and growth of the students they teach in all subject disciplines. "Due to the increased impact of these assessments on directors' jobs, it will probably be necessary for them to be aware of all variables that may impact their students' success" (Norona, 2008, p. 2). As a means of good teaching, an educator should be as aware as possible about how students are perceiving the concepts taught and the level of difficulty they expose their students to; "Otherwise, teachers may make incorrect assumptions about what students hear and think, when in fact, students' perceptions may be quite unlike their [own]"(Duke, 1994, p. 33).

Sequencing by Difficulty

In many educational theories, sequencing is important to the construct of information. Richardson's research (2008) conveyed that "The likelihood of student success improves when they can connect the known to the unknown" (p. 42). The sequencing of material has shown to be effective and also leads to a more comfortable and enjoyable classroom experience for students and teachers (Yarbrough & Price, 1989, p. 180). "To encourage optimal progress with the use of any reading materials, teachers need to be aware of the difficulty level of the text relative to a child's reading level" (Stenner, 1999, p. 5). The Arizona Department of Education (2006) believes that performance objectives should build one upon the other, and cascade upward in terms of difficulty of skill and technique (p. 1). Van Patten, Chao, and Reigeluth

(1986) state that, "…teaching the prerequisite knowledge first seems to facilitate the learning of the higher order skills better than teaching the prerequisite knowledge out of sequence" (p. 447).

In many cases the process of sequencing is related to the difficulty of the different aspects of the subject, but researchers and practitioners sometimes do not consistently identify what can be shown to actually be a correct sequence or hierarchy of difficulty (Stenner, 1996, p. 11). "Research on a better understanding of teachers' perceptions of difficulty in their pedagogy can sharpen our thinking about, and understanding of, the concept [of difficulty]" (McEnaney, 2006, p. 14). While the study of reading in literature classes has the Lexile framework, music does not have that type of tool.

Educational theory has long advocated for thoughtful sequencing. Identifying the level of difficulty of items into a hierarchy and sequencing them so that simpler component skills are taught before the more complex or difficult is logical and has been needed for some time (Van Patten et al., 1986, p. 450). Ester et al.(2006) agree in their work that "…an effective learning sequence builds on principles… of learning that are rooted in the ideas of Pestalozzi and formalized in the learning theories of Gagné…." (p. 60). The sequencing of instruction from easy to difficult or simple to complex is relevant to music as well (Colwell, 1987, p. 19). "Bruner proposed that content should be introduced commensurate with the students' intellectual development throughout their entire educational process and should be built around the crucial ideas in the subject"(Van Patten et al., 1986, p. 446). Commonly known as the spiral approach, it is suggested that "…each concept of a subject be taught at each grade but with increasing degrees of complexity and sophistication" (Van Patten et al., 1986). Wareham (1967) agrees that material should be sequenced, but sequences must be organized for specific reasons—in particular, the degree of difficulty.

As shown, the concept of difficulty is important in the evaluation of our educational system and is not only worthy of study, it is vital to study (Wareham, 1967, p. 12). In education, "…ratings of item difficulty often serve as the basis for determining passing scores for tests" (Secolsky, 1987, p. 227). These same tests are at least factors in determining grades, which are consequentially factors in determining future opportunities in the lives of students and for determining the perceived effectiveness of teachers. When teaching, it is important to remember that "Most concepts exist not in isolation but as parts of related concepts" (Alvarez, 1981, p. 135). It is because of this importance that "In any subject area, carefully arranged sequences of contingencies are dependent on a knowledge of material graded by degree of difficulty" (Wareham, 1967, p. 1).

The sequencing of skills is important. "Results of recent research [of the time] support the notion that effective teaching involved the ability to sequence teaching and learning events in an optimal pattern of instruction" (Yarbrough & Price, 1989, p. 179). That leads to an important question: How should the material/concepts be sequenced over time (Van Patten, Chao, & Reigeluth, 1986, p. 437)? While the answer to this question is beyond the scope of this study, the results and information of this study may lead to answers.

Problems of Estimating and Scoring Difficulty

Some things that might not be thought of as difficult may be extremely difficult when compared to a like item (Scheuneman & Gerritz, 1990, p. 109). Complexity is often interpreted as difficulty as is: range, quick tempo, and musical interpretation. Unfortunately, "…estimating item difficulty accurately is quite difficult" (Impara & Plake, 1998, p. 79). Many times students at like grade levels have different backgrounds that may contribute to students not always having a consistent personal difficulty scale. This may hinder a teacher from accurately identifying difficulty level of the different parts of their curriculum, units, or even lessons. Furthermore, in most cases, a teacher is not able to control the attributes or varying levels of the students they teach (Mohamadi, 2013, p. 987). As challenging and ineffective as difficulty is to estimate, it is important to have a list of rhythmic patterns arranged according to difficulty level as predetermined by research.

When professionals in different fields are asked why they feel items are difficult, they often have to pause and consider their reasoning for determining level. Often they feel that something is challenging, or they have an idea about the level of difficulty but have not considered why that may be the case (Beecher, 2006, p. 33). It is understandable that experts of music performance or music education are assumed to have the ability and skill to: (a) find the level of difficulty for different items, (b) discover the skills and achievement levels typical of those who perform at that level, and (c) indicate how well an individual or group perform each item based on those factors (Impara & Plake, 1998, pp. 69-70). The resulting—often subjective—scoring criteria put forth by the experts are also problematic in trying to determine the accurate level of skill and or/achievement. “If standards are too strict, nearly all performances would be scored as incorrect. If standards are too lax, all subjects get high scores and little information results” (Grieshaber, 1993, p. 128).

Secolsky (1987) gives further insight into judging and the subjectivity of the process. Judges are often influenced by attitudinal and interpretive factors which may include the recognition of component subskills and general skill, and a realization of the perceived complexity of a task in relation to the expected level of performance (pp. 227, 230). Common factors include “…the characteristics of the judges, the judges’ experiences with the examinee population, and the judges' attitudes toward the purpose of the test and the potential consequences of the standard" (Secolsky, 1987, p. 227).

The way a judge perceives the level of difficulty of a measured skill will also likely influence evaluation (Secolsky, 1987, p. 228). For instance, "…item difficulty ratings tended to be higher for judges who interpreted items in terms of the specific difficult subskills required to answer an item correctly" (Secolsky, 1987, 230). In addition, a judge's perception of how they evaluate may influence scoring in this setting. Secolsky (1987) found that "The more teachers perceived themselves as grading high in relation to their colleagues, the more they tended to rate these to items as being difficult" (p. 229). It has been found that "…in general, judges are able to rank order items accurately in terms of item difficulty, but they are not particularly accurate in estimating actual levels of examinee performance" (Impara & Plake, 1998, p. 70). Again, these factors tend to lead to subjective individual criteria of evaluation rather than criteria of standards according to performance on a common standard of difficulty.

In regard to the attributes of a student in relation to difficulty level and assessments, a student's attitude and understanding of what is being assessed, as well as how a test is constructed may influence scoring.

> …Persons with propensities and abilities other than those the test is intended to measure may tend to approach the various item tasks differently. If these approaches are not equally likely to meet with success, differential difficulty may result, even when levels of the intended ability in the examinee groups being compared are controlled. Basically, both classical and modern measurement theory assume that the probability of a correct response increases with increasing levels of the ability being measured by a test; or to

> state it another way, the higher the demand on that ability, the more difficult the test item. (Scheuneman & Gerritz, 1990, p. 110)

It is clear that difficulty level determination and assessment should be done better than it has been in the past.

Purpose and Practice of Assigning Difficulty Levels to Works of Music

It is understood that authors and composers may make conscious, unconscious, or aesthetic choices as they create their work for specific groups of performers or students. They keep their readers in mind, which may lead to a more likely commercial success. Most times these creators must choose to yield to their artistic spirit, compromise for a perceived level, or try to find an amiable combination of the two (Fitzgerald et al., 2015, p. 5). Specific to actual difficulty, "The comprehensibility or difficulty of a message is governed largely by the familiarity of the semantic units and by the complexity of the syntactic structures used in constructing the message" (Stenner, 1996, p. 11). This applies both to the written work and to music literature.

"…Research examining the rating of music difficulty has almost exclusively been a predetermined component of a music literature study of some other kind" (Norona, 2008, p. 10). The goal of many, if not most state or organization-recommended or required lists is to organize the pieces of music that are deemed to be of high quality in order to allow directors to efficiently select music for their groups (Beecher, 2006, p. 1; Norona, 2008, p. 9). These lists are often compiled or created by publishers of music or state music organizations with the express purpose of guiding directors for level selection or for an adjudicator or panel of adjudicators to evaluate their performance (Beecher, 2006, p. 1; Norona, 2008, p. 10). It is further explained,

> These lists are very common among state music education organizations. To create such a list, pieces are usually evaluated by the music committee of one of these organizations. If it is decided a piece is of high enough quality it will be given a difficulty rating and be added to the list, while pieces not earning the same status are left out. (Norona, 2008, p. 3)

“By ranking the pieces according to a *standard* [italics added by researcher] measure of difficulty, students and teachers can work through a list more incrementally, as well as understand why pieces were assigned a given level of difficulty and what specific challenges a piece would hold for a student” (Beecher, 2006, pp. 5-6). “Twenty-five states use some sort of list” (Beecher, 2006, p. 7). “Michigan, Texas, Florida, and many other states have extensive music lists for just this purpose” (Norona, 2008, p. 4). While there are many lists, these lists are not all agreeable for each state organization. If this was the case, twenty plus different states would not feel the need to produce their own lists (Beecher, 2006, p. 7).

Problems with subjectivity in list construction. While lists are prevalent, some believe they miss the mark on their intended purpose. “Graded lists of solos are always a problem because they are never specific enough in indicating precisely the technical difficulty of a piece” (Rasmussen, 1962, p. 78). “What is missing is any descriptive element helping the practitioner to define or identify the difficulty appropriate to the specific student or context” (McEnaney, 2006, p. 12). While most, if not all, lists label a difficulty level, few seem to organize the levels internally, and there is normally no indication on the lists as to why a piece has been given a specific label relevant specifically to that work (Beecher, 2006, p. 2). In addition, “...by their very nature the global rating systems are also fraught with subjective judgments” (Saville, 1991, p. 2). In a study by Wareham (1967) of major music lists [at that time], containing over 800 individual titles, it was found that there was less than 9% of total agreement of level designation across them. Also disturbing, Beecher (2006) found that, "… [there is] an apparent overlap in the pieces' technical and musical difficulties that may occur between the levels. Therefore, students could select a piece from a more advanced level that is easier than a piece from the lower level" (Beecher, 2006, p. 2).

In studies by Rasmussen (1962), Saville (1991), Beecher (2006), and Norona (2008), each found marked problems with these types of lists. Common findings described and consistently found were large margins of disagreement and little objective criteria in lists. Even within a single list, "There is a large margin of difficulty between the pieces within a given level" (Beecher, 2006, p. 2). Minimitaka (2012) explains the reason this is so:

> When a difficulty level of music is evaluated, professionals in music education or musicians subjectively evaluate the difficulty level of the music taking into consideration of various elements in the music, for example, series of musical notes included in the music. In the conventional subjective evaluation, no objective difficulty levels of elements composing the music are included, but just the whole difficulty level of music is evaluated. (p. 1)

By classifying and defining how difficult a piece is on some identifier (such as the elements of music) and what makes it difficult, students and their teachers might select repertoire in a manner where a performer might have a better chance of a sense of achievement, and at times stretch themselves beyond their current abilities (Beecher, 2006, pp. 33-34). It would also be wise to recognize what the different selections within each level have in common in relation to difficulty (Beecher, 2006, p. 5).

Most concert band repertoire lists tend to be graded in general—that is, overall designation of difficulty, not by elements of music. The ratings are designed to classify compositions. According to Saville (1991), in general, they may be categorized into six levels:

> (a) mainly for the first year instrumentalist, (b) for those definitely beyond the beginning stages, (c) for those who have acquired some technique, (d) for more advanced instrumentalists, (e) mostly for college players, and (f) for the skilled professional. These categories average the individual problems and technical requirements of complex compositions into global ratings. (Saville, 1991, p. 1)

Specific to rhythm difficulty rating for level I-III, Dvorak, Schmalz, and Taggard in *Best Music for Young Band* (1986) offer the following guidelines:

> Grade I: Basic rhythms….Grade II: Intermediate rhythms; some syncopation; duplet and triplet rhythms….Grade III: Challenging rhythms; free use of syncopation…. (p. 11)

Specific to rhythm difficulty rating for level IV-VI, Dvorak, Grechesky, and Ciepluch in *Best Music for High School Band* (1993) offer the following guidelines:

> Grade IV: Challenging rhythms including free use of syncopation; changing meters, asymmetrical meters….Grade V: Very challenging rhythms including polyrhythms; changing meters, asymmetrical meters, non-metric notation. (p. 11)

In a slightly less subjective manner, The American Band College (2014), put forth the following note/rest value selection for grading music in levels of 1 to 5:

> Grade 1-whole note, dotted half note, half note, quarter note, eighth note, dotted quarter note; grade 2-as in grade 1 plus simple 16th note patterns and triplets; grade 3-all values in duple excluding complex syncopation play easy compound rhythms; grade 4-all values

> in duple and all values in compound; and grade 5-complex duple and compound rhythms. (p. 1)

Again, for rhythm value, the American Band College (2014), put forth the following for grading music in levels of 1 to 5:

> Grade 1-Simple, mostly unison rhythm (dotted rhythm end of the year); grade 2-Add simple syncopation and well-prepared dotted rhythms with more use of non-unison rhythms; grade 3-basic duple and triple syncopation, dotted rhythms; grade 4-all rhythms except complex compound or complex 16th note syncopations; grade 5-All rhythms. (p. 1)

Similar subjective or nonexistent verbiage is put forth by such other entities or organizations such as the Evansville School District #65 of Illinois (Berger et al., 2010, p. 28), the Maryland Music Educators Association in conjunction with the Maryland Band Directors Association (Maryland Music Educators Association & Maryland Band Directors Association, 2014), the National Coalition for Core Arts Standards (National Coalition for Core Arts Standards, 2015), and the New Hampshire Curriculum for Core Arts Standards (New Hampshire Department of Education, 2001), to name a few. It is clear that, based upon separate research by Norona (2008), Beecher (2006), Saville (1991), and Sebastien et al. (2012), there is not a consistent and objective description of difficulty level in lists that are designed to differentiate by difficulty.

Improving Evaluation and Identification of Level

Many things affect performance or scoring of ability. For instance, it has been shown that "…social and cultural differences may account for variations of performance in ability tests…" (Murphy, 1999, p. 48). For there to be objectivity in evaluation, all aspects other than the specific entity being measured should be eliminated. "The difficulty of a test question is usually judged on a statistical basis. A simple, and common, coefficient for this concept of difficulty is the percent of those taking a test who answer the question correctly" (Myers, 1954, p. 30). In practice, "In the 'standard' design, the interpretation that there is something in common between certain items is based on the empirical fact that the same persons tend to fail or succeed in these items" (Karma, 1986, p. 20).

Specific to rhythm, like other elements of music, "…rhythmic measurement is more complex than previously thought" (Grieshaber, 1993, p. 127). It has been found that "Item difficulty traditionally has been defined in terms of the performance of examinees rather than in terms of intrinsic feature of the items" (Scheuneman & Gerritz, 1990, p. 109):

> Perhaps the most common method of scoring rhythmic performance is to listen to subjects' performances, deciding at the moment whether the performance is accurate. This suggests that performances are compared to the research's mental model of a given rhythm pattern. This method lacks objectivity because criteria are vague and the absence of a recorded copy prevents confirmation of scoring accuracy. (Grieshaber, 1993, p. 128).

Shortcomings in the Evaluation of Music Performance

Like other fields that are not usually numerically based, "…the formal assessing of music performance may be conceptualized as a complex system comprising numerous interrelated influences" (McPherson & Thompson, 1998, p. 12). Some might ask whether it truly is possible to reliably and validly assess music or any other art (Norona, 2008, p. 2). This question is reinforced by Murphy (1999) as "…the arts may transcend the distinction between affect and cognition as, for Gardner, aesthetic objects are the objective embodiment of subjective experience" (p. 47). It has been shown that "…the assessment of music performances by adjudicators and teachers is not without difficulties; reliability among assessors is sometimes low and significant biases often influence the results” (McPherson & Thompson, 1998, p. 12). This difficulty is further compounded by the context of the evaluation. When an in-person performance-based evaluation takes place, in order “...to get at underlying response factors, where the deeper and more complex cognitive-affective response is likely to lie, the evaluative factor must be damped” (Bartel, 1994, p. 4).

> Performance context represents a central influence on assessment and includes at least four factors. First, the purpose of the assessment…strongly influences the way a judge will listen to, and therefore evaluate a musical performance. Second, the type of performance, that is being assessed will affect judgments. (McPherson & Thompson, 1998, pp. 12-13)

The Lexile Framework

Perhaps a long-term goal of both the music performance, music education, and music publishers—and likely others—would be the creation of a system of objective identification of music performance skill and of music literature that may correspond with the levels of performers. What would result is much like what English literature has in the Lexile Framework. As it is now, music simply does not have many—if any—truly objective measures of either student level or music literature. This lack of objective measure limits music teachers in a variety of ways as far as organization of curriculum, unit and lesson planning, and the understanding of and measurement of student growth. The latter of these items may become exceedingly important to showing music’s value and viability in advocacy and in educational discussions on the total education of a child. The ability to identify the difficulty level of rhythmic patterns and the ability to determine the level of a student's performance of a rhythmic pattern may be an initial step in the creation of a music system comparable to Lexile.

In English literature, Lexile Framework, Map, Analyzer, and the Pathfinder Reading Lists are extremely versatile and valuable tools for teacher and parents. "The Lexile Framework is comprised of tools and resources that educators can use to plan instruction that correctly targets students" (Stenner, 1999, p. 6). Lexile can measure many different aspects of reading and literature. "The Lexile Map, Lexile Analyzer, Lexile Framework and the Path Finder Reading Lists enable teachers to provide students with age-appropriate reading material that they will comprehend" (Stenner, 1999, p. 5). Unfortunately, as it has been stated and/or alluded to, musicians only have the perception of difficulty rather than a scored level of difficulty, whereas, for English literature, the Lexile measurements link reading comprehension levels to material for the entire range of reading abilities. This will help all involved to pinpoint age-appropriate reading materials that may challenge readers or be at appropriate levels (Stenner, 1999, p. 4). Beyond that, the tools within the Lexile family allow for standardized documentation and then communication of that information.

The importance of the Lexile format is difficult to overstate. "To encourage optimal progress with the use of any reading materials, teachers need to be aware of the difficulty level of the text relative to a child's reading level" (Stenner, 1999, p. 5). Many discoveries yielded by the Lexile format relate to word or sentence complexity, not specifically to difficulty, yet showing that a student is able to interpret context is a key to difficulty. Lexile accommodates that aspect as "The interpretation of texts provides a model for qualitative forms of objectivity adequate to the methodological demands of science because…[some texts in certain situations] take on lives of their own addressing audiences unimagined by their authors" (Fisher & Stenner, 2011, pp. 92–

93). Regarding complexity, which has been found to be a key component of difficulty, “Across the various systems, the most common text characteristics that are best predictors of text complexity are word familiarity, word length, sentence syntax, and/or sentence length” (Fitzgerald et al., 2015, p. 7). It is noted that complexity does not always yield difficulty or degree of difficulty (Stenner, 1996). Furthermore, “As educators attempt to support youngsters to read increasingly complex texts, early-grades teachers need a sound understanding of what makes texts more or less complex for young students who are beginning to learn to read” (Fitzgerald et al., 2015, p. 4). As teachers have a tool to identify the kind of text that would be challenging for a group of readers, they can more specifically target instruction which will allow students to encounter difficult text according to best practice (Stenner, 1999, p. 5). This may enable teachers to more directly plan and structure lessons that are relevant to where their students are and cater to individual needs as appropriate through reinforcement, remediation, or other means.

It is notable that Lexile is not method or program specific but only gives information as “The Lexile Framework was designed to be flexible enough to use alongside any type of reading program, and improve that reading program by making assessment and recommendation of appropriate reading materials easier for teachers, students and parents” (Stenner, 1999, p. 4). Schools or teachers are able to use the information from the Lexile framework to make informed choices for subsequent instruction and measure the effectiveness of interventions. Progress toward goals can be monitored and this progress or lack of progress can be shared with other stakeholders including parents in a manner that is clear, concise, and standardized (Fisher & Stenner, 2011; Stenner, 1996, 1999).

Identification of Difficulty Level as a Step toward Better-Informed Instruction

"Knowledge concerning the kinds of patterns that children of different ages can handle may indicate which compositions should be employed most sensibly as examples, and what kinds of assignments and problems are likely to be comprehended" (Gardner, 1971, p. 360). To elaborate:

> It is widely accepted, for example that a person can have a 'reading age' above or below their chronological age, or that their numerical ability is above or below average for their age. It is not quite so clear what levels of competence we should expect at different ages in music, although the [British] National Curriculum, for example, is largely based on assumptions regarding 'stages' of musical development. (Murphy, 1999, p. 46)

However, "[At that time] It has not proved practical to establish a differentiated base-line on which to monitor musical achievement in all children" (Murphy, 1999, p. 48). Regardless, in identifying these stages, "…knowledge of the difficulty level of…rhythm patterns should serve to identify specific content and establish sequence for a course of study through which students learn to perceive and ultimately read and write music" (Gordon, 1974, p. 41). Determining the difficulty level of rhythmic patterns still must be done in order to properly identify and carry out well-informed teaching (Gordon, 1974, p. 41). By implementing a curriculum of sequential rhythm exercises, our students might have a much-improved chance of becoming musically independent and literate (Richardson, 2008, p. 43). "Pattern difficulty levels determine the order in which individual students are taught tonal patterns and rhythm patterns in learning sequence activities" (Gordon, 1997, p. 208).

Survey of Relevant Rhythm Studies

In performance and understanding of how a phrase should be put together, or simply done accurately, “Of all musical skills, [rhythm] is the one most generally lacking and the easiest to claim” (Bowers, 2007, p. 535). The performance of rhythm in relation to reading for performance has been a longstanding difficulty for teachers to help their students master (Gage, 1994, p. 1). “Regardless of the cause, the performance of rhythms is still recognized is the most deficient element in the performance of school bands ” and remains so today (Boyle, 1970, p. 308). Perhaps the study of rhythm has not been focused on enough. While rhythm performance studies have yielded fascinating results, “Most of the studies in the field of rhythm during the first half of this [20th] century were performed by psychologists, and practically none of them attempted to measure response to actual notation” (Drake, 1968, 329). In the second half of the 20th century, research has at times been suspect as many studies have been based on the assumption of incorrect tendencies of the performance of rhythm (Murphy, 1999, p. 44). It is imperative to note that that majority of the rhythm studies done had little to no basis for the assigning of difficulty in the manner and level of objectivity that Rasch analysis gives. This lack of objectivity gives little to no true basis for the establishing of a hierarchy of difficulty and only subjective information for the planning of instruction or curriculum.

In 1971, Howard Gardner studied the ability of students to duplicate rhythm patterns. The study subjects were sixty students who were in first, third, or sixth grade. The subjects listened to recordings of patterns and then attempted to duplicate them. The twenty-item assessment ranged in number of taps from four to eight along with rests. Subjects’ success levels were judged dichotomously as *correct* or *incorrect* (Gardner, 1971). Gardner (1971) noticed that “…the difficulty of an item seems to be a function of three factors: the number of taps, their arrangement, and the item's position in the test" (p. 359). It was recommended to incorporate a variety of ways to respond to rhythm patterns to best ensure student learning. Sink (1983) and Wolf (2004) made similar recommendations in their work. While the results of each of these studies were summarized and suggestions were given, no information on how items were assessed or how data was analyzed was given. Furthermore, there was no determination of how much more or less difficult one item may have been from another item, only that some were more difficult. The subjects in each of these studies were of different age groupings and had almost certainly not been involved in small or large instrumental performance ensembles as first or third graders. The sixth graders may have been involved in small or large instrumental performance ensembles or band, but that information was not included.

Studies have indicated that most choose to describe rhythmic patterns as either figural or metric but not both (Upitis, 1987, p. 42). "Rhythmic notation is essentially a symbolic system representing discrete units of time" (Johnson, 2003, p. 30). Figural and metric rhythm structures have also been classified both in terms of the music itself and in terms of an individual's understanding of music (Upitis, 1987, p. 41). Because of the presence of metric explanation, "The relationship between music and math has inspired additional studies in the area of math, music, and the human brain" (Johnson, 2003, p. 30). In those studies of notation and in learning rhythm though process of relating to metrics or fractions of a beat, "The various beats are proportionally related to one another and the relationship between the levels of beats defines the type of metric hierarchy which in turn determines the meter generated by the melody" (Upitis, 1987, p. 41). Several pedagogies address rhythm in a variety of formats, but "…there does not seem to be an approach to rhythm that incorporates mathematical concepts for inherently musical goals" (Johnson, 2003, p. 30). In a study by Johnson (2003), it was found that, "Illustrating the similarities between musical notation and fractions did not improve the subjects' kinesthetic performance ability; instead, the traditional model of instruction involving percussion instruments, rhythm syllables, and echo patterns increased progress as compared to the experimental instruction" (pp. 37-38). Gordon (1974) explains why this might be the case:

> Like the relationship of the alphabet to language, the spelling of pitch names and the fractional values of notes are useful only as *theoretical* explanations of music notation after one has already acquired the fundamental ability of reading music through meaning. Because it takes more than one note to make a meaningful tonal or rhythm pattern, the knowledge of the pitch name or of the arithmetic value of one isolated note does not constitute readiness or ability to read music. (p. 40)

Indeed, "People seldom perform with mathematical accuracy" (Grieshaber, 1993, p. 129). Sometimes performers speed up or play slightly out of tempo. For instance, "There is a marked tendency for subjects to shorten beats or play faster than a given, or required, beat while performing musical durational notation" (Drake, 1968, p. 337). Even though this may be true,

> It has been stated that most traditional music instruction emphasizes metric aspects of rhythmic structure over figural aspects. By stressing the metric mode, teachers not only underplay the equally important figural aspect, but may also be speaking to children in terms that they cannot readily understand. (Upitis, 1987, p. 59)

Johnson's (2003) work only summarized the result of the study. It does not address the method of scoring nor by whom or when. In fact, it does not specifically address difficulty level at all other than indicating that, in this case, a mathematical approach to teaching rhythm did not yield positive results.

In 2004, Wolf studied kindergarten students' ability to vocally duplicate rhythm patterns in order to develop a hierarchy of rhythm pattern difficulty to be used for more informed instruction. As part of the process, a test called Rhythm Pattern Performance Test (RPT) was created, which used duple and triple meter rhythmic patterns. A six-point scale was used to rate the varied responses to students duplicating a voice heard on a recording. Results indicated that more students were able to more accurately duplicate rhythms in duple meter compared to triple meter. The patterns were classified as easy, moderate, or difficult based on the results of the test. A hierarchy of rhythm pattern difficulty was also created based on the results of the RPT (Wolf, 2004). This is consistent with the research of Bradford (1995), Gordon (1976), Lai (1999), and Spohn (1977). Wolf's study identified a hierarchy of rhythmic patterns but not specifically in terms of the performance of written notation. Truly, the study may have identified a hierarchy of the difficulty of the duplication of rhythm patterns scored on a subjective six-point scale for the kindergarten-aged student. While this information may be useful, for the purposes of this study there are too many differences between the goals of each.

Beecher (2006) defined his rhythm evaluation work as rhythmic complexity, not specifically rhythmic difficulty. In labeling this, a count of unique rhythmic values for a selection is established. Notes were and measured on a scale from 1 to 8 based on duration within the given tempo of a piece with "…smaller rhythms [being defined as] more difficult" (Beecher, 2006, p. 37). The length of the shortest-played duration note was then calculated in his formula as "…the inverse of twice the duration of note" (Beecher, 2006, p. 38). Beecher's formula for rhythm complexity was then factored in along with formulas relating to other aspects and elements of music to give a possibly objective evaluation of a musical composition in terms of measured criteria. While rhythm was part of this calculation, it was not the primary aspect of his research and a research-based understanding of difficulty was not used in his calculation.

In a similar manner, Minamitaka (2012) prepared an apparatus and a calculation for objectively measuring difficulty level of piano pieces based on his criteria for Casio Computer Co., Ltd. In his calculation, "…a rhythm difficulty level concerning musical-note duration and timing of key playing based on time information" was included (Minamitaka, 2012, p. 1). Like Beecher (2006), Minamitaka's (2012) calculation, "…calculates the whole difficulty level of music…" based on different elements of music performance (p. 1). While rhythm was part of this calculation, it was not the primary aspect of his work and research-based understanding of difficulty were not used in his calculation.

In attempting to objectively measure rhythmic performance, the problem of identifying rhythmic difficulty still remains (Grieshaber, 1993, p. 127). In the context of performance, "Rhythmic difficulties are noticeable on intermediate pieces. They generally feature characteristic rhythmic patterns, which constitute interesting educational material," but are not so on all levels of difficulty (Sebastien, Ralambondrainy, Sebastien, & Conruyt, 2012, pp. 574-575). Specific to rhythm, Beecher (2006) and Minamitaka (2012) have constructed systems to calculate rhythm difficulty objectively. In Minamitaka's (2012) words, "…the difficulty level of music can be calculated from the respective difficulty levels in an objective manner, not far separating from the evaluation by the professionals" (p. 23). Both the methods of Beecher (2006) and Minamitaka (2012) relied solely on durational values rather than a research-based identified hierarchy for rhythmic pattern difficulty (Beecher, 2006, pp. 37-38; Minamitaka, 2012, pp. 2, 17). This ignored the possibility of difficulty being different from complexity. While their different equations may or may not relate to difficulty, without a study, it is not possible to know for sure.

According to past relatable studies and general knowledge, it is explained by Fraisse (1982) that “Generally, one can say that, the more a temporal form is brief and simple, the easier it is to perceive” (p. 170). Furthermore, in rhythm pattern production, “It is generally recognized that rhythms embodying simple interval ratios are easier to produce and reproduce than more complex temporal patterns” (Repp et al., 2002, p. 565). Pulse and metrical considerations also influence the difficulty of the performance of rhythmic patterns. Drake (1993) found that “Sequences composed of events organized around a regular beat are easier to perceive and reproduce than are sequences without such an organization” (p. 25). The research of Katz, Chelmla, and Pallier (2015) and Thaut (2005) reinforced Drake’s work. Studies by Drake (1993), Farley (2014), Fitch and Rosenfeld (2007), Katz et al. (2015), and Repp and Su (2013) all found that syncopated rhythmic patterns are more difficult to perform than non-syncopated rhythmic patterns. While Drake’s (1993) research did not go about the process of determining which patterns were more difficult than others, it was noted that types of rhythm patterns were played correctly or incorrectly in generally the same ratios regardless of age.

Regarding the rhythm pattern hierarchies that were found in previous research, many were similar, but none of the studies or sources yielded the same results. This is consistent with the lack of a study specifically geared toward that conclusion or goal. In the study of band method books, ranks of difficulty found in other studies, and textbooks on the study of music education (basic rhythm patterns most found in the repertoire), no specific and consistent list was found. This is consistent with the research of Brittin (2001), Ester et al., (2006), Gage (1994), Hoffman (2009), and Palkki (2010). Most materials introduced either the quarter note first

(Choksy, Abramson, Gillespie, Woods, & York, 2001; Gordon, 1974; McIntosh, 2009; Pearson, 2005; Spohn, 1977) or the whole note (Elledge & Haddad, 1992; Lautzenheiser et al., 2000; Sheldon, Boonshaft, Black, & Phillips, 2011). All of them introduced common time as the first meter. Only Harding (2010) and Maxwell (1973)introduced paired eighth notes in common time first. After the initial notes were introduced, there were no consistent second or following notes, but there were general agreements on the introduction or difficulty determined in terms of complexity. Triple rhythms generally were introduced either right before or right after sixteenth notes were introduced—if sixteenth notes were introduced at all—though Spohn (1977) found sixteenth notes to be no more or no less difficult than paired eighth notes (p. 65).

The Work and Influence of Gordon

Gordon undertook several significant studies that are relevant to this topic. In his 1971 work, Gordon used rhythmic duration series consisting of two, three, four, five, and six notes used in duple and triple meters that were categorized as *basic* and *complex.* The result of the work yielded the rhythm pattern taxonomy as indicated, growth rates between grade levels, and a method for the development of taxonomy classifications for future study (Gordon, 1971).

In 1974, a study by Gordon was done to develop a taxonomy of tonal and rhythm patterns. The 1974 study used the 1971 information from the national standardization program of the six levels of the *Iowa Tests of Music Literacy* (ITML). Subjects included children in grades 4-12 and represented 27 different school system located in 13 different states. In all, 18,680 subjects were available for use. Of those available, 250 were sampled in each norm group resulting in the actual sample size of 2,750.

Gordon reported on an additional study in his 1976 publication *Tonal and Rhythm Patterns: An Objective Analysis*. Two research problems were decided upon: (a) develop extensive separate taxonomies of tonal patterns and rhythm patterns and (b) establish the aural perception difficulty level and growth rate of the individual patterns in the taxonomies. 1,395 different patterns, including 533 rhythm patterns were taped and used in the study. The different patterns were used with 10,121 fourth, fifth, and sixth grade students. Rhythm patterns in the test were classified by meter as usual duple, usual triple, usual combined, unusual duple, unusual triple, unusual paired combined, unusual unpaired combined, and unusual unpaired nonmetrical. Subjects listened to two patterns for each item and filled out a bubble sheet whether they perceived the second pattern in each item was the same (S) or not the same (NS) as the first pattern. If the student could not tell if it was one of those choices, they were to choose the 'in-doubt response'. Item difficulty coefficients were used to decide the difficulty level of the patterns. Based on these results, patterns were classified as easy, moderately difficult, and difficult.

Patterns were also classified in terms of possessing high, typical, or static-regressive growth rates. Patterns shown as easier with age were classified as high; those that sustained their difficulty level as typical; and patterns that were shown to be more difficult as static-regressive. Based on the item difficulty coefficients, Gordon found rhythm patterns in usual duple meter patterns were easier in general than rhythm patterns in usual triple meter.

In 1978, Gordon reported on a different study. In it, four groups of fourth, seventh, and eighth-grade students in the Erie County public schools of New York participated. The resulting *easy* and *static* patterns were then used in the *Primary Measures of Music Audiation* (PMMA) (Gordon, 1979). The study (Gordon, 1979) does not have specific ramification or information that is relevant to the proposed study other than that difficulty levels of rhythm patterns were decided in the same manner as the 1976 study.

Specific to Gordon's studies—easily the most prestigious—some aspects have been found lacking. In Tunks' (1978) review of the most relevant study to this work, two significant matters were questioned. They were (a):

> Estimated difficulty levels of patterns, however, tended to be highly unstable, as indicated by extremely low correlations between item difficulty levels for different groups within grades and between item difficulty levels for different grades. This unreliability of item difficulty estimates renders suspect any generalizations concerning individual pattern difficulty level or growth rate. (p. 58)

and (b): "…a label of 'easy' does not necessarily indicate that a pattern was determined to be easy at all grade levels, but is based on combined responses of students across all three grades" (p. 59). By no means are these reflections put forth to criticize the work or Dr. Gordon or of others but rather to show where work is still left to be done.

The studies of Bradford (1995), Danahy (2013), Gardner (1971), Gordon (1971, 1974, 1976, 1979), Harding (2010), Lai (1999), Spohn (1977), Wolf (2004) all differ in significant ways from the current study. In none of them were the subjects of consistent age or developmental levels of high school students, and only the 1974 Gordon study having any in that realm at all. None measured rhythm reading. Only Danahy (2013), Gardner (1971), Harding (2010), and Wolf (2004) had any performance aspect. The studies of Bradford (1995), Gordon (1971 and 1979), Harding (2010), Spohn (1977), and Wolf (2004) all indicated a hierarchy of rhythm difficulty within the confines of their studies, though they were secondary goals or discoveries rather than the primary goal.

Assessment of Rhythm and Interpretation in the Field

With the different ways of scoring, assessments, and designs, each of the different tests or studies that have been discussed have aspects within them that, in the opinion of this researcher, could have been improved upon to yield clearer or more complete results. In addition, only the Bergee and Antonetti study (2012) had a similar sample—as 9th graders were used as well as third and fourth-year college students made up different sample populations. While the Bergee and Antonetti (2012) and Farley (2014) studies were similar in many ways to this study, each scored participants based upon large groups of rhythmic patterns; they also suspended tests after students were lost within the items. This did not allow for the possibility of the sequence of all measures to be done in some cases. That would possibly not allow for later measures in the given items to be identified accurately as less or more difficult as they were never even attempted due to students stopping or getting lost earlier in the assessment. Instead, any time a measure or rhythmic pattern was not attempted, those measures and/or patterns were scored as incorrect. Other tests or studies such as Gordon's work (1971, 1974, 1976, 1979) that did not have performance aspects, or those by Garner (1971) and Wolf (2004), which did not have rhythmic reading aspects to them, obviously would not allow for any type of measurement of those aspects.

Validity of Sight Reading for Tests

When reading music is addressed in the same manner that Lobier et al. (2013) addressed reading the written word, similarities are present. Sight reading, rather than prepared or rehearsed playing of music, can take on very similar procedures as reading the written word for fluency or comprehension. It is granted that reading and playing music at sight goes beyond the scope of reading and comprehending the written word as "Sight-reading is the ability to read and play music without prior rehearsal involving coordination of auditory, visual, spatial and kinesthetic systems to produce an accurate and musical performance" (Farley, 2014, p. 1). Rarely will someone read the same passages over and over for hours a day, and sometimes for weeks, in preparation for demonstrating fluency and comprehension, yet that is a common practice for musical ensembles as they prepare for concerts. Instead, "Sight-reading is… an evaluation of one's fluency in music reading, a skill that demonstrates musicians' comprehension of the system of musical symbols" (Farley, 2014, p. 1). Gromko (2004) found a positive correlation of sight reading with "…reading, audiation skills, reading achievement, and performance ability" (p. 9). This was in line with Hodges' (1992) work which stated that "It has been shown that there is a high positive correlation between rhythm reading and general performance when sight reading" (p. 467). In addition, Hodges (1992) showed that rhythmic sight reading ability, more than other factors, is a strong predictor variable in sight reading and overall musicianship assessment. Furthermore, sight reading overall "…is often included in auditions, during ensemble rehearsals and as part of individual practice" (Farley, 2014, p. 10). Based on these reports of the value and positive correlation of sight reading with musical performance skill and historical basis of use, it is justifiable that sight reading—rhythmic sight reading in particular—is used in studies which may determine musical competence and achievement.

CHAPTER 3

METHODOLOGY

Subjects

The subjects were 146 high school instrumental musicians from as many as eight suburban high schools in eastern Georgia. Each took one of three versions of the test—Appendix A, Appendix B, and Appendix C—where they performed each notational representation of a rhythmic pattern. Each student's information was held in confidence and attached to their results through the assigning of a number. Along with their performance on one of three versions of a test of rhythm patterns, information was collected for this and possible further study related to years of experience playing their instrument, and primary instrument. Subjects were randomly assigned to one of the three versions of the test.

Test Design

The development of the tests was undertaken after an expansive survey of rhythm tests, published band method, books, articles, and other sources was concluded to determine as many rhythm patterns as possible that appeared within the sources. The results of the survey identified 165 unique/different rhythm patterns that have been used in the instruction or testing of rhythm pattern reading (Appendix D). It is acknowledged that there are many fewer rhythm patterns in compound meter as opposed to simple meter. It is also acknowledged that there are likely many more groupings of rhythms that may or may not strictly fit Gordon's (1971, 1997) definition of rhythm patterns.

Rhythm Patterns for the Development of the Test

The selection of the rhythmic patterns for the study was of significant importance. In rhythmic patterns, duration(s) of sound in a given meter are sequential and exist as a result of the interaction among notes and rests; generally including at least two notes or rests and comprised of up to six notes or rests (Gordon, 1971, 1997). This is in line with the work of London (2002) and Repp (2005) who each gave their own specific guidelines of rhythmic patterns in research on tapping. This also relates to the studies of Bergee and Antonetti (2012) and Farley (2014), each of which had different goals but are relevant to this study. The rhythmic patterns used in this study were gleaned from a survey of the following instrumental method books, music education and psychology books, articles, and research in the general meters that they were noted in: "Applying Rasch Modeling to Develop a Rhythm-Reading Measure" (Bergee & Antonetti, 2012), *Teaching Music in The Twenty-First Century* (Choksy et al., 2001), *Comparative Audiation Difficulty of Tonal, Rhythm, and Melodic Patterns Among Grade 4 Students* (Danahy, 2013), *Band Technique Step-by-Step* (Elledge & Haddad, 1992), "The Relationship Between Musicians' Internal Pulse and Rhythmic Sight-Reading" (Farley, 2014), *The Rhythm Bible* (Fox, 2002), "Children's Duplication of Rhythmic Patterns" (Gardner, 1971), *The Psychology of Music Teaching* (Gordon, 1971), *Toward the Development of a Taxonomy of Tonal Patterns and Rhythm Patterns: Evidence of Difficulty Level and Growth Rate* (Gordon, 1974), *Learning Sequences in Music* (Gordon, 1997), *An Investigation of the Rhythmic Aptitude and Rhythm Achievement of First, Second, and Third Grade Students* (Harding, 2010), *Superior Bands in Sixteen Weeks* (Hilliard & Sheldon, 2003), *Essential Elements 2000-Comprehensive Band Method-Book 2* (Lautzenheiser et al., 2000), *Fourteen Weeks to a Better Band-Senior High Edition (Book 2)* (Maxwell, 1973), *The Jedi's Kung Fu Guide to Sight Reading (So Simple Even* *a Cave Man Drummer Can Understand It)* (McIntosh, 2009), *Standard of Excellence-Enhanced Comprehensive Band Method-Book 2* (Pearson, 2005), *Teacher Resource Kit* (Peterson, 1991), "Research in Learning Rhythms and the Implication for Music Education" (Spohn, 1977), *A Hierarchy of Rhythm Performance Patterns for Kindergarten Children* (Wolf, 2004), and *Sequential Patterns of Instruction in Music* (Yarbrough & Price, 1989).

Method of Test Performance

As the goal of the study was to yield a hierarchy of difficulty of the performance of rhythmic patterns, the test clearly had to be a performance-based assessment. This is in line with the work of Bergee and Antonetti (2012) and Farley (2014). There is ample research regarding the value and positive correlation of sight reading with musical performance skill and a historical basis of the use of sight reading for assessment of musical skill; therefore, it is reasonable that a sight reading test was used in this study. This was done to help discern rhythm reading competence and fluidity for the determination of the level of difficulty (Farley, 2014; Gromko, 2004; Hodges, 1992; Hodges & Nolker, 2011). The actual method of performance of the test by the subjects was a cause for thought. Bergee and Antonetti (2012) and this researcher contemplated the same issues and concluded as is described:

> One [problem] to resolve was how to assess participants' rhythm reading ability…. I considered allowing the participant to choose a comfortable note on their instruments, or in their vocal range, and perform the rhythms on this one pitch. I rejected that approach. An array of performing media was represented; inevitably, psychomotor issues (e. g., one tongue versus two sticks or bow directions) would have interfered with rhythm reading as such. (pp. 5–6)

In order to resolve the above problems and conclusions, students were assessed by tapping on a percussion pad. This allowed for a natural indication of performance, but did not increase the complexity of the task. This is in a similar manner to many of previous tapping experiments (Repp, 2006, 2010; Repp et al., 2002). The tapping of the performance of the test did not yield audible feedback in the sound of an instrument as on a keyboard or piano, but the sound of the tapping was more clearly audible to the subjects than tapping on a table or desk. Guided by the research of Bergee and Antonetti (2012) and Farley (2014), it was decided that a tempo of 80 bpm should be set for the rhythm patterns to be played as in Farley's (2014) study. While it is conceded that in the findings of Repp et al. (2002) the potential impact of global tempo on the grouping of notes or rhythmic patterns are valid, only one tempo was used. Each test was given as a video/slide presentation with computers of identical size, and at consistent distance and volume as all the other tests/subjects. Students sat in a normal school chair and table or a desk of normal height for their school while taking the test.

Test Versions

After the determining the rhythm patterns to be used, three tests were constructed—Test 1, Test 2, and Test 3 as shown in Appendix A, B, and C—each holding two-thirds of the rhythm patterns in a randomized order. Each rhythm pattern was given an arbitrary number and then randomized. The final order of items was grouped in thirds. The three tests were put together by selecting two of the three groups for each test so that each test used two of the three groups of items. This allowed for each test to have at least one group of items be the same as the other two tests.

To begin each item of the test, each rhythm pattern was performed after a subject had the opportunity to preview the pattern for the time it would take to perform it at the given tempo. For patterns two beats long, it was 1.7 seconds of preview time, and 3.4 seconds for patterns four beats long. After that preview time, two full measures of guiding tones were given. This is in line with the work of Farley (2014). The tones indicated the beat (and therefore tempo) in the given meters. The tones did not continue through the performance of the item. The decision not to continue the tones takes into account the work of Repp (1998, 2005, 2006, 2010) and Repp and Su (2013), which indicate that, while guiding tones can be helpful, they also may become a distraction when expressive timing is allowed. This distractor could cause an unintended error on the part of the subject as they seek to correct or overcorrect to the guiding tones. The research of Fitch and Rosenfeld (2007) found that musicians are generally able to keep a steady pulse without a guiding tone or pulse for tempo.

To assess the performance of the subjects, a main panel of three secondary instrumental music teachers assessed each rhythmic pattern in the tests. As was the case with Farley's (2014) research, this study acknowledges, but is not strictly interested in, mechanical reproduction of rhythm patterns as long as the performance is within reason of expressive timing. As such, like Farley's study (2014), outside evaluators were given the instructions to make a determination on whether the performance of the rhythmic pattern was correct or incorrect according to their best judgment. This was done as, "Rasch, Andersen, and Barndorff-Nielsen each proved decisively that only item difficulty can actually be estimated consistently and sufficiently from the right/wrong item response data available for item analysis" (Wright & Stone, 1979, p. ix). If all three main panelists agreed, it was be deemed as correct or incorrect depending on the determination. If they did not all agree, a fourth judge assessed the performance of the item. If the fourth judge agreed with the majority, the item was recorded as the majority decided; however, if the fourth judge disagreed with the majority, the item was thrown out for that specific subject. Judge did not assess the performances live, but instead listened to the recordings of each performance. This was done individually on their own, not together with each other. None of the main panelists knew what the other panelist rated any item, nor were they told who the other main panelists were. The no judge knew the name, age, gender, instrument, or school of any of the subjects, but only the confidential random number assigned by the researcher.

Method of Scoring and Interpretation of Data

The data of correct and incorrect answers for the three tests were compiled and put through the MFR model using *FACETS* software (Linacre, 2009). “Only the Rasch model allows us to estimate difficulty and ability independently of one another in such a way that the estimates are freed from the effects of each other” (Wright & Stone, 1979, p. 15). This process and the background are thoroughly explained in the book *Best Test Design*. Dichotomous (e.g., right/wrong) scoring of the latent variable—the performance of rhythm patterns—allowed for the calculation of a specific difficulty level for each item, achievement level for each person, and for each instrument category.

The Rasch model has five requirements of invariant measurement:

1. The measurement of persons must be independent of the particular items that happen to be used for the measuring: Item-invariant measurement of persons.

2. A more able person must always have a better chance of success on an item than a less able person: Non-crossing person response functions.

3. The calibration of the items must be independent of the particular persons used for calibration: Person-invariant calibration of test items.

4. Any person must have a better chance of success on an easy item than on a more difficult item: Non-crossing item response functions.

5. Items must be measuring a single underlying latent variable: Unidimensionality.

(Perkins & Engelhard Jr., 2009, p. 1184)

This study's adherence to these requirements was necessary to realize the benefits of the MFR model. For this study, the calibration of the items was done independently of the measurement of persons and the scoring of subjects was done independently from the items. This allowed for the relevant identification of a hierarchy of difficulty of the given rhythm patterns (research question 1) and for the estimation of ability level of the persons that was independent of each other or the primary instrument of the persons using *FACETS* software (Linacre, 2009). The resulting information allowed for the answer of research question 2, 3 and 4. The MFR model was ideal as the study was focused specifically on the identification of the difficulty of the performance level of each rhythmic pattern (research question 2). The MFR model is able to develop sample-independent results by taking facet data and transforming them through analysis to give measure values. It is significant that the MFR model, an item response theory model, allows for the placement and rating of subjects on the same scale as the items once the calibration of items by difficulty has been achieved (Bond & Fox, 2015).

CHAPTER 4

RESULTS

The overreaching purpose of this study was to objectively identify a hierarchy of performance difficulty of rhythm patterns in the context of high school band students. Chapter 4 provides the results of the Rasch analysis of the constructed rhythm tests (Appendix A, B, and C). This study was guided by the following research questions:

1. Can a hierarchy of difficulty be objectively identified?
2. How should the items be analyzed to best achieve accuracy of scoring?
3. Does the instrument one plays (primarily) have an impact on the level of the student performance of rhythm patterns?
4. Do students generally have different levels of rhythm reading skill based upon years of study in band?

The primary instrument type and the data of correct and incorrect answers for the three tests (Appendix A, B, and C) as determined by a panel of judges were compiled for each student. Once this information was compiled, the application of the MFR model was used to transform observed scores to linear measures using *FACETS* software (Linacre, 2009). The analysis results show the difficulty of the rhythm patterns (item), the level of the students (subjects), and the average level by instrument type (category) through a measure score for each item, subject, and category. Each of these are able to be shown in alignment and independently of the other facets. It was not deemed important to include the number of years in public school band programs in the MFR analysis as the number of years does not influence the type of pattern a student is capable of performing or their primary instrument directly. This will be elaborated on in Chapter 5.

Participant Characteristics

Table 4.1 provides a breakdown of major instruments and number of years in public school band programs. The subjects were 146 high school instrumental musicians from as many as eight suburban high schools in eastern Georgia. In addition to taking part in the rhythm tests, each student indicated their primary instrument and the number of years they have been involved in public school band programs. Four students did not complete the tests, which invalidated their results. The number of students who completed the study was 142. The largest group of students by instrument was flute players with 31. The largest group of students by the number of years of band experience was four years with 39 participants. 74 participants were woodwind players, 46 subjects were brass players and 22 were percussionists. This is a fairly general distribution of students within an average band program of instrument coverage. 118, or 83% of the subjects, by far the largest amount of students by years, were in year 4, 5, 6, or 7. Generally, that may indicate that most of the subjects began band in sixth grade and have continued in band to their present year. The rest of the 24 subjects either began in band later or started before their sixth-grade year. It is likely that if a student started band earlier than sixth grade, they moved from a different part of the country than in eastern Georgia where the majority of the students attend school.

Table 4.1

Subject Characteristics by Instrument and Years in Public School Bands

Characteristic	Number of Students (*n* = 142)	Percentage of Students
Instrument		
Flute	31	21.83
Oboe	2	1.41
Bassoon	1	.70
Soprano Clarinet	19	13.38
Bass Clarinet	1	.70
Alto Saxophone	14	9.86
Tenor Saxophone	3	2.11
Bari Saxophone	3	2.11
Trumpet	18	12.68
Horn in F	7	4.93
Trombone	4	2.82
Euphonium	11	7.75
Tuba	6	4.23
Percussion	22	15.49
Number of Years in Public School Band		
1	0	0.00
2	4	2.82
3	12	8.45
4	39	27.46
5	32	22.54
6	26	18.31
7	21	14.79
8	7	4.93
9	1	.70

Multifaceted Rasch Analysis Results

Table 4.2 presents summary statistics from the MFR analysis of students (*n* =142), item/rhythm patterns (*n* =165), and instruments (*n* =14). The analysis indicated overall significant differences in chi-square between subjects/students (3156.4), item/rhythm patterns (2045), and category/instruments (11.6); however, probability for each was under .001 and reliability for separation for each facet is high: students (.96), item/rhythm patterns (.94), and instrument (.90).

This indicates a very good spread of elements within each facet along the rhythm patterns measure. Mean Information-weighted fit (Infit) and Outlier-sensitive fit (Outfit) Mean Square Errors (MSE) values close to 1.00 indicate a good model fit and show validity evidence that the variable map (Figure 4.1) may be utilized as a graphical representation of the model. This specifically addresses research questions 1 and 2: Can a hierarchy of difficulty be objectively identified; and How should the items be analyzed to best achieve accuracy of scoring?

Table 4.2

Summary Statistics from MFR Model

	Facets		
	Student	**Instrument**	**Item/Rhythm Pattern**
Measure (Logits)			
Mean	0.00	0.81	-0.04
SD	1.36	0.42	1.21
n	142	14	165
Infit *MSE*			
Mean	0.99	1.01	1.00
SD	0	0.00	-0.10
Std. Infit			
Mean	0.12	0.08	0.19
SD	1.10	1.20	1.40
Outfit *MSE*			
Mean	1.05	1.08	1.05
SD	0.10	0.70	0.00
Std. Outfit			
Mean	0.65	0.22	0.69
SD	1.30	2.20	1.30
Separation Statistics			
Reliability of Separation	0.96	0.90	0.94
Chi-Square	3156.40*	11.60*	2045.00*
Degrees of Freedom	141	13	164

* $p < 0.01$

```
Measr|+Students  |-Instrument                              |-Items
-----+-----------+-----------------------------------------+------------------------------------------------------------------------
   4 +           +                                         +
     | .         |                                         |
     |           |                                         |
     | *         |                                         | 131
     |           |                                         |
     |           |                                         |
   3 + *         +                                         +
     | .         |                                         |
     | *.        |                                         |
     |           |                                         | 136
     | *         |                                         | 139
     | *         |                                         | 137
   2 + *         +                                         + 126  165
     | .         |                                         | 129  145  85
     | *         |                                         | 123  132  147
     | ***       |                                         | 125  128  130  134  26
     | *.        | Bassoon        Oboe           Trombone  | 133  140  96
     | *         | Tuba                                    | 102  118  119  120  49
   1 + **        + Bari Sax       Euphonium                + 121  124  138  73   82   87
     | ***.      | Clarinet       Flute                    | 127  146  150  81   83   97
     | .         | Trumpet                                 | 117  135  144  153  31   34   38   50   69
     | *         | Alto Sax       Bass Clarinet  Horn      | 141  25   57   74   75   76   84   98
     | **.       | Percussion                              | 106  111  115  143  152  18   36   51   72   78
     | ********. |                                         | 151  154  158  161  163  27   29   32   42   56   67   77   90
   0 * **.       * Tenor Sax                               * 105  112  114  116  155  16   160  22   8    94
     | *         |                                         | 101  110  148  35   37   40   44   58   61   80
     | ****      |                                         | 149  19   59   66   79   86   99
     | ****.     |                                         | 122  142  20   24   33   41   43   48   53   68   70
     | *****.    |                                         | 108  109  11   159  17   30   4    47   5    55   62   65   89   93   95
     | **.       |                                         | 13   156  162  52   6    64
  -1 + ****      +                                         + 21   54   63   88
     | **        |                                         | 113  15   23   7    91   92
     | **        |                                         | 100  104  107  12   28   45   60   71   9
     | ****      |                                         | 14
     | **        |                                         | 164
     | .         |                                         | 103  46
  -2 + .         +                                         + 10
     |           |                                         | 39
     | *.        |                                         | 157
     | .         |                                         |
     | *         |                                         |
     |           |                                         |
  -3 + .         +                                         +
     |           |                                         |
     |           |                                         |
     |           |                                         |
     |           |                                         | 1    2
     |           |                                         |
  -4 +           +                                         + 3
-----+-----------+-----------------------------------------+------------------------------------------------------------------------
Measr| * = 2     |-Instrument                              |-Items
----------------------------------------------------------------------------------------------------------------------------------
```

Figure 4.1. Variable Map

Figure 4.1 is a variable map that graphically displays the latent variable investigated in this study. It specifically contains the calibration of facets included in the model on the same linear scale: Students (column 2), Primary Instrument (column 3), and Item/Rhythm Pattern (column 4). The labels at the top and bottom of the map indicate the facet and directionality of the measure. Column 1 includes the units of the logit scales whereby all the facets can be calibrated for comparison with one another. This specifically addresses research questions 1 and

2: Can a hierarchy of difficulty be objectively identified; and How should the items be analyzed to best achieve accuracy of scoring?

Column 2 of Figure 4.1 includes the spread of the student achievement where each period (.) represents one student and each asterisk (*) represents two students. This is expanded up on in Table 4.3. Student achievement ranged from 3.87 to -2.92 logits (*M* = .00, *SD* = 1.36, *n* = 142). Higher measure scores indicate higher student achievement just as lower measure scores indicate lower student achievement. It is understood that there are misfit results for one reason or another. Misfit items may be identified based upon Infit and Outfit MSE statistical results yielding outside of the rule-of-thumb ranges of .60 and 1.40 and/or Standardized (Std.) Infit and/or Outfit ranges of +/- 2.00 as indicated by Bond and Fox (2007). Misfit student achievement included students 4, 7, 9, 15, 27, 94, 98, and 135. Only 5.63% of the total subjects would possibly be labeled as misfits. The results provide a fair and impartial rank ordering of student achievement based upon the probabilistic distribution of responses as a logistic function of person and item parameters.

Table 4.3

Calibration of Student Achievement

Student Number	**Instrument**	**Years in Band**	**Observed Average**	**Measure**	**SE**	**Infit *MSE***	**Std. Infit**	**Outfit *MSE***	**Std. Outfit**
43	Clarinet	6	0.9	3.87	0.39	0.82	-0.5	0.38*	-1.2
36	Euphonium	6	0.9	3.52	0.33	0.96	-0.1	0.94	0.0
87	Alto Sax	7	0.9	3.46	0.37	1.25	0.9	8.06*	5.9*
136	Flute	7	0.9	3.03	0.29	0.95	-0.2	0.98	0.0
21	Tuba	7	0.8	2.93	0.26	0.86	-0.9	0.63	-1.3
49	Flute	5	0.8	2.90	0.28	0.97	-0.1	0.84	-0.4
120	Trumpet	6	0.9	2.72	0.30	0.91	-0.4	0.72	-0.6
46	Trumpet	6	0.8	2.69	0.29	1.03	0.2	1.14	0.5

Student Number	Instrument	Years in Band	Observed Average	Measure	SE	Infit *MSE*	Std. Infit	Outfit *MSE*	Std. Outfit
41	Clarinet	6	0.8	2.60	0.27	1.12	0.7	0.99	0.0
130	Flute	5	0.8	2.28	0.24	0.91	-0.7	0.79	-0.9
39	Horn in F	5	0.8	2.28	0.26	1.14	0.9	1.15	0.5
11	Horn in F	6	0.8	2.24	0.27	0.94	-0.3	0.81	-0.5
35	Alto Sax	5	0.8	2.12	0.26	1.20	1.3	1.38	1.2
44	Clarinet	5	0.8	2.08	0.24	1.02	0.1	0.96	0.0
5	Percussion	4	0.8	1.92	0.26	0.82	-1.2	0.77	-0.7
111	Percussion	5	0.8	1.90	0.25	0.88	-0.8	0.77	-0.8
73	Tenor Sax	3	0.8	1.67	0.27	0.96	-0.1	1.03	0.1
134	Horn in F	6	0.7	1.59	0.23	0.83	-1.6	0.82	-0.9
48	Trumpet	7	0.7	1.55	0.22	0.84	-1.6	0.81	-1.0
119	Percussion	5	0.7	1.49	0.24	1.04	0.3	0.95	-0.1
18	Percussion	7	0.7	1.48	0.23	0.98	-0.1	0.91	-0.3
19	Trumpet	7	0.7	1.46	0.22	0.89	-1.0	0.84	-0.9
63	Percussion	6	0.7	1.44	0.23	0.90	-0.8	0.87	-0.6
17	Percussion	7	0.7	1.43	0.24	0.89	-0.9	0.75	-1.0
40	Percussion	4	0.7	1.38	0.23	0.98	-0.1	0.91	-0.4
96	Flute	6	0.6	1.32	0.21	1.01	0.1	1.01	0.1
81	Clarinet	3	0.6	1.28	0.21	0.88	-1.4	0.92	-0.5
16	Tenor Sax	5	0.7	1.23	0.24	1.01	0.1	1.03	0.1
90	Alto Sax	4	0.6	1.15	0.22	0.99	0.0	0.95	-0.3
125	Percussion	5	0.7	1.08	0.22	1.01	0.1	1.08	0.5
33	Percussion	8	0.7	1.07	0.22	0.90	-1.0	0.81	-1.1
12	Trumpet	7	0.6	1.03	0.21	0.94	-0.7	0.87	-0.9
89	Flute	8	0.5	0.96	0.21	0.83	-2.3*	0.79	-1.7
108	Euphonium	5	0.5	0.90	0.21	1.02	0.2	0.96	-0.2
76	Clarinet	5	0.5	0.89	0.21	0.93	-0.9	1.22	1.5
64	Trombone	4	0.4	0.85	0.22	0.91	-1.0	0.85	-1.1
86	Oboe	7	0.4	0.84	0.22	0.83	-2.0	0.75	-1.8
37	Flute	5	0.5	0.83	0.21	0.87	-1.7	0.83	-1.4
123	Percussion	3	0.6	0.82	0.22	0.94	-0.6	0.87	-0.7
94*	Flute	2	0.5	0.75	0.21	1.16	1.9	1.31	2.2*
145	Flute	8	0.5	0.74	0.21	1.05	0.7	1.11	0.8
53	Euphonium	4	0.4	0.45	0.22	1.01	0.1	1.05	0.3
24	Trumpet	4	0.5	0.45	0.21	1.02	0.2	0.99	0.0
42	Trumpet	6	0.5	0.41	0.21	1.09	1.1	1.11	0.8
4*	Alto Sax	4	0.5	0.40	0.21	0.68	-4.5*	0.61	-3.4*
144	Tuba	4	0.4	0.39	0.22	1.01	0.0	0.95	-0.2
15*	Alto Sax	5	0.5	0.34	0.21	1.26	3.1*	1.37	2.6*

Student Number	Instrument	Years in Band	Observed Average	Measure	SE	Infit *MSE*	Std. Infit	Outfit *MSE*	Std. Outfit
20	Clarinet	4	0.4	0.26	0.22	1.03	0.3	1.02	0.1
13	Clarinet	4	0.4	0.24	0.22	1.10	1.2	1.28	1.7
100	Flute	4	0.4	0.24	0.22	1.02	0.2	0.94	-0.3
26	Trumpet	4	0.4	0.24	0.21	1.10	1.2	1.12	0.9
82	Trumpet	5	0.4	0.24	0.21	0.82	-2.4*	0.96	-0.2
32	Bass Clarinet	6	0.4	0.22	0.22	0.95	-0.5	0.95	-0.2
9*	Euphonium	9	0.4	0.22	0.21	1.22	2.6*	1.61*	4.0*
1	Alto Sax	4	0.4	0.20	0.21	0.89	-1.4	0.82	-1.3
61	Percussion	4	0.5	0.17	0.21	1.13	1.6	1.2	1.4
80	Alto Sax	7	0.3	0.16	0.22	0.97	-0.2	0.87	-0.7
78	Euphonium	7	0.4	0.16	0.21	0.90	-1.3	0.88	-0.8
30	Flute	8	0.3	0.15	0.24	0.97	-0.2	1.09	0.4
88	Trombone	7	0.4	0.15	0.22	0.90	-1.0	0.82	-1.2
14	Euphonium	4	0.3	0.12	0.22	1.13	1.3	1.16	1.0
27*	Clarinet	6	0.4	0.10	0.22	1.41*	4.1*	1.87*	4.5*
115	Clarinet	7	0.4	0.10	0.22	1.00	0.0	1.01	0.1
7*	Flute	7	0.3	0.09	0.22	1.26	2.6*	1.65*	3.2*
97	Flute	4	0.3	0.09	0.22	0.97	-0.2	0.97	-0.1
91	Clarinet	4	0.4	0.07	0.22	1.15	1.6	1.11	0.7
133	Flute	6	0.3	0.04	0.22	1.13	1.3	1.72*	3.5*
124	Percussion	8	0.4	-0.02	0.21	0.83	-2.2	0.78	-1.8
38	Flute	3	0.3	-0.04	0.22	0.99	-0.1	1.04	0.2
106	Percussion	5	0.4	-0.07	0.21	1.03	0.4	1.09	0.6
116	Tuba	7	0.2	-0.10	0.24	1.10	0.8	1.06	0.3
23	Trumpet	4	0.4	-0.18	0.22	1.06	0.6	1.11	0.7
140	Flute	4	0.3	-0.27	0.23	1.04	0.4	1.01	0.1
85	Bari Sax	7	0.3	-0.28	0.24	0.94	-0.4	0.95	-0.1
67	Alto Sax	3	0.3	-0.30	0.22	1.00	0.0	0.93	-0.3
135*	Percussion	7	0.4	-0.33	0.22	0.74	-3.3*	0.65	-2.8*
102	Alto Sax	4	0.3	-0.36	0.22	1.01	0.1	0.95	-0.2
65	Bari Sax	8	0.2	-0.36	0.24	1.12	0.9	1.05	0.2
51	Percussion	4	0.4	-0.39	0.22	1.01	0.1	0.98	0.0
132	Bari Sax	5	0.2	-0.40	0.24	0.99	0.0	0.97	0.0
118	Percussion	4	0.4	-0.43	0.22	0.99	0.0	1.03	0.2
52	Tuba	4	0.2	-0.44	0.25	0.88	-0.8	0.91	-0.3
22	Trumpet	4	0.3	-0.45	0.23	1.00	0.0	1.23	1.1
141	Flute	4	0.3	-0.47	0.24	1.05	0.4	1.31	1.4
31	Clarinet	7	0.2	-0.53	0.24	1.03	0.2	1.19	0.8

Student Number	Instrument	Years in Band	Observed Average	Measure	SE	Infit *MSE*	Std. Infit	Outfit *MSE*	Std. Outfit
62	Percussion	4	0.3	-0.53	0.22	0.82	-1.9	0.72	-1.8
112	Flute	8	0.2	-0.56	0.25	1.06	0.4	1.10	0.4
34	Flute	6	0.3	-0.56	0.23	0.91	-0.8	0.78	-1.0
92	Trumpet	7	0.2	-0.56	0.25	1.18	1.3	1.07	0.3
10	Horn in F	6	0.3	-0.59	0.23	1.15	1.3	1.24	1.1
129	Bassoon	5	0.2	-0.60	0.27	1.11	0.7	1.18	0.7
57	Flute	6	0.2	-0.62	0.25	1.04	0.3	0.89	-0.3
72	Flute	4	0.2	-0.62	0.25	1.12	0.9	1.58*	1.9
127	Clarinet	5	0.2	-0.64	0.25	0.99	0.0	0.88	-0.4
105	Flute	6	0.2	-0.68	0.25	0.86	-0.9	0.77	-0.8
98	Tuba	5	0.2	-0.71	0.27	1.19	1.1	2.00*	2.8*
101	Flute	5	0.2	-0.72	0.25	0.88	-0.8	0.74	-1.1
28	Trumpet	6	0.2	-0.73	0.24	1.14	1.1	1.43*	1.6
70	Alto Sax	2	0.2	-0.74	0.25	1.10	0.7	1.25	1.0
103	Clarinet	4	0.2	-0.74	0.24	1.23	1.8	1.88*	3.1*
128	Alto Sax	4	0.3	-0.79	0.23	1.02	0.2	1.09	0.5
109	Percussion	5	0.2	-0.79	0.24	1.03	0.2	0.98	0.0
69	Flute	3	0.2	-0.82	0.26	1.10	0.6	1.17	0.6
131	Flute	6	0.2	-0.82	0.26	1.00	0.0	0.93	-0.1
117	Flute	5	0.2	-0.85	0.26	1.02	0.2	1.00	0.0
143	Clarinet	6	0.2	-0.97	0.28	0.89	-0.6	0.63	-1.2
99	Flute	5	0.2	-0.97	0.27	0.86	-0.8	0.71	-1.0
25	Trumpet	4	0.2	-0.98	0.26	1.01	0.1	0.89	-0.3
93	Trombone	4	0.1	-0.99	.0.32	1.03	0.2	1.13	0.4
104	Clarinet	6	0.2	-1.00	0.26	0.95	-0.2	1.40	1.4
56	Trumpet	5	0.2	-1.04	0.26	0.92	-0.5	0.78	-0.7
77	Percussion	5	0.2	-1.06	0.24	1.01	0.1	1.31	1.3
139	Euphonium	5	0.1	-1.08	0.29	1.17	0.9	1.78*	1.9
84	Alto Sax	7	0.2	-1.11	0.26	1.10	0.7	1.23	0.8
6	Alto Sax	6	0.2	-1.18	0.26	0.93	-0.4	0.75	-0.8
113	Euphonium	6	0.1	-1.18	0.30	0.91	-0.3	0.69	-0.7
137	Flute	3	0.1	-1.21	0.30	1.00	0.0	1.15	0.5
142	Horn in F	4	0.2	-1.25	0.27	0.82	-1.1	0.61	-1.4
114	Trumpet	4	0.2	-1.28	0.27	0.92	-0.4	0.90	-0.2
50	Percussion	6	0.2	-1.34	0.25	0.96	-0.2	0.86	-0.5
2	Euphonium	5	0.1	-1.37	0.31	1.18	0.8	1.36	0.9
121	Flute	4	0.1	-1.47	0.32	0.89	-0.4	0.68	-0.7
60	Clarinet	3	0.1	-1.48	0.31	0.91	-0.3	0.70	-0.6
138	Flute	4	0.1	-1.49	0.31	0.97	0.0	0.82	-0.3

Student Number	Instrument	Years in Band	Observed Average	Measure	SE	Infit *MSE*	Std. Infit	Outfit *MSE*	Std. Outfit
122	Flute	5	0.1	-1.50	0.32	0.83	-0.7	0.63	-0.8
71	Horn in F	4	0.1	-1.56	0.29	1.00	0.0	1.08	0.3
55	Alto Sax	3	0.1	-1.58	0.33	0.97	0.0	0.86	-0.2
110	Euphonium	3	0.2	-1.58	0.29	0.93	-0.3	0.92	-0.1
126	Euphonium	5	0.1	-1.58	0.33	1.06	0.3	1.49*	1.1
107	Tenor Sax	6	0.2	-1.60	0.25	0.96	-0.2	0.75	-1.1
3	Clarinet	5	0.1	-1.66	0.33	1.13	0.6	1.38	0.9
45	Percussion	4	0.1	-1.66	0.31	0.98	0.0	0.73	-0.6
95	Trumpet	3	0.2	-1.66	0.28	0.83	-1.0	0.70	-0.9
59	Oboe	2	0.1	-1.90	0.44	0.98	0.0	0.88	0.0
83	Clarinet	7	0.1	-2.02	0.37	1.02	0.1	1.03	0.2
47	Trombone	4	0.0	-2.28	0.49	0.84	-0.3	0.81	0.0
54	Flute	6	0.1	-2.33	0.44	0.95	0.0	0.89	0.0
146	Horn in F	5	0.1	-2.36	0.39	0.97	0.0	0.68	-0.4
75	Percussion	4	0.1	-2.47	0.37	0.89	-0.3	1.23	0.5
58	Clarinet	3	0.1	-2.65	0.45	0.90	-0.1	1.39	0.7
68	Trumpet	5	0.1	-2.70	0.44	0.93	0.0	0.55	-0.5
74	Tuba	2	0.0	-2.92	0.61	0.88	0.0	0.69	0.0
Mean			0.4	0.00	0.26	0.99	0.0	1.05	0.1
SD			0.2	1.38	0.06	0.12	1.1	0.65	1.3

Note. The items are presented in Measure order, from high (highest achievement) to low (lowest achievement). Misfit students/scores have an asterisk.

Column 3 of Figure 4.1 represents the calibration of the major instruments. This is expanded upon in Table 4.4. Category achievement ranged from 1.41 to -0.05 logits (*M* = .81., *SD*,= .42, *n* = 14). Misfit item difficulty included only Bass Clarinet. Only 1 student was a Bass Clarinetist. Linacre (2002) recommended that the minimum number of subjects for a category be 10. Bass clarinet, oboe, bassoon, tenor saxophone, baritone saxophone, horn in F, trombone, and tuba are all underrepresented based on Linacare's recommendation (2002). For the well-represented groups of flute, clarinet, alto saxophone, trumpet, euphonium and percussion, the results provide a fair and impartial rank ordering of category achievement based upon the probabilistic distribution of responses as a logistic function of person and item parameters. This specifically addresses research question 3: Does the instrument one plays (primarily) have an impact on the level of the student performance of rhythm patterns? Based on the results from Rasch analysis, the primary instrument a student plays has an impact upon a student's rhythm pattern performance skill. The impact may be small compared to the range of the overall scale of eight logits, but it is significant. The reason for the impact is beyond the scope of this study.

Table 4.4

Calibration of Primary Instruments

Instrument Number	**Observed Average**	**Measure**	**Standard Error**	**Infit MSE**	**Std. Infit**	**Outfit MSE**	**Std. Outfit**
2-Oboe	0.2	1.41	0.19	0.86	-1.4	0.82	-0.4
11-Trombone	0.2	1.4	0.14	0.95	-0.7	0.97	0.0
8-Bassoon	0.2	1.28	0.27	1.11	0.7	1.18	0.7
13-Tuba	0.3	1.17	0.11	1.00	0.0	1.04	0.2
7-Bari Sax	0.2	1.03	0.14	1.02	0.2	0.99	0.0
12-Euphonium	0.3	1.01	0.08	1.03	0.6	1.10	1.0
1-Flute	0.3	0.89	0.04	1.00	0.1	1.01	0.1
3-Clarinet	0.4	0.81	0.06	1.04	1.1	1.09	1.1
9-Trumpet	0.4	0.60	0.06	0.98	-0.9	0.94	-0.8
5-Alto Sax	0.4	0.54	0.06	1.01	0.4	1.55	7.0*
10-Horn	0.4	0.52	0.10	0.98	-0.3	0.91	-0.6
4-Bass Clarinet*	0.4	0.46	0.21	1.22	2.6*	1.61*	4.0*
14-Percussion	0.5	0.27	0.05	0.94	-2.5*	0.92	-1.6
6-Tenor Sax	0.6	-0.05	0.14	0.98	-0.2	0.93	-0.4
Mean	0.4	0.81	0.12	1.01	0.0	1.08	0.7
SD	0.1	0.42	0.07	0.08	1.2	0.22	2.2

Note. The items are presented in Measure order, from high (highest achievement) to low (lowest achievement). Misfit categories/scores have an asterisk.

Column 4 of Figure 4.1 represents the calibration of the item/rhythm patterns difficulty. This was expanded upon in Table 4.5. Difficulty ranged from 3.46 to -7.27 logits (M = -.04., SD,= 1.21, n = 165). Misfit items may include items 1, 3, 5, 20, 28, 35, 37, 58, 59, 61, 73, 92, 94, 121, 125, 144, 149, 159, 160, and 163. Misfit items may be identified based upon Infit and Outfit MSE statistical results and/or Standardized (Std.) Infit and/or Outfit as indicated by Bond and Fox (2007, p. 243). Only items 1 and 3 do not have several other items shown to have statistically significant reliability for a similar level of difficulty. The results provide a fair and impartial rank ordering of item/rhythm pattern difficulty based upon the probabilistic distribution of responses as a logistic function of person and item parameters. This specifically addresses research questions 1 and 2: Can a hierarchy of difficulty be objectively identified; and How should the items be analyzed to best achieve accuracy of scoring?

Table 4.5

Calibration of Item/Rhythm Pattern Difficulty

Item Number	Observed Average	Measure	Standard Error	Infit MSE	Std. Infit	Outfit MSE	Std. Outfit
131	0.0	3.46	0.55	1.02	0.1	1.04	0.4
136	0.1	2.53	0.41	0.99	0.0	1.63	0.9
139	0.1	2.26	0.38	1.25	1.0	0.90	0.0
137	0.1	2.22	0.38	1.32	1.2	1.71	1.1
165	0.1	2.08	0.37	1.05	0.2	1.19	0.5
126	0.1	1.95	0.36	1.05	0.3	1.05	0.2
129	0.1	1.86	0.35	0.98	0.0	1.11	0.3
145	0.1	1.86	0.35	1.19	0.9	1.31	0.6
85	0.1	1.84	0.35	0.76	-1.1	0.61	-0.5
123	0.1	1.75	0.34	1.40	1.8	2.14	1.8
132	0.1	1.72	0.34	0.96	-0.1	0.95	0.0
147	0.2	1.60	0.33	0.99	0.0	0.82	-0.1
125*	0.2	1.53	0.32	1.49*	2.2*	1.39	0.8
130	0.2	1.49	0.33	0.93	-0.2	0.65	-0.6
26	0.2	1.49	0.32	0.70	-1.6	0.46	-1.4
128	0.2	1.43	0.32	1.14	0.8	1.50	1.1
134	0.2	1.43	0.32	0.99	0.0	0.79	-0.3
133	0.2	1.39	0.32	1.30	1.4	1.54	1.1
96	0.2	1.33	0.31	0.94	-0.2	0.57	-1.0
140	0.2	1.33	0.31	1.07	0.4	1.44	1.0

Item Number	Observed Average	Measure	Standard Error	Infit MSE	Std. Infit	Outfit MSE	Std. Outfit
119	0.2	1.19	0.31	0.90	-0.5	0.80	-0.3
118	0.2	1.14	0.30	1.11	0.6	0.97	0.0
49	0.2	1.11	0.30	0.73	-1.6	0.59	-1.2
102	0.2	1.11	0.30	0.96	-0.1	0.67	-0.9
120	0.2	1.10	0.30	1.13	0.7	1.45	1.1
82	0.2	1.02	0.29	0.76	-1.4	0.58	-1.3
124	0.2	1.02	0.29	1.13	0.7	1.44	1.2
73*	0.2	1.01	0.30	0.65	-2.2*	0.51	-1.4
121*	0.2	0.93	0.29	1.42*	2.2*	1.90*	2.3*
138	0.2	0.93	0.29	1.12	0.7	1.09	0.3
87	0.2	0.92	0.29	0.67	-2.1*	0.49	-1.6
81	0.2	0.88	0.29	0.97	-0.1	0.95	0.0
146	0.2	0.88	0.29	1.23	1.3	1.52	1.4
150	0.2	0.88	0.29	0.94	-0.3	0.87	-0.2
97	0.2	0.84	0.29	1.35	1.9	2.03*	2.4*
127	0.3	0.80	0.28	1.11	0.7	1.09	0.3
83	0.2	0.75	0.29	0.80	-1.2	0.84	-0.4
34	0.3	0.67	0.28	1.05	0.3	0.84	-0.4
117	0.3	0.67	0.28	1.17	1.0	1.12	0.4
144*	0.3	0.67	0.28	1.46*	2.5*	1.61*	1.7
31	0.3	0.65	0.28	1.13	0.8	1.19	0.7
50	0.3	0.61	0.28	0.83	-1.1	0.74	-0.9
69	0.3	0.61	0.28	0.87	-0.7	0.77	-0.8
38	0.3	0.60	0.28	0.75	-1.6	0.67	-1.1
135	0.3	0.60	0.28	1.12	0.7	1.02	0.1
153	0.3	0.60	0.28	0.89	-0.6	0.72	-0.9
57	0.3	0.52	0.28	0.87	-0.8	1.02	0.1
75	0.3	0.46	0.27	0.77	-1.6	0.64	-1.5
84	0.3	0.46	0.27	0.94	-0.3	0.88	-0.4
76	0.3	0.44	0.27	0.74	-1.9	0.60	-1.6
25	0.3	0.42	0.27	0.77	-1.7	0.57	-1.8
74	0.3	0.42	0.27	1.10	0.7	1.52	1.8
98	0.3	0.42	0.27	1.08	0.5	1.15	0.6
141	0.3	0.42	0.27	1.03	0.2	1.03	0.2
36	0.3	0.39	0.27	1.11	0.7	1.15	0.6
143	0.3	0.39	0.27	0.98	-0.1	0.83	-0.6
72	0.3	0.37	0.27	1.06	0.4	1.24	0.9
106	0.3	0.32	0.26	0.87	-0.8	0.80	-0.8
111	0.3	0.32	0.26	0.97	-0.1	1.13	0.5
152	0.3	0.32	0.26	0.91	-0.5	1.00	0.0

Item Number	Observed Average	Measure	Standard Error	Infit MSE	Std. Infit	Outfit MSE	Std. Outfit
51	0.3	0.30	0.27	0.92	-0.5	0.93	-0.1
78	0.3	0.30	0.27	0.75	-1.8	0.74	-1.0
18	0.3	0.28	0.26	0.77	-1.7	0.67	-1.4
115	0.3	0.28	0.26	0.92	-0.5	0.93	-0.2
154	0.3	0.23	0.26	0.92	-0.5	0.72	-1.1
32	0.3	0.21	0.26	0.87	-0.9	0.96	-0.1
56	0.3	0.21	0.26	0.92	-0.5	0.91	-0.3
77	0.3	0.21	0.26	1.09	0.7	1.14	0.6
42	0.3	0.18	0.26	0.94	-0.4	0.85	-0.6
163*	0.3	0.18	0.26	1.35	2.3*	1.29	1.2
27	0.3	0.15	0.26	0.82	-1.3	0.85	-0.5
90	0.3	0.15	0.26	1.05	0.4	1.02	0.1
29	0.3	0.12	0.26	0.91	-0.6	0.81	-0.8
161	0.3	0.12	0.26	0.85	-1.0	0.78	-1
67	0.3	0.09	0.26	1.01	0.1	0.88	-0.4
151	0.3	0.09	0.26	0.96	-0.2	0.87	-0.5
158	0.3	0.09	0.26	0.87	-0.9	0.81	-0.8
114	0.4	0.08	0.26	1.29	2.0	1.50*	2.0*
105	0.4	0.05	0.26	0.83	-1.3	1.10	0.5
112	0.4	0.05	0.26	1.24	1.7	1.26	1.2
8	0.4	0.02	0.26	1.21	1.5	1.48	1.9
116	0.4	0.02	0.26	0.98	0.0	1.02	0.1
22	0.4	0.01	0.26	1.26	1.8	1.16	0.7
160*	0.4	-0.01	0.25	1.47*	3.1*	1.86*	3.4*
155	0.4	-0.04	0.26	0.97	-0.2	0.88	-0.4
16	0.4	-0.05	0.25	0.99	0.0	0.92	-0.3
94*	0.4	-0.08	0.25	0.73	-2.2*	0.62	-2.1*
40	0.4	-0.12	0.25	0.82	-1.5	0.72	-1.3
58*	0.4	-0.12	0.25	0.64	-3.2*	0.51	-2.7*
80	0.4	-0.14	0.25	0.96	-0.3	0.91	-0.3
110	0.4	-0.14	0.25	0.95	-0.3	0.84	-0.7
37*	0.4	-0.17	0.25	1.52*	3.7*	1.78*	3.1*
35*	0.4	-0.18	0.25	1.37	2.7*	1.86	3.4*
148	0.4	-0.18	0.25	0.87	-1.1	0.80	-0.9
61*	0.4	-0.20	0.25	0.65	-3.1*	0.54	-2.8*
101	0.4	-0.20	0.25	1.19	1.4	1.21	1.0
44	0.4	-0.24	0.25	0.76	-2.1*	0.81	-0.9
19	0.4	-0.30	0.25	1.07	0.6	1.28	1.3
149*	0.4	-0.30	0.25	1.13	1.0	1.56*	2.4*
66	0.4	-0.31	0.25	1.03	0.2	0.92	-0.3

Item Number	Observed Average	Measure	Standard Error	Infit MSE	Std. Infit	Outfit MSE	Std. Outfit
86	0.4	-0.33	0.25	0.93	-0.5	0.79	-1.1
99	0.4	-0.36	0.25	1.24	1.9	1.32	1.5
59*	0.4	-0.39	0.25	0.72	-2.6*	0.63	-2.2*
79	0.4	-0.39	0.25	1.07	0.6	1.06	0.3
48	0.4	-0.42	0.25	1.07	0.6	1.16	0.8
33	0.4	-0.48	0.25	1.14	1.2	1.25	1.2
53	0.4	-0.48	0.25	0.91	-0.8	0.96	-0.1
68	0.4	-0.48	0.25	1.00	0.0	0.91	-0.4
24	0.5	-0.49	0.25	0.82	-1.6	0.70	-1.6
70	0.5	-0.49	0.25	1.30	2.5*	1.34	1.6
142	0.5	-0.49	0.25	1.15	1.3	1.30*	1.4
20*	0.5	-0.55	0.25	1.77*	5.7*	2.04*	4.1*
43	0.5	-0.55	0.25	1.09	0.8	1.19	0.9
122	0.5	-0.55	0.25	1.06	0.5	0.94	-0.2
41	0.5	-0.57	0.24	0.77	-2.2*	0.73	-1.5
4	0.5	-0.61	0.25	0.80	-1.9	0.71	-1.6
47	0.5	-0.61	0.25	1.05	0.5	1.15	0.8
17	0.5	-0.61	0.24	0.98	-0.1	0.93	-0.2
89	0.5	-0.61	0.24	1.12	1.0	1.20	1.0
95	0.5	-0.61	0.24	0.89	-1.0	0.75	-1.2
11	0.5	-0.63	0.24	0.87	-1.2	1.05	0.3
65	0.5	-0.67	0.24	1.12	1.1	1.08	0.4
109	0.5	-0.68	0.24	0.88	-1.1	0.75	-1.3
62	0.5	-0.73	0.24	1.07	0.6	1.07	0.4
5*	0.5	-0.73	0.24	1.32	2.7*	1.47*	2.1*
55	0.5	-0.73	0.24	0.86	-1.3	0.78	-1.1
30	0.5	-0.74	0.24	0.86	-1.4	0.81	-0.9
93	0.5	-0.74	0.24	0.88	-1.1	0.76	-1.3
108	0.5	-0.74	0.24	0.92	-0.7	0.80	-1.0
159*	0.5	-0.74	0.24	0.77	-2.3*	0.71	-1.6
162	0.5	-0.78	0.24	0.95	-0.4	1.07	0.4
13	0.5	-0.79	0.24	0.82	-1.7	0.81	-0.9
156	0.5	-0.79	0.24	0.84	-1.6	0.82	-0.9
64	0.5	-0.80	0.24	1.20	1.8	1.14	0.7
6	0.5	-0.84	0.24	0.82	-1.9	0.69	-1.7
52	0.5	-0.91	0.24	0.95	-0.4	0.90	-0.4
54	0.5	-0.96	0.24	0.85	-1.5	0.73	-1.4
21	0.5	-0.96	0.24	0.87	-1.3	0.94	-0.2
88	0.5	-0.96	0.24	1.19	1.8	1.20	0.9
63	0.5	-0.97	0.24	0.85	-1.5	0.71	-1.5

Item Number	Observed Average	Measure	Standard Error	Infit MSE	Std. Infit	Outfit MSE	Std. Outfit
7	0.6	-1.08	0.24	0.87	-1.3	0.73	-1.3
91	0.6	-1.08	0.24	0.81	-2.1	0.67	-1.7
113	0.6	-1.14	0.24	0.94	-0.5	0.93	-0.2
15	0.6	-1.14	0.24	0.98	-0.2	1.00	0.0
23	0.6	-1.14	0.24	0.82	-1.9	0.66	-1.7
92*	0.6	-1.20	0.24	1.05	0.5	1.63*	2.4*
9	0.6	-1.26	0.24	1.10	1.0	1.32	1.3
28*	0.6	-1.26	0.24	1.21	2.1*	1.47*	1.9
100	0.6	-1.26	0.24	0.95	-0.5	0.91	-0.3
60	0.6	-1.26	0.24	0.99	0.0	0.98	0.0
71	0.6	-1.26	0.24	0.88	-1.2	0.76	-1.1
107	0.6	-1.26	0.24	0.92	-0.8	0.75	-1.2
104	0.6	-1.32	0.24	1.03	0.3	0.92	-0.2
12	0.6	-1.32	0.25	0.93	-0.7	0.80	-0.9
45	0.6	-1.38	0.25	1.01	0.1	0.92	-0.2
14	0.6	-1.44	0.25	0.91	-0.8	0.74	-1.1
164	0.7	-1.75	0.25	1.00	0.0	0.80	-0.6
103	0.7	-1.75	0.25	1.02	0.2	0.89	-0.3
46	0.7	-1.88	0.26	0.83	-1.6	0.64	-1.2
10	0.7	-2.04	0.26	0.98	-0.1	0.87	-0.2
39	0.7	-2.23	0.27	1.00	0.0	0.88	-0.2
157	0.8	-2.37	0.28	0.79	-1.5	0.67	-0.9
1*	0.9	-3.62	0.37	1.31	1.1	8.69*	4.3*
2	0.9	-3.67	0.38	1.30	1.1	1.29	0.6
3*	1.0	-7.27	1.83	Minimum			
Mean	0.4	-0.04	0.28	1	-0.1	1.05	0
SD	0.2	1.21	0.13	0.19	1.4	0.69	1.3

Note. The items are presented in Measure order, from high (difficult) to low (easy). Misfit items/scores have an asterisk.

With this information, a hierarchy of rhythm pattern performance difficulty was objectively identified. Appendix E shows this information from most difficult to easiest. Appendix F shows this information form easiest to most difficult. Appendix G shows the same information but in the order of the original list or order of rhythm patterns. Each show the rank of difficulty at the top left of each pattern and the logit score at the bottom of each rhythm pattern. The original rhythm pattern number from Appendix D is located in the top center of each rhythm pattern.

Items identified as misfit are indicated with an asterisk (*) after the rhythm pattern number. This specifically meets the main goal of the study as well as relates to research questions 1 and 2: Can a hierarchy of difficulty be objectively identified; and How should the items be analyzed to best achieve accuracy of scoring?

In contrast to instrument categories, where some players may be more likely to see music literature of different level based on the way composers write for different instruments, the number of years a student is involved in band classes does not specifically limit exposure to different rhythm patterns. It is acknowledged that students may be at different skill or achievements levels regardless of experience. Any lack of exposure to multiple rhythm patterns is more likely based on the level of the group in which a student performs. The scores of the students for each level of the number of years in band were grouped and a mean logistical function score was taken to determine if there was an indication that students do generally perform rhythm patterns at a higher level based on how many years they have been in band. Table 4.6 shows the mean logit measure score by the number of years in a public school band program. Figure 4.2 shows the same graphically. Mean scores increase each year until year 8 when they start to decline. Why the mean measures score drops in years 8 and 9 is beyond the scope of this study. Linacre (2002) recommended that the minimum number of subjects for a category be 10. It is clear that the sample size is not at the recommended level for years 2, 8, and 9.

Table 4.6

Mean Logit Score by Number of Years in Public School Band Program

Years in Band	**Number of Students**	**Mean Measures Score**
2	4	-1.20
3	12	-0.63
4	39	-0.32
5	32	0.01
6	26	0.46
7	21	0.62
8	7	0.15
9	1	0.22

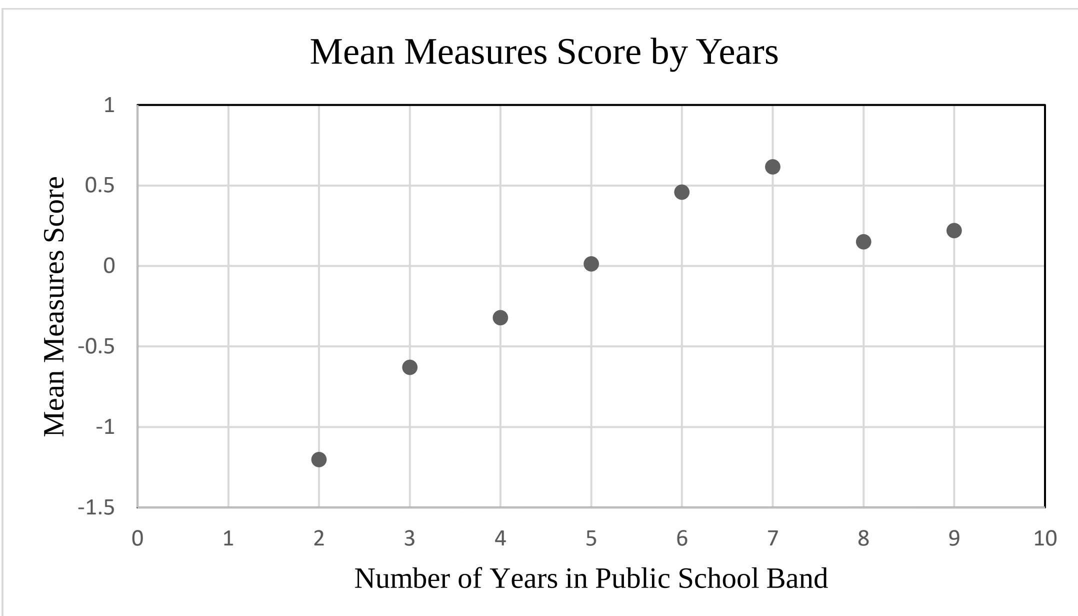


Figure 4.2. Mean Measures Score by Number of Years in Band

CHAPTER 5

DISCUSSION AND CONCLUSION

Introduction

The overreaching purpose of this study was to objectively identify a hierarchy of performance difficulty of rhythm patterns in the context of high school band students. Once data was scored dichotomously from the testing of the subjects, application of the MFR model was used to transform observed scores to linear measures (Rasch, 1960). These results show both the difficulty of the items, which are rhythm patterns, the level of the subjects, and the level of the category of what instrument each subject primarily played independently of each other. This allowed for the objective identification of a hierarchy of performance difficulty of rhythm patterns in the context of high school grade level band students. First, this study discussed the existing literature on a variety of topics that were around or within the topic of rhythm pattern reading, performance, and those that relate to the aspects of difficulty within rhythm pattern reading and performance. Next, an overview of the methodology was provided which included information regarding subjects, test design, development, implementation, and scoring and interpretation of data using MFR analysis. Results of the analysis were provided in the previous chapter. This chapter will summarize the study and present the findings to the four research questions, identify possible limitations, and discuss suggestions for future research in the area of rhythm pattern performance assessment and implementation of new information.

Discussion

Research Questions

Research Question 1. Can a hierarchy of difficulty be objectively identified? The factors of rhythm pattern performance and primary instrument had strong correlations with one another in the MFR analysis. The MFR model was ideal as the study was focused specifically on the identification of the difficulty of the performance level of each rhythmic pattern. This allowed for the objective identification of a hierarchy of difficulty of the given rhythm patterns and for the identification of ability level of the persons that was independent of each other or the primary instrument of the persons. It is significant that the MFR model, an Item Response Theory model, allows for the placement and rating of subjects on the same scale as the items once the calibration of items by difficulty has been achieved (Bond & Fox, 2015).

In the actual scoring of the performance of the rhythm patterns, much care and thought was put into creating a situation where each performance of a rhythm pattern would be judged fairly. Each test was recorded by a digital audio device allowing a main panel of three secondary instrumental music teachers to assess each rhythmic pattern in the tests. As was the case with Farley's research (2014), this study acknowledges but is not strictly interested in, mechanical reproduction of rhythm patterns as long as the performance is within reason of expressive timing. As such, like Farley's study (2014), evaluators were given the instructions to make a determination on whether the performance of the rhythmic pattern was correct or incorrect according to their best judgment.

If all three main panelists agreed, it was be deemed as correct or incorrect depending on the determination. If they did not all agree, a fourth judge assessed the performance of the individual item. If the fourth judge agreed with the majority, the item was recorded as the majority decided; however, if the fourth judge disagreed with the majority, the item was thrown out for that specific subject. The panel did not assess the students in real time. Judging was done individually on their own, not together with each other. None of the panelists knew what the other panelist rated any item, nor were they told who the other panelists were. The panel did not know the name, age, gender, instrument, or school of any of the subjects, but only the confidential random number assigned by the researcher.

With these guidelines in place, it was assumed that there would be little disagreement between the three main panelists. Unfortunately, this was not to be. Out of the 15,620 total rhythm patterns assessed, the total agreement between the three main judges was 78.09% or 12,198 items. The main panel disagreed on 3,422 items or 21.91% of the items. It was notable that one particular judge was disagreed with 1,650 times. This is in contrast to 966 for another judge, and 806 for a third judge. This is a significant difference as the judge was disagreed with 48% of the time when the decision was not unanimous. Remarkably, in each case, the fourth judge agreed with the assessment of the main panel majority. The results of this study are statistically significant and lend credence to the list being accurate and provide a fair and impartial—or objective—rank ordering of item/rhythm pattern performance difficulty in the context of high school band students.

The question of why the panelists disagreed on 1 in 5 items is valid, but disagreement among judges is not a new phenomenon. Two specific possibilities are offered and addressed: a) expressive timing, and b) subjective judgment. Regardless of the level of disagreement of the three main panelists, the verification of the fourth judge of the decision of the majority—also without an understanding of the verdict of the panelists—indicates significant validation of the assignment of correct or incorrect. That evaluators were not consistent in the judgment of performances is not unheard of. The fact that judge disagreement is more the rule is certainly worthy of continued study, such as in the work of A. Edwards, K. Edwards, and Wesolowski (n.d.), K. Edwards, A. Edwards, and Wesolowski (n.d.), Wesololowski and Wind (2017), and Wesolowski, Wind, and Engelhard (2016).

In both the perception and the production of rhythmic patterns, timing and artistic understanding or intention are important factors because "…musical rhythms are rarely performed with the exact ratios specified in musical notation" (Repp et al., 2002, p. 588). The term 'expressive timing' usually identifies this concept (Farley, 2014, p. 10). Musicians may make choices that alter the timing but does not make the performance inaccurate within parameters of good musical taste or stylistic concerns. Farley (2014) states, "The nature of rhythm performance is not required to be exact, but maintenance of temporal ratios is necessary for rhythmic accuracy to be perceived by the listener" (p. 10).

Secolsky (1987) indicates that judges are often influenced by attitudinal and interpretive factors which may include the recognition of component subskills and general skill, and a realization of the perceived complexity of a task in relation to the expected level of performance (pp. 227, 230). Common factors include "…the characteristics of the judges, the judges' experiences with the examinee population, and the judges' attitudes toward the purpose of the test and the potential consequences of the standard" (Secolsky, 1987, p. 227). The way a judge perceives the level of difficulty of a measured skill will also likely influence evaluation (Secolsky, 1987, p. 228). These factors tend to lead to subjective individual criteria of evaluation rather than criteria of standards according to performance on a common standard of difficulty.

Research Question 2. How should the items be analyzed to best achieve accuracy of scoring? Unidimensionality is a vital aspect of the MFR model. The MFR model is able to develop sample-independent results by taking facet data and transforming them through analysis to give measure values (Bond & Fox, 2015). In this case, the latent variable is rhythm pattern performance.

Difficulty of rhythm pattern performance ranged from 3.46 to -7.27 logits (*M* = .81., *SD*,= .42, *n* = 165). Misfit items may include items 1, 3, 5, 20, 28, 35, 37, 58, 59, 61, 73, 92, 94, 121, 125, 144, 149, 159, 160, and 163. These items fall outside of the rule of thumb averages put forth by Bond and Fox (2007) with the disclaimer that there is not a hard and fast rule of thumb to go by in all circumstances. Instead, "…fit statistics should be used to assist in the detection of problem item and person performances, not just to decide which items should be omitted from a test" (p. 241). For this reason, items that fell outside of the rule of thumb averages were noted but not excluded altogether. As indicated in Chapter 4, misfit items may be identified based upon Infit and Outfit MSE statistical results yielding outside of the rule of thumb ranges of .60 and 1.4 and/or standardized Infit and/or Outfit ranges of +/- 2.00 as indicated by Bond and Fox (2007, p. 243). This is also the case with both instrument category fit and student achievement fit. Regarding misfit items of the rhythm pattern performance, it is notable that items 1, 3, 58, and 61 are the only ones with well outside the rule of thumb guidelines.

All in all, the items, students, or instruments that are flagged as misfit are all possibly valid but do not fit the probabilistic model put forth by the MFR. There will be expected variation from the model as perfect fit is unrealistic and likely indicates that the items are not valid for the subjects or subjects not valid with the items. The resulting list (Appendix E and Appendix F) of the identified hierarchy of rhythm pattern performance difficulty in the context of high school band students is, therefore, more of an identified likely hierarchy of rhythm pattern performance difficulty in the context of high school band students. While this may be the case, the results of this study are statistically significant and lend credence to the list being quite accurate and provide a fair and impartial—or objective—rank ordering of item/rhythm pattern performance difficulty based upon probabilistic distribution of responses as a logistic function of person and item parameters in the context of high school band students.

Research Question 3. Does the instrument one plays (primarily) have an impact on the level of the student performance of rhythm patterns? Based upon the MFR analysis, the instrument that one primarily plays likely has some impact on the level of the student performance of rhythm patterns, though several of the categories do not have sample sizes to give a statistically valid answer in this study. In fact, the top 5 instruments and 3 of the bottom 4 do not have an adequate sample size while the instruments of flute, clarinet, alto saxophone, trumpet, euphonium, and percussion do have an adequate sampling. It seems noteworthy that the majority of the instruments with adequate sample size are mostly bookended in scoring by those without. It is likely that the inadequate sample size had a significant impact in this regard. In addition, the euphonium (n=11) and alto saxophone (n=14) are also near the top and bottom of the list with just enough recommended sample size to be valid. It may be reasonable to research the type and variety of rhythm patterns that composers generally may use in the different instrument parts in their writing. It is possible that a correlation may be found between variety for an instrument and the skill level of an instrument category for the performance of rhythm patterns.

Research Question 4. Do students generally have different levels of rhythm reading skill based upon years of study in band? Generally, this was a common sense verification question that sought to reinforce or dispute possible results of the MFR analysis regarding student level measure scores. It is understandable, expected, and somewhat obvious that the longer a student would study something, the better they should or could be expected to be at it. In this case, it is understandable and expected that the longer or more that a student would have practice in performing rhythm patterns, the better at it they would be. This is reinforced they the writings of Jerome Bruner (1961), Gordon (1971), and many other educational thinkers that subscribe to the constructivist methodology or philosophy of education as well as more empirical educational researchers such as Lobier et al. (2013). As patterns or items become familiar, they may be expanded on. As complex or larger patterns become familiar, they are accepted into larger chunks rather than as separate small parts. This is done through the connection of a known pattern to an unknown, which makes the formerly unknown a new known grouping. Larger chunks are then able to better understood and expanded upon once again (Fitzgerald et al., 2015).

While lengthy study may very well be an expected path to improvement, it is seen in everyday life and in writing of thinkers such as Gardner's (2002) theory of multiple intelligences, that some individuals seem to have aptitudes for some things that others may not. If a student does not possess a particularly high aptitude for music or does not cultivate the aptitude or ability that they have, they will not advance their skill level. In that case, if a band program seats their band or bands by perceived skill level, some longstanding band members would not be in high-level bands. This is in contrast to instrument categories, where some players may be more likely to see music literature of different level based on the way composers write for different instruments. Plainly, the number of years a student is involved in band classes does not specifically yield exposure to different rhythm patterns, though it should allow for more time experiencing rhythm patterns. It is acknowledged that students are at different skill or achievements levels regardless of experience. Any lack of exposure to multiple rhythm patterns is more likely based on the level of the group in which a student performs.

The results of the MFR analysis indicate what may be a bit of each of these scenarios. There is a consistent and significant improvement in the mean measure score by years in band classes from year 2 through 7. Year 8 drops and year 9 slightly improves. It is important to acknowledge the that samples size for years 2 (n = 4), 8 (n = 7), and 9 (n = 1) are not at the recommended minimum number of subjects. Linacre (2002) indicates that the minimum should be 10. These results continue to give strength to the MFR analysis results and are in agreement with common sense.

Identified Hierarchy of Rhythm Pattern Difficulty

The resulting hierarchy of rhythm pattern performance difficulty yielded from the MFR analysis has been shown to be statistically significant and valid. It is completely understandable that there will be skeptics regarding specific orders of rhythm patterns and the validity of the study based upon experience with specific patterns. This type of mindset was foreshadowed in Chapter 2, as many times when professionals in different fields are asked why they feel items are difficult, they often have to pause and consider their reasoning for determining level. Often they feel that something is challenging or they have an idea about the level of difficulty but have not considered why that may be the case (Beecher, 2006, p. 33). Even on official state lists, agreement of difficulty level is quite rare. In separate research by Norona (2008), Beecher (2006), Saville (1991), and Sebastien et al. (2012), there is not a consistent and objective description of difficulty level in lists that are designed to differentiate by difficulty. It would only be surprising if there were no disagreements or skepticism about the resulting hierarchy of rhythm pattern difficulty list.

It seems that evenly organized rhythms tend to be easier to perceive and perform than more uneven rhythm patterns as generally there is more unevenness in rhythm patterns of higher performance difficulty than those lower in performance difficulty. This appears to validate the work of previous researchers such as Drake (1993), Katz et al.(2015), Repp et al. (2002), and Thaut (2005); however, most rhythm patterns used have unevenness within them.

In particular, it was interesting to compare the mean of rhythm patterns in each of the different types of meters overall. For the purposes of this study patterns corresponded to full measures in 2/4 (simple duple) time, 4/4 (simple quadruple) time, and 6/8 (compound duple) time, with the understanding that the rhythm patterns are not exclusive to the given meters of the study. Those in simple duple (n = 106) had a mean measure score of -0.39. Those in simple quadruple (n = 18) had a mean measure score of -0.13. Those in compound duple (n = 41) had a mean measure score of 0.89. Gordon's (1976) indication that duple patterns were easier than triple patterns also seems to be validated by the results. The hierarchy of rhythms pattern difficult for simple duple may be found in Appendix H. The hierarchy of rhythms pattern difficult for simple quadruple may be found in Appendix I. The hierarchy of rhythms pattern difficult for compound duple may be found in Appendix J.

The criteria of indication of difficulty for the compound duple, shown in this study as in 6/8 rhythms is generally in line with the guidelines of the American Band College Ratings (2014), which have the most detailed ratings found. Other rating systems identified in Chapter 2 usually specified difficulty by meter alone rather than by pattern or classification of rhythm patterns and were still very general at that. It seems that rating systems in place tend to focus on complexity rather than performance outcome, just as Beecher (2006) and Minamitaka (2012) did in their work. Complexity does not always determine difficulty. Sometimes in performance, rhythm patterns that look simple are found to be difficult. Four rhythm patterns from the 34 most difficult to perform are shown in Figure 5.1. In a like manner, some rhythm patterns that look complex are found to be easy. Four rhythms patterns from the 34 least difficult to perform are shown in Figure 5.2. The logit measure score is at the bottom of each pattern and the difficulty ranking at the top left of both Figure 5.1 and Figure 5.2.

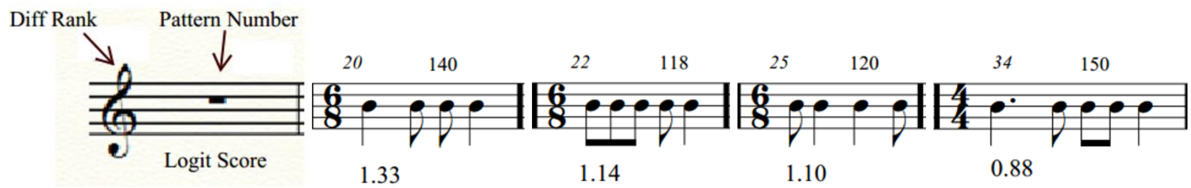


Figure 5.1. A Sample of Simple Rhythm Patterns Found to be Difficult to Perform

Figure 5.2. A Sample of Complex Rhythm Patterns Found to be Easy to Perform

Implications of the Findings

Teaching rhythm reading and rhythm performance have consistently been a challenge for teachers (Boyle, 1970, Gage, 1994). Johnson (2003) indicates that teaching rhythm is at the heart of producing musically literate students. Honing (2002) indicates that music theory curriculum only addresses rhythm sparingly. Perhaps part of the reason for this challenge that there is a lack of objective or research-based information about the level of difficulty for the performance of different rhythm patterns. What is clear is that study of rhythm reading generally improves rhythm performance in students (Bebeau, 1982; Boyle, 1970; Brittin, 2001; Colley, 1987; Dalby, 2005; Ester et al., 2006; Gage, 1994; Hoffman et al., 1996; Johnson, 2003; Richardson, 2008; Shehan, 1987; Sink, 1983; Winik, 1973). As rhythm must be taught, it should be taught well.

As a means of good teaching, an educator should be as aware as possible about how students are perceiving the concepts taught and the level of difficulty to which they expose their students. “Otherwise, teachers may make incorrect assumptions about what students hear and think, when in fact, students’ perceptions may be quite unlike their [own]”(Duke, 1994, p. 33). The identified hierarchy of rhythm pattern performance difficulty specifically offers that type of information. There are many ways that this type of information might be used to inform instruction.

In many educational theories, sequencing is important to the construct of information. Richardson’s (2008) research reported that “The likelihood of student success improves when they can connect the known to the unknown” (p. 42). The sequencing of material has shown to be effective and also leads to a more comfortable and enjoyable classroom experience for students and teachers (Yarbrough & Price, 1989, p. 180). “To encourage optimal progress with the use of any reading materials, teachers need to be aware of the difficulty level of the text relative to a child’s reading level” (Stenner, 1999, p. 5). With information discovered in this study, teachers in the field may now access the type of information that was not available before. Lessons, units, or overall curricula might be better constructed with the understanding of performance difficulty level as suggested by those such as Campbell (1991), Gordon (1971 1974, 1976, 1979, 1997), Richardson (2008), Tillmann (2012), and Yarbrough and Price (1989). This information can allow for both bottom-up and top-down processing approaches to be implemented, whichever may be best suited to the student’s level. This may not only allow for a more informed lesson but one in which differentiation is less challenging for both the student(s) and the teacher (Liu, 2010).

Composers, publishers, and list makers may choose to use this information to further and more accurately identify difficulty level as they classify or write new or review existing literature. As composers are writing pieces for a particular grade or skill level, this information can help them make informed decisions about rhythm patterns that would be most appropriate for their performers. Publishers, editors, and list makers could use this information to more accurately identify level for the music that they are giving descriptions about or trying to sell. This would not only allow for a more informed and suitable selection by skill level, but would likely make for a more enjoyable experience for the performers and a more profitable one for the publishers as their music would be able to be purchased with more confidence by band directors for their groups.

As band directors are using literature to teach through in their classes or preparing supplemental and/or remedial materials for their students, this information could inform their instruction to know what to supply and what to look and listen for in the music as their players learn their parts. Ultimately this could lead to a higher level of musical accomplishment or achievement for groups and individual students as directors would possess a valid tool to help students get better.

Ultimately, the identification of a hierarchy of difficulty in the performance of rhythm patterns could be a step in the direction of a Lexile-type of system for music and music education. The subjectivity in nearly all aspects of music education in the performance setting has been a significant hindrance for music in the attempt to stake a claim as a valid and imperative discipline. With a Lexile-like system in place for music, teachers would be able to use information to make informed choices for instruction, measure the effectiveness of interventions, see progress towards goals, and make recommendations in a clear, concise and standardized way—just as English literature is able to do (Fisher & Stenner, 2011; Stenner, 1996, 1999). Difficulty level is a key component of a Lexile-type system (Stenner, 1996).

Limitations

While the results of the MFR analysis showed statistically strong validity and reliability, there were problems that may have hindered results from being as precise as possible. In particular, it is noteworthy that while a great number of rhythm patterns were tested, none were in polymeter or mixed meter, something that many advanced band works have as attributes. It is also a foregone conclusion that not all rhythm patterns were found in the research and survey of literature. The nature of the aspect of expressive timing in rhythmic performance almost surely caused the judges of the performances to use subjective judgment in their determinations of whether a performance was correct or incorrect. Performing all patterns at the given tempo does not allow the possibility for the discovery of how different tempos may affect the level of difficulty for the given patterns. The fact that students were asked to tap a rhythm rather than perform it on their instrument may have impacted their personal score in a positive or negative way from what they may truly be able to achieve on their instruments. While the sample size was large, a larger and more diverse—in their geographical region of residence—may possibly yield different or slightly different results. A larger sample of specific categories of instruments and years in public school band programs would give a more valid look at what impact, if any, instrument choice or time involved in band has upon achievement level in this area.

Suggestions for Future Research

As this is the first or one of the few objective identification of a hierarchy of rhythm pattern performance difficulty level studies, it would be wise to further validate the study through duplicating it. Beyond that, a different geographic location and a fuller range of instrumentalists and level of experience would be wise to pursue. To amplify the study, research using subjects at different levels or ages would be appropriate to seek to validate the work of Drake (1993) who found that generally, difficulty level of items remained consistent in rhythm performance regardless of level or age of the subject. Testing students using their instruments would get a more relevant picture of what a student could and could not do on their instrument as opposed to tapping, though the choice to have students tap was soundly based upon previous studies. It is advised that a future test on rhythm pattern performance might choose a different or multiple tempi. A study such as this could be expanded upon in different areas of music performance, such as choir or orchestra. There is still much work to be done; however, this study could be an important step toward a significantly more valid way of teaching, learning, and assessing music performance.

Conclusion

There have been previous studies done researching the difficulty level of rhythmic patterns, though none found have been related specifically to ascertain whether there is a hierarchy of difficulty in the performance of rhythmic patterns for the high school level instrumentalist (Beecher, 2006; Danahy, 2013; Gardner, 1971; Gordon, 1971, 1974, 1979; Grieshaber, 1993; Harding, 2010; Norona, 2008; Spohn, 1977; Wolf, 2004). This study sought to address a lack of literature in the field and used methodology to do just that. Once data was scored dichotomously from the testing of the subjects, application of the MFR model was used to transform observed scores to linear measures (Rasch, 1960).

The strength of the validity and reliability of the MFR model should encourage educational researchers to consider applying the Rasch model as a possibility for the examination and analysis of data. These results show the difficulty of the items, which are rhythm patterns, the level of the subjects, and the level of the category of what instrument each subject primarily played independently of each other. This allowed for the objective identification of a hierarchy of performance difficulty of rhythm patterns in the context of high school grade level band students. The capabilities of the Rasch model also allow for the production of variable maps, which give visual references to the different facets of studies upon the same line of measurement. Furthermore, this model provides useful information regarding the difficulty level of items, student achievement level, and other facets studied.

Understanding difficulty as it relates to motivation and the success of students and in determining achievement levels of students cannot be overlooked. Many educational thinkers such as Gagné, Pestalozzi, Bruner, Dewey, Gardner, and beyond indicate the importance of difficulty in determining the sequencing of material. Sequencing is vital to the structuring of lessons and the learning process of students. This supposes that the constructivist ideas of making connections from previous knowledge and the spiral curriculum as recorded by Jerome Bruner at the 1959 Woods Hole Conference are indeed correct. In this, one idea may relate and/or build on the idea of another more effectively than without a frame of reference.

The element of rhythm is unquestionably vital to music. Its very definition dictates the movement in time of notes or sound. Beyond that, “Rhythm gives music a sense of organization and must be methodically taught” (Palkki, 2010, p. 101). The resulting researched-based list of rhythmic patterns identified by difficulty level may be used for a much larger process of creating something for musicians like what English literature has in the Lexile framework—a research-based framework for the identification of leveling of literature and the corresponding reading level of an individual. The knowledge of a level of difficulty could greatly influence music education in much the same way that that the Lexile framework has influenced the teaching of reading and the English language. This is all the more likely as it is understood that the reading of rhythm is done in much the same way as the reading of words—through the identification and stimuli of groups or patterns.

For too long music education performance assessment and teaching has relied almost solely upon knowledge that is not objective or research-based. Specifically, music educators have not had an objective identifier of what is or is not difficult in terms of the performance of rhythm patterns. With research and results such as this, music education may continue to emerge from the subjective nature of knowledge and assessment and join other disciplines that have embraced data to inform the constructing of curriculum, planning of lessons, and knowledge of student level. In the area of rhythm pattern performance, music educators, publishers, students, and other researchers now have a resource of a hierarchy of difficulty level that has been objectively identified.

REFERENCES

Alvarez, M. (1981). Effects of sequencing, classifying, and coding on identifying harmonic functions. *Journal of Research in Music Education*, *29*(2), 135–141.

American Band College. (2014). American Band College music grading chart. R

Arizona Department of Education. (2006). Arizona music standards.

Bartel, L. R. (1994). Cognitive-affective pesponse test—music: Questions of validity. *Bulletin of the Council for Research in Music Education*, *120*, 1–16.

Bebeau, M. J. (1982). Effects of traditional and simplified methods of rhythm-reading instruction. *Journal of Research in Music Education*, *30*(2), 107–119.

Beecher, M. A. (2006). *Defining difficulty: Analysis of state solo repertoire lists for the horn*. University of Wisconsin-Madison.

Bengtsson, I., & Gabrielsson, A. (1983). Analysis and synthesis of musical rhythm. In J. Sundber (Ed.), *Studies of Music Performance* (pp. 27–60). Stockholm, Sweden: ADEBE Reklam & Tryckservice.

Bergee, M. J., & Antonetti, J. J. (2012). Applying Rasch modeling to develop a rhythm-reading measure. In *National Association for Music Education Symposium*. St. Louis.

Berger, A., Jacobs, C., Philbrick, M., & Murphy, H. R. (2010). *Instrumental music curriculum guide (Evanston distrct #65)*. Evanston, IL.

Bond, T. G., & Fox, C. M. (2007). *Applying the Rasch model* (2nd ed.). Mahwah, NJ: Lawrence Erlbaum Associates, Inc., Publishers.

Bond, T. G., & Fox, C. M. (2015). *Applying the Rasch model* (3rd ed.). New York: Routledge.

Bowers, T. A. (2007). Rhythm and its position in the hierarchy of a teacher's values. *Journal of Singing*, *63*(5), 531–536.

Boyle, J. D. (1970). The effect of prescribed rhythmical movements on the ability to read music at sight. *Journal of Research in Music Education*, *18*(4), 307–318.

Bradford, P. (1995). The aural/oral difficulty levels of selected rhythm patterns among kindergarten children. (Doctoral dissertation, University of Oklahoma, 1995). Dissertation Abstracts International, 56, 3044.

Brittin, R. V. (2001). Middle school instrumentalists' perceptions of counting systems. *Bulletin of the Council for Research in Music Education*, (148), 12–18.

Bruner, J. S. (1961). The act of discovery. *Harvard Educational Review*, *31*(1).

Campbell, M. R. (1991). Musical learning and the development of psychological processes in perception and cognition. *Bulletin of the Council for Research in Music Education*, *107*, 35–48.

Choksy, L., Abramson, R. M., Gillespie, A. E., Woods, D., & York, F. (2001). *Teaching music in the twenty-first century* (2nd ed.). Upper Saddle River, NJ: Prentice Hall.

Clarke, E. F. (1999). Rhythm and timing in music. In D. Deutsch (Ed.), *The Psychology of Music* (2nd ed., pp. 473–500). Academic Press.

Colley, B. (1987). A comparison of syllabic methods for improving rhythm literacy. *Journal of Research in Music Education*, *35*(4), 221–235.

Colwell, R. (1987). Test item difficulty and perception. *Bulletin of the Council for Research in Music Education*, (91), 19–22.

Dalby, B. (2005). Toward an effective pedagogy for teaching rhythm. *Music Educators Journal*, *92*(1), 54–60.

Danahy, A.(2013). *Comparative audiation difficulty of tonal, rhythm, and melodic patterns among grade 4 students*. (Master's thesis). Retrieved from http://scholarcommons.sc.edu/etd/2564

Deutsch, D. (1999). Grouping mechanisms in music. In D. Deutsch (Ed.), *The Psychology of Music* (2nd ed., pp. 299–348). Academic Press.

Dewey, J. (1934). *Art as experience*. New York: Berkely Publishing Group.

Drake, A. H. (1968). An experimental study of selected variables in the performance of musical durational notation. *Journal of Research in Music Education*, *16*(4), 329–338.

Drake, C. (1993). Reproduction of musical rhythms by children, adult musicians, and adult nonmusicians. *Perception & Psychophysics*, *53*(1), 25–33.

Duke, R. A. (1994). When tempo changes rhythm: The effect of tempo on nonmusicians' perception of rhythm. *Journal of Research in Music Education*, *42*(1), 27–35.

Dvorak, T., Grechesky, R., & Ciepluch, G. (1993). *Best music for high school band*. Brooklyn: Manhattan Beach Music.

Dvorak, T., Schmalz, P., & Taggard, C. (1986). *Best music for young band*. Brooklyn: Manhattan Beach Music.

Edwards, A. S., Edwards, K. E., & Wesolowski, B. C. (n.d.). The psychometric evaluation of a wind band performance rubric using the multifaceted Rasch partial credit measurement model. *Research Studies in Music Education.*

Edwards, K. E., Edwards, A. S., & Wesolowski, B. C. (n.d.). Evaluation of a string performance rating scale using the Rasch measurement model. *Bulletin of the Council for Research in Music Education*.

Elledge, R., & Haddad, D. (1992). *Band technique step-by-step*. San Diego, CA: Neil A. Kjos Company.

Ester, D. P., Scheib, J. W., & Inks, K. J. (2006). Takadimi: A rhythm system for all ages. *Music Educators Journal*, *93*(2), 60–65.

Farley, A. L. P. (2014). *The relationship between musicians' internal pulse and rhythmic sight-reading (doctoral dissertation)*. University of Washington.

Fisher, W. P. J., & Stenner, A. J. (2011). Integrating qualitative and quantitative research approaches via the phenomenological method. *International Journal of Multiple Research Approaches*, *5*(1), 89–103.

Fitch, W. T., & Rosenfeld, A. J. (2007). Perception and production of syncopated rhythms. *Music Perception: An Interdisciplinary Journal*, *25*(1), 43–58.

Fitzgerald, J., Elmore, J., Koons, H., Hiebert, E. H., Bowen, K., Sanford-Moore, E. E., & Stenner, A. J. (2015). Important text characteristics for early-grades text complexity. *Journal of Educational Psychology*, *107*(1), 4–29.

Fox, D. (2002). *The rhythm bible*. Alfred Publishing Company.

Fraisse, P. (1982). Rhythm and tempo. In D. Deutsch (Ed.), *The Psychology of Music* (1st ed., pp. 149–180). Academic Press.

Gabrielsson, A. (1993). The complexities of rhythm. In T. J. Tighe & W. J. Dowling (Eds.), *Psychology and Music: The Understanding of Melody and Rhythm* (pp. 93–120). Hillsdale, NJ: Erlbaum.

Gage, S. L. (1994). *An analysis and comparison of rhythm instruction materials and techniques for beginning instrumental music students*. (Doctoral dissertation) Retrieved from http://hdl.handle.net/2142/19490

Gardner, H. (1971). Children 's duplication of rhythmic patterns. *Journal of Research in Music Education*, *19*(3), 355–360.

Gardner, H. (2002). The theory of multiple intelligences (1983). In M. L. Mark (Ed.), *Music Education: Source Readings from Ancient Greece to Today* (2nd ed., p. 231). New York: Routledge.

Gordon, E. E. (1971). *The psychology of music teaching*. Englewood Cliffs, New Jersey: Prentice-Hall, Inc.

Gordon, E. E. (1974). Toward the development of a taxonomy of tonal patterns and rhythm patterns: Evidence of difficulty level and growth rate. In E. E. Gordon (Ed.), *Experimental Research in the Psychology of Music* (9th ed., pp. 39–232). Iowa City, IA: University of Iowa Press.

Gordon, E. E. (1976). *Tonal and rhythm patterns: An objective analysis*. Albany, NY: State University of New York Press.

Gordon, E. E. (1979). *Primary measures of music audiation*. Chicago, IL: GIA Publications, Inc.

Gordon, E. E. (1997). *Learning sequences in music*. Chicago, IL: GIA Publications, Inc.

Grieshaber, K. (1993). Development of a comprehensive computerized scoring method for measuring rhythmic performance. *Bulletin of the Council for Research in Music Education*, (119).

Gromko, J. E. (2004). Predictors of music sight-reading ability in high school wind players. *Journal of Research in Music Education*, *52*(1), 6–15.

Harding, K. K. (2010). *An investigation of the rhythmic aptitude and rhythm achievement of first, second, and third grade students*. University of Delaware.

Hilliard, Q. C., & Sheldon, D. A. (2003). *Superior bands in sixteen weeks*. Fort Lauderdale, FL: The FJH Music Company, Inc.

Hodges, D. A. (1992). The acquisition of music reading skills. In R. Colwell (Ed.), *Handbook of Research on Music Teaching and Learning* (1st ed., pp. 466–471). New York: Schirmer Books.

Hodges, D. A., & Nolker, D. B. (2011). The acquisition of music reading skills. In R. Colwell & P. R. Webster (Eds.), *MENC Handbook of Research on Music Learning Volume 2: Applications* (pp. 61–91). New York: Oxford University Press.

Hoffman, R. (2009). *Learning rhythm with the takadimi system of rhythm solfege*.

Hoffman, R., Pelto, W., & White, J. W. (1996). Takadimi: A beat-oriented system of rhythm pedagogy. *Journal of Music Theory Pedagogy*, *10*, 7–30.

Honing, H. (2002). Structure and interpretation of rhythm and timing. *Tijdschrift Voor Muziektheorie*, *7*(3), 227–232.

Honing, H. (2013). Structure and interpretation of rhythm in music. In D. Deusch (Ed.), *The Psychology of Music* (3rd ed., pp. 369–404). Elsevier, Inc.

Impara, J. C., & Plake, B. S. (1998). Teachers' ability to estimate item difficulty: A test of the assumptions in the angoff standard setting method. *Journal of Educational Measurement*, *35*(1), 69–81.

Johnson, D. C. (2003). The effect of mathematical models on rhythm instruction. *Contributions to Music Education*, *30*(2), 29–41.

Karma, K. (1986). Item difficulty values in measuring components of musical aptitude. *Bulletin of the Council for Research in Music Education*, *89*(89), 18–31.

Katz, J., Chemla, E., & Pallier, C. (2015). An attentional effect of musical metrical structure. *PLoS ONE*, *10*(11), 1–14.

Lai, C. (1999). *An investigation of developmental music aptitude and music achievement in children from Taiwan*. (Unpublished master's thesis) Temple University, Philadelphia.

Lautzenheiser, T., Higgins, J., Menghini, C., Lavender, P., Rhodes, T. C., & Bierschenk, D. (2000). *Essential elements 2000-comprehensive band method-book 2*. Milwaukee, WI: Hal Leonard Publishing Corporation.

Linacre, J. M. (2002). Understanding Rasch measurement: Optimizing rating scale category effectiveness. *Journal of Applied Measurement*, *31*(1), 85–106.

Linacre, J. M. (2009). FACETS (version 3.65.0) [computer software]. Chicago, IL: MESA Press.

Liu, F. (2010). A short analysis of the nature of reading. *English Language Teaching*, *3*(3), 152–157.

Lobier, M., Dubois, M., & Valdois, S. (2013). The role of visual processing speed in reading speed development. *PLoS ONE*, *8*(4).

London, J. (2002). Cognitive constraints on metric systems: Some observations and hypotheses. *Music Perception*, *19*(4), 529–550.

Maryland Music Educators Association, & Maryland Band Directors Association. (2014). *Maryland Music Educators Association Maryland Band Directors Association policies and procedures*.

Maxwell, R. (1973). *Fourteen weeks to a better band-senior high edition (book 2)*. Oskaloosa, IA: C. L. Barnhouse Co.

McEnaney, R. (2006). *Perceptions of difficulty in the work of secondary instrumental music teachers*. (Unpublished doctoral dissertation). Northern Arizona University, Flagstaff.

McIntosh, B. (2009). *The jedi's kung fu guide to sight reading (so simple even a cave man drummer can understand it)*. Waycross, GA: Studio M Publishing Co.

Mclaughlin, P., & Boals, A. (2010). Perceptual organization can affect performance on rhythmic tasks. *Psychology of Music*, *38*(4), 395–401.

McPherson, G. E., & Thompson, W. F. (1998). Assessing music performance: Issues and influences. *Research Studies in Music Education*, *10*(1), 12–24.

Minamitaka, J. (2012). *U. S. Patent No. US 8,106,281 B2.* Washington, DC: U. S. Patent and Trademark Office.

Mohamadi, Z. (2013). Determining the difficulty level of listening tasks. *Theory and Practice in Language Studies*, *3*(6), 987–994.

Murphy, C. (1999). How far do tests of musical ability shed light on the nature of musical intelligence? *British Journal of Music Education*, *16*(1), 39–50.

Myers, C. T. (1954). Relationship between item difficulty and test validity, the. *Yearbook of the National Council on Measurements Used in Education*, (11), 30–32.

National Coalition for Core Arts Standards. (2015). *Music model cornerstone assessment: Middle/high school ensembles discipline: Music*.

New Hampshire Department of Education. (2001). *K-12 curriculum framework for the arts: Music k-12*. Concord, NH.

Norona, D. H., "Florida Bandmasters Association's "Significant Literature" selected for music performance assessments" (Master's Thesis, Florida State University). Electronic Theses, Treatises and Dissertations. Paper 2547.

Palkki, J. (2010). Rhythm syllable pedagogy: A historical journey to Takadimi via the Kodály method. *Journal of Music Theory Pedagogy*, *24*, 101–129.

Parncutt, R. (1994). A perceptual model of pulse salience and metrical accent in musical rhythms. *Music Perception: An Interdisciplinary Journal*, *11*(4), 409–464.

Patel, A. D., Peretz, I., Tramo, M., & Labreque, R. (1998). Processing prosodic and musical patterns: A neuropsychological investigation. *Brain and Language*, *144*(61), 123–144.

Pearson, B. (2005). *Standard of excellence-enhanced comprehensive band method-book 2* (2nd ed.). San Diego, CA: Neil A. Kjos Company.

Perkins, A., & Engelhard Jr., G. (2009). Crossing person response functions. *Rasch Measurement Transactions of the Rasch Measurement SIG American Educational Research Association2*, *32*(1), 1183–1184.

Peterson, L. (1991). *Teacher resource kit*. Milwaukee, WI: Hal Leonard Publishing Corporation.

Rasch, G. (1960). *Probabilistic models for some intelligence and attainment tests*. Chicago, IL, IL: MESA Press.

Rasmussen, M. (1962). A system of numerical symbols for indicating rhythmic difficulty. *Music Educators Journal*, *48*(3), 78.

Repp, B. H. (1998). Variations on a theme by Chopin: Relations between perception and production of timing in music. *Journal of Experimental Psychology: Human Perception and Performance*, *24*(3), 791–811.

Repp, B. H. (2005). Sensorimotor synchronization: A review of the tapping literature. *Psychonomic Bulletin & Review*, *12*(6), 969–992.

Repp, B. H. (2006). Does an auditory distractor sequence affect self-paced tapping? *Acta Psychologica*, *121*, 81–107.

Repp, B. H. (2010). Sensorimotor synchronization and perception of timing: Effects of music training and task experience. *Human Movement Science*, *29*, 200–213.

Repp, B. H. (2011). Comments on “ tactus ≠ tempo: Some dissociations between attentional focus, motor behavior, and tempo judgment ” by Justin London. *Empirical Musicology Review*, *6*(1), 56–62.

Repp, B. H., & Su, Y.-H. (2013). Sensorimotor synchronization: A review of recent research (2006-2012). *Psychonomic Bulletin & Review*, *20*(3), 403–452.

Repp, B. H., Windsor, W. L., & Desain, P. (2002). Effects of tempo on timing of simple musical rhythms. *Musical Perception*, *19*(4), 565–593.

Richardson, C. (2008). Teaching students to be rhythmically independent. *Canadian Music Educator/Musicien Éducateur Au Canada*, *49*(3), 41–44.

Saville, K. R. (1991). *A computer-assisted program for the selection of band music relative to the difficulty rating of individual instruments*. (Doctoral dissertation). Utah State University.

Scheuneman, J. D., & Gerritz, K. (1990). Using differential item functioning procedures to explore sources of item difficulty and group performance characteristics. *Journal of Educational Measurement*, *27*(2), 109–131.

Sebastien, V., Ralambondrainy, H., Sebastien, O., & Conruyt, N. (2012). Score analyzer: Automatically determining scores difficulty for instrumental e-learning. In *13th International Society for Music Information Retrieval* (pp. 571–576).

Secolsky, C. (1987). Attitudinal and interpretive influences on difficulty ratings in setting standards for high school minimum competency tests. *The Journal of Educational Research*, *80*(4), 227–232.

Shehan, P. K. (1987). Effects of rote versus note presentations on rhythm learning and retention. *Journal of Research in Music Education*.

Sheldon, R., Boonshaft, P., Black, D., & Phillips, B. (2011). *Sound innovation-book 2*. Alfred Publishing Company.

Sink, P. E. (1983). Effects of rhythmic and melodic alterations on rhythmic perception. *Journal of Research in Music Education*, *31*(2), 101–113.

Spohn, C. L. (1977). Rhythms and the implication for music education. *Bulletin of the Council for Research in Music Education*, (50), 62–66.

Stenner, A. J. (1996). Measuring reading comprehension with the Lexile framework. In *Fourth North American Conference on Adolescent/Adult Literacy*. Washington, D.C: MetaMetrics, Inc.

Stenner, A. J. (1999). *Instructional uses of the Lexile framework*.

Stetson, R. (1923). The teaching of rhythm. *The Musical Quarterly*, *9*(2), 181–190. Retrieved

Thaut, M. H. (2005). *Rhythm, music, and the brain: scientific foundations and clinical applications*. New York: Routledge.

Thaut, M. H., Trimarchi, P. D., & Parsons, L. M. (2014). Human brain basis of musical rhythm perception: common and distinct neural substrates for meter, tempo, and pattern. *Brain Sciences*, *4*(2), 428–452.

Tierney, A., & Kraus, N. (2015). Evidence for multiple rhythmic skills. *PLoS ONE*, *10*(9), 1–14.

Tillmann, B. (2012). Music and language perception: Expectations, structural integration, and cognitive sequencing. *Topics in Cognitive Science*, *4*, 568–584.

Toney, B. M. (2014). *The effectiveness of word based and Takadimi rhythm reading systems on high school band students*. (Unpublished manuscript), Universtiy of Georgia.

Tunks, T. W. (1978). Tonal and rhythm patterns: An objective analysis. *Journal of Research in Music Education*, *26*(1), 57–60.

Upitis, R. (1987). Children's understanding of rhythm: The relationship between development and music training. *Psychomusicology: A Journal of Research in Music*, *7*(1), 41–60.

Van Patten, J., Chao, C.-I., & Reigeluth, C. M. (1986). A review of strategies for sequencing and synthesizing instruction. *Review of Educational Research*, *56*(4), 437–471.

Wareham, D. E. (1967). *The development and evaluation of objective criteria for grading band music into six levels of difficulty*. Pennsylvania State University.

Waters, A. J., Townsend, E., & Underwood, G. (1998). Expertise in musical sight reading: A study of pianists. *British Journal of Psychology*, *89*, 123–149.

Wesolowski, B. C., & Wind, S. A. (2017). Investigating rater accuracy in the context of secondary-level solo instrumental music performance. *Musicae Scientiae*. Prepublished June, 13, 2017

Wesolowski, B. C., Wind, S. A., & Engelhard Jr., G. (2016). Examining rater precision in music performance assessment: An analysis of rating scale structure using the multifaceted Rasch partial credit model. *Music Per*, *33*(5), 662–678.

Winik, S. D. (1973). *An evaluation of selected methods of rhythmic instruction for the high school instrumentalist with a selective, annotated bibliography of rhythm materials*. (Unpublished doctoral dissertation). University of Rochester.

Wolf, D. L. (2004). A hierarchy of rhythm performance patterns for kindergarten children. *Visions of Research in Music Education*, *4*.

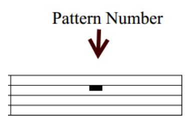
Wright, B. D., & Stone, M. H. (1979). *Best test design*. Chicago, IL: MESA Press.

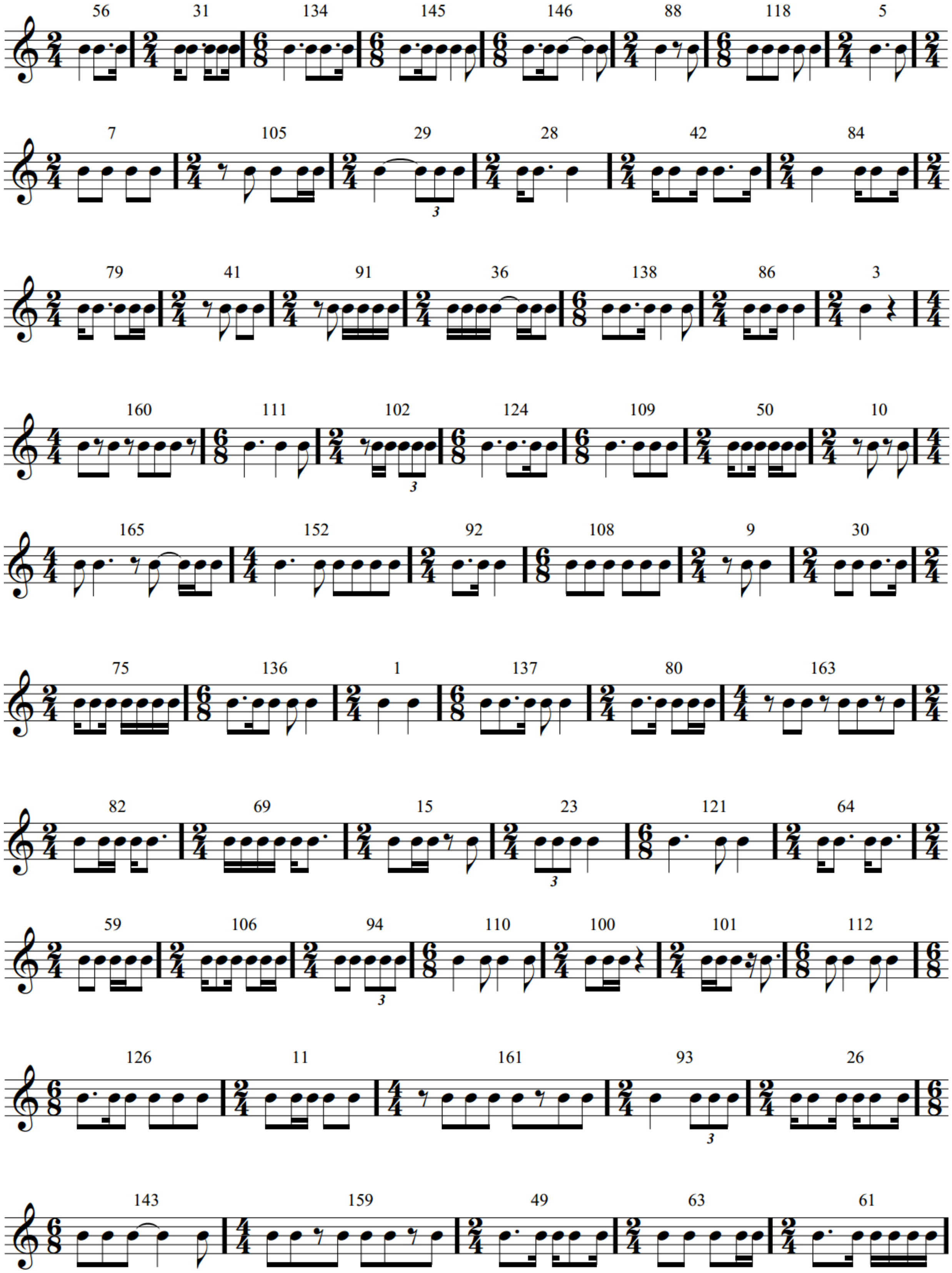
Yarbrough, C., & Price, H. E. (1989). Sequential patterns of instruction in music. *Journal of Research in Music Education*, *37*(3), 179–187.

Zatorre, R. J., Chen, J. L., & Penhune, V. B. (2007). When the brain plays music: Auditory-motor interactions in music perception and production. *Nature Reviews. Neuroscience*, *8*(7), 547–558.

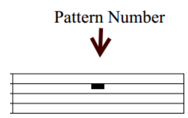
APPENDICIES

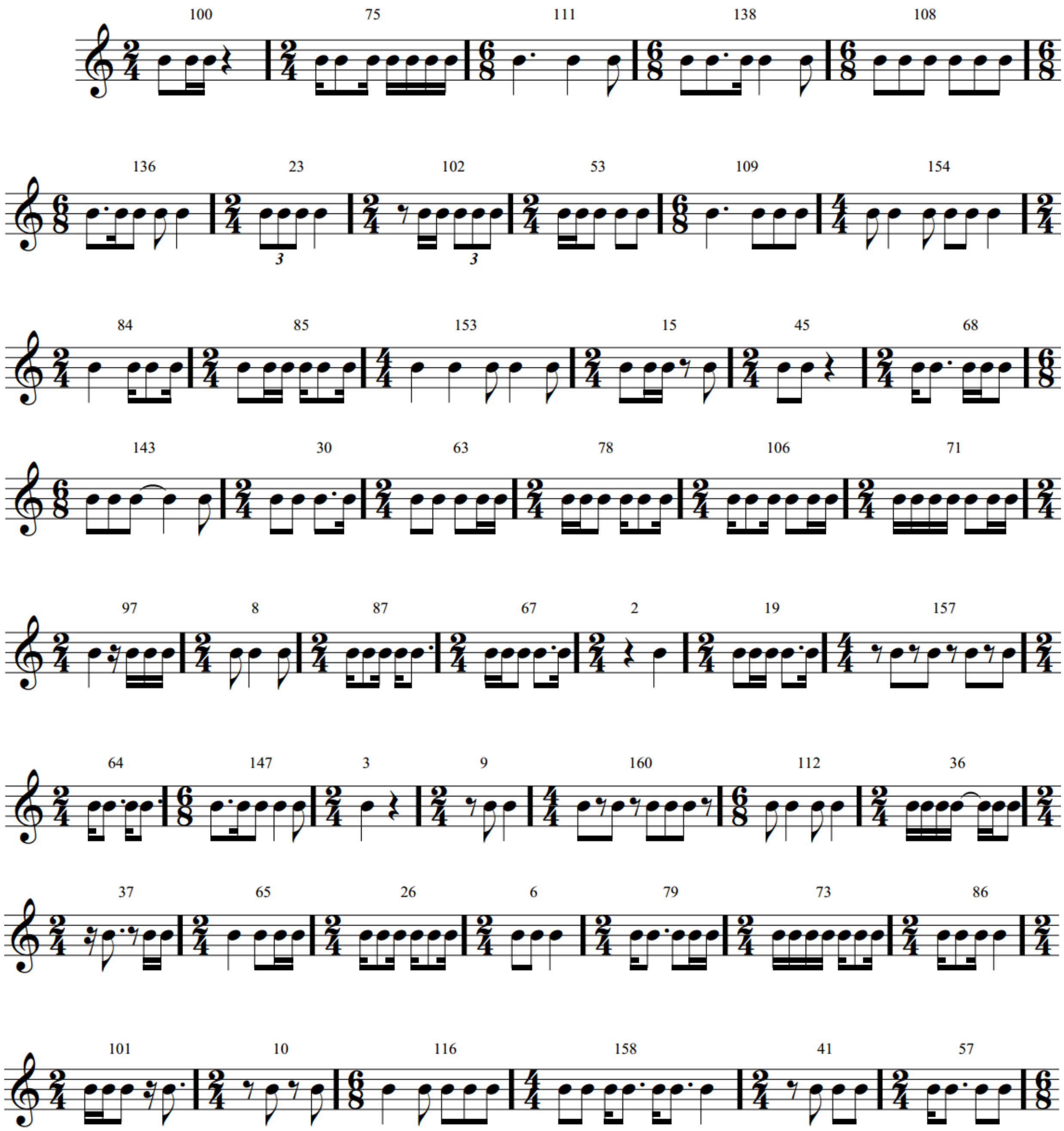
Appendix A: Test 1

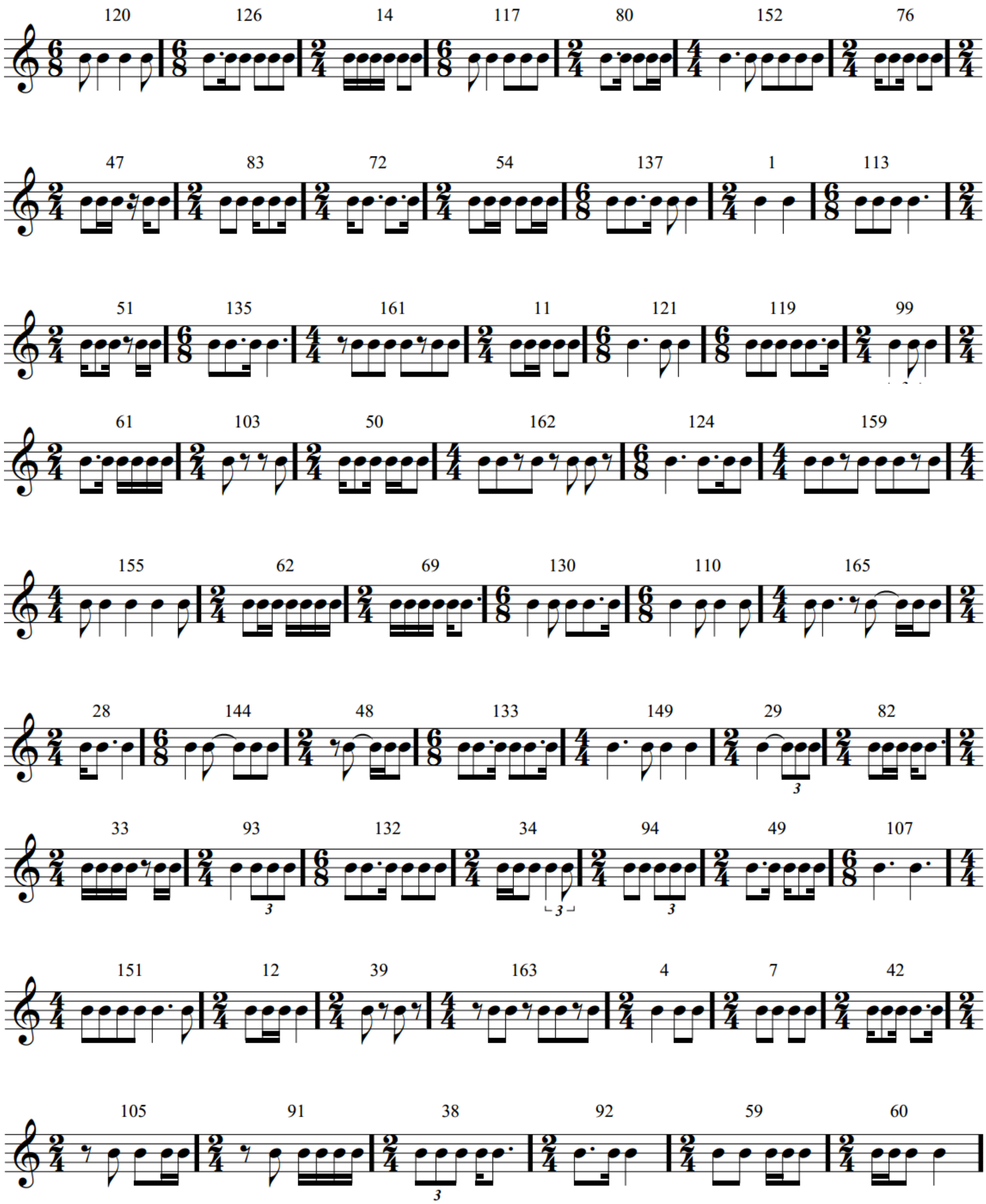



56 31 134 145 146 88 118 5
7 105 29 28 42 84
79 41 91 36 138 86 3
160 111 102 124 109 50 10
165 152 92 108 9 30
75 136 1 137 80 163
82 69 15 23 121 64
59 106 94 110 100 101 112
126 11 161 93 26
143 159 49 63 61

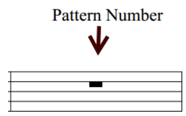
Appendix B: Test 2

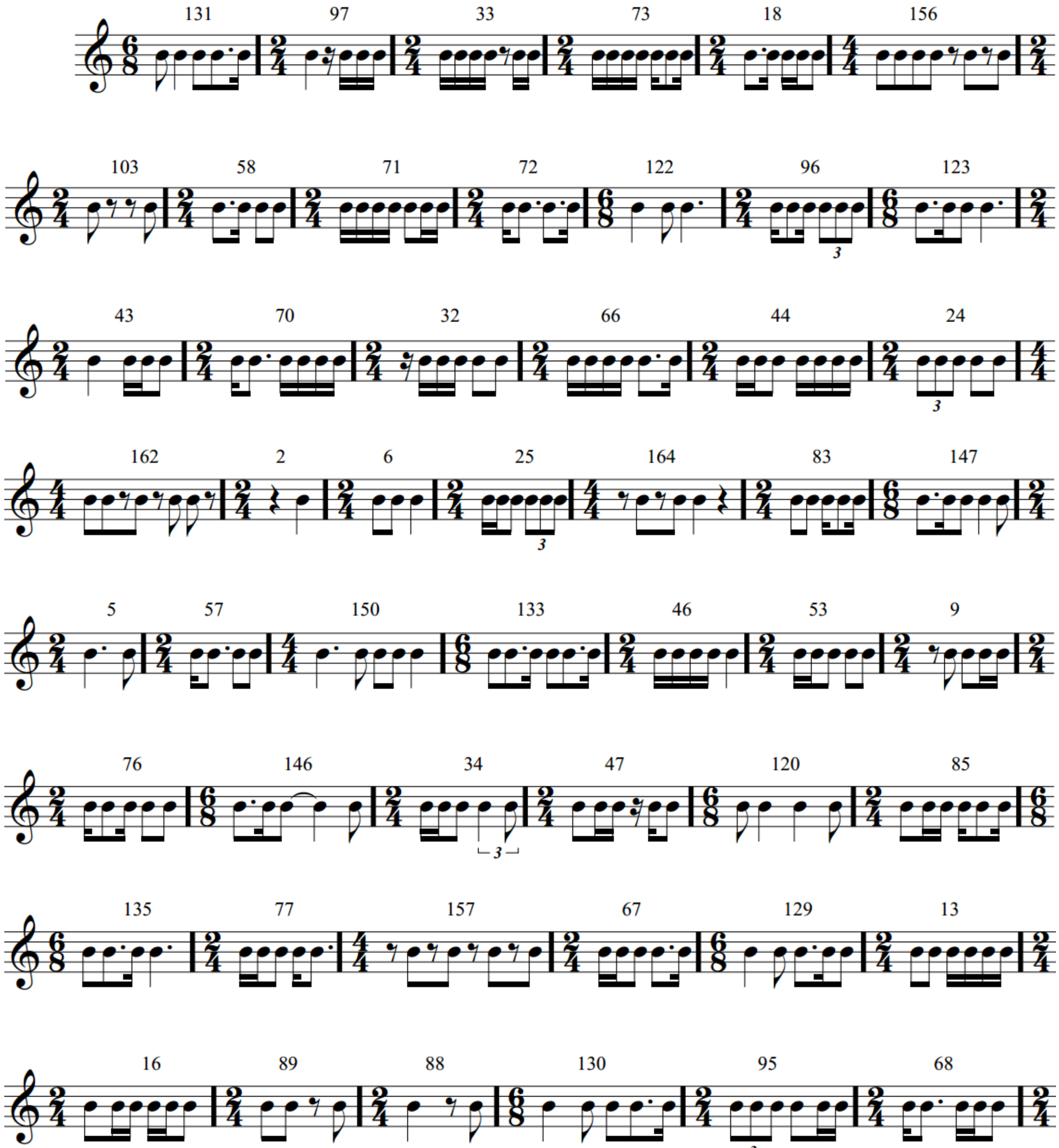





120 126 14 117 80 152 76
47 83 72 54 137 1 113
51 135 161 11 121 119 99
61 103 50 162 124 159
155 62 69 130 110 165
28 144 48 133 149 29 82
33 93 132 34 94 49 107
151 12 39 163 4 7 42
105 91 38 92 59 60

Appendix C: Test 3






98
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107
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140
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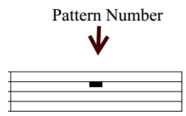
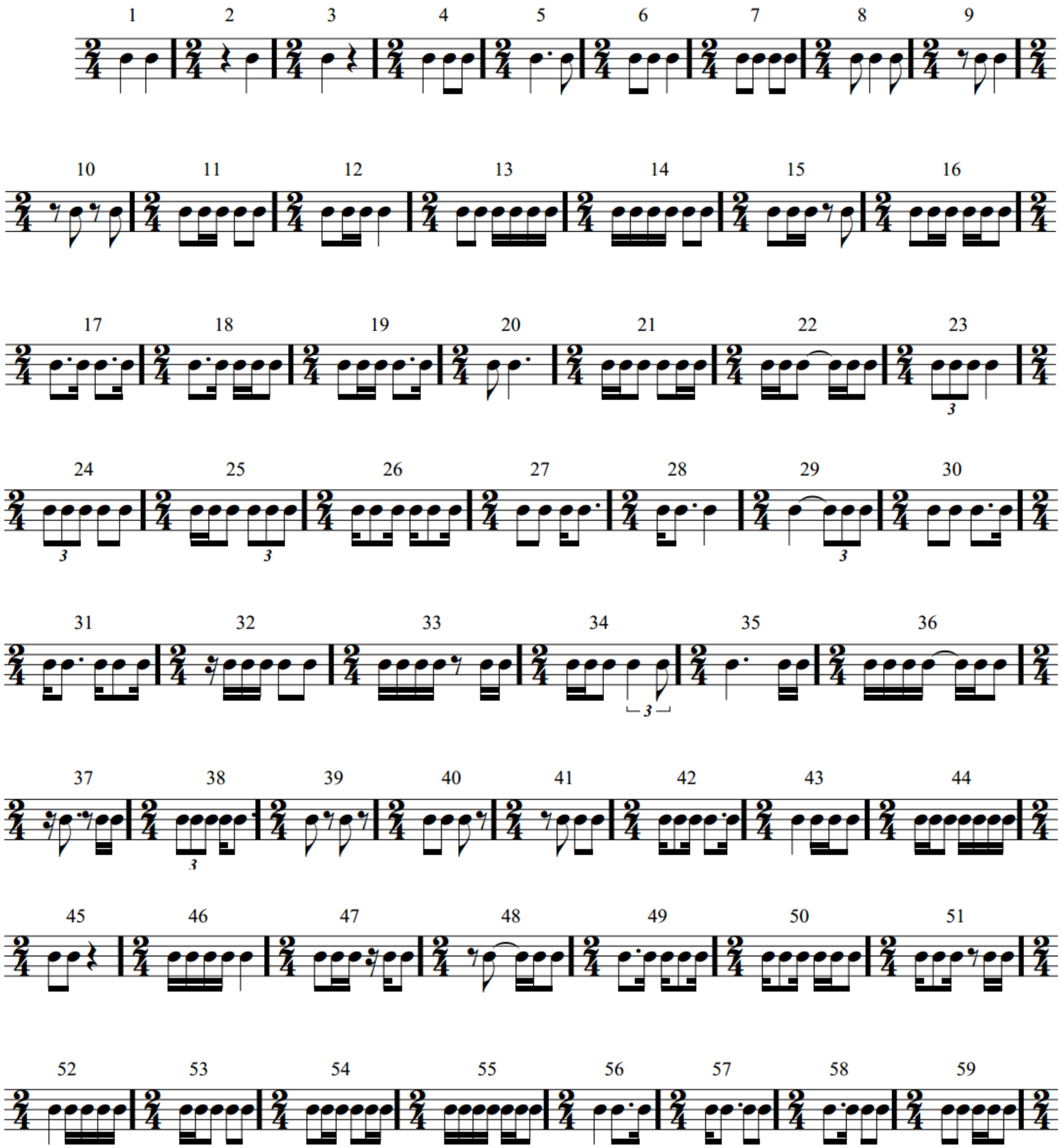
141
87
127

Appendix D: All Rhythm Patterns

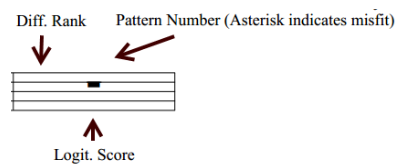





60 61 62 63 64 65 66
67 68 69 70 71 72 73
74 75 76 77 78 79 80
81 82 83 84 85 86 87
88 89 90 91 92 93 94
95 96 97 98 99 100 101
102 103 104 105 106 107 108
109 110 111 112 113 114 115
116 117 118 119 120 121


122 123 124 125 126 127
128 129 130 131 132
133 134 135 136 137 138
139 140 141 142 143
144 145 146 147 148
149 150 151 152 153
154 155 156 157
158 159 160 161
162 163 164 165

Appendix E: Hierarchy of Rhythm Patterns—Most Difficult to Easiest

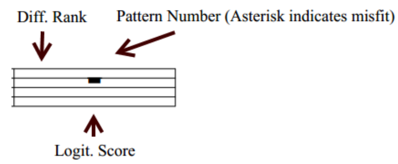


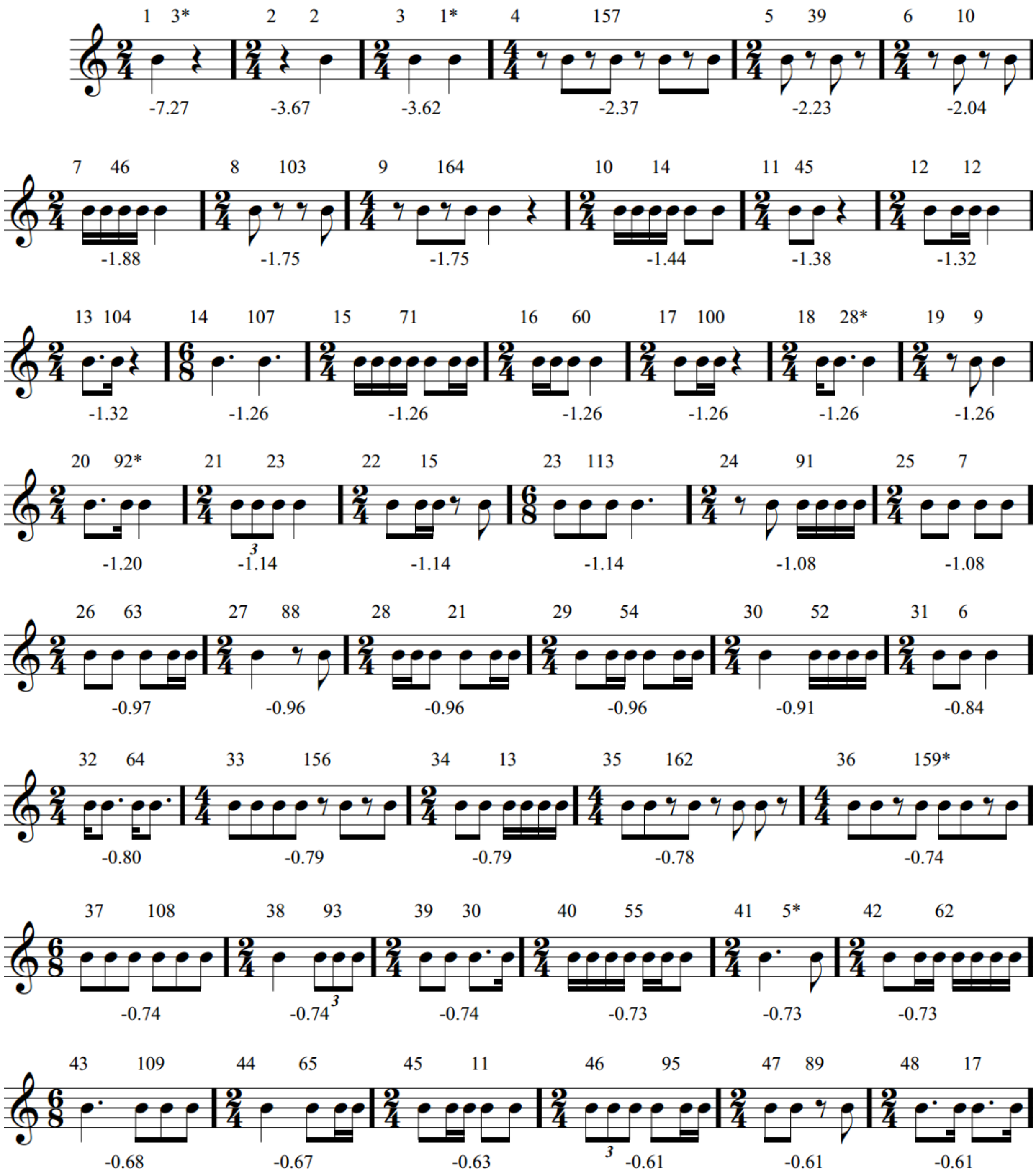
44 38 45 135 46 153 47 57 48 75 49 84
0.60 0.60 0.60 0.52 0.46 0.46
50 76 51 25 52 74 53 98 54 141 55 36
0.44 0.42 0.42 0.42 0.42 0.39
56 143 57 72 58 106 59 111 60 152 61 51
0.39 0.37 0.32 0.32 0.32 0.30
62 78 63 18 64 115 65 154 66 32 67 56
0.30 0.28 0.28 0.23 0.21 0.21
68 77 69 42 70 163* 71 27 72 90 73 29
0.21 0.18 0.18 0.15 0.15 0.12
74 161 75 67 76 151 77 158 78 114
0.12 0.09 0.09 0.09 0.08
79 105 80 112 81 8 82 116 83 22 84 160*
0.05 0.05 0.02 0.02 0.01 -0.01
85 155 86 16 87 94* 88 40 89 58* 90 80
-0.04 -0.05 -0.08 -0.12 -0.12 -0.14
91 110 92 37* 93 35* 94 148 95 61* 96 101
-0.14 -0.17 -0.18 -0.18 -0.20 -0.20


97 44 98 19 99 149* 100 66 101 86 102 99
-0.24 -0.30 -0.30 -0.31 -0.33 -0.36
103 59* 104 79 105 48 106 33 107 53 108 68
-0.39 -0.39 -0.42 -0.48 -0.48 -0.48
109 24 110 70 111 142 112 20* 113 43 114* 122
-0.49 -0.49 -0.49 -0.55 -0.55 -0.55
115 41 116 4 117 47 118 17 119 89 120 95
-0.57 -0.61 -0.61 -0.61 -0.61 -0.61
121 11 122 65 123 109 124 62 125 5* 126 55
-0.63 -0.67 -0.68 -0.73 -0.73 -0.73
127 30 128 93 129 108 130 159* 131 162
-0.74 -0.74 -0.74 -0.74 -0.78
132 13 133 156 134 64 135 6 136 52 137 54
-0.79 -0.79 -0.80 -0.84 -0.91 -0.96
138 21 139 88 140 63 141 7 142 91 143 113
-0.96 -0.96 -0.97 -1.08 -1.08 -1.14
144 15 145 23 146 92* 147 9 148 28* 149 100
-1.14 -1.14 -1.20 -1.26 -1.26 -1.26


150
60
-1.26
151
71
-1.26
152
107
-1.26
153
104
-1.32
154
12
-1.32
155
45
-1.38
156
14
-1.44
157
164
-1.75
158
103
-1.75
159
46
-1.88
160
10
-2.04
161
39
-2.23
162
157
-2.37
163
1*
-3.62
164
2
-3.67
165
3*
-7.27

Appendix F: Hierarchy of Rhythm Patterns—Easiest to Most Difficult






49 47 50 4 51 41 52 122 53 43 54 20*
-0.61 -0.61 -0.57 -0.55 -0.55 -0.55
55 142 56 70 57 24 58 68 59 53 60 33
-0.49 -0.49 -0.49 -0.48 -0.48 -0.48
61 48 62 79 63 59* 64 99 65 86 66 66
-0.42 -0.39 -0.39 -0.36 -0.33 -0.31
67 149* 68 19 69 44 70 101 71 61*
-0.30 -0.30 -0.24 -0.20 -0.20
72 148 73 35* 74 37* 75 110 76 80 77 58*
-0.18 -0.18 -0.17 -0.14 -0.14 -0.12
78 40 79 94* 80 16 81 155 82 160*
-0.12 -0.08 -0.05 -0.04 -0.01
83 22 84 116 85 8 86 112 87 105 88 114
0.01 0.02 0.02 0.05 0.05 0.08
89 158 90 151 91 67 92 161 93 29
0.09 0.09 0.09 0.12 0.12
94 90 95 27 96 163* 97 42 98 77 99 56
0.15 0.15 0.18 0.18 0.21 0.21


100 32 101 154 102 115 103 18 104 78
0.21 0.23 0.28 0.28 0.30
105 51 106 152 107 111 108 106 109 72 110 143
0.30 0.32 0.32 0.32 0.37 0.39
111 36 112 141 113 98 114 74 115 25 116 76
0.39 0.42 0.42 0.42 0.42 0.44
117 84 118 75 119 57 120 153 121 135 122 38
0.46 0.46 0.52 0.60 0.60 0.60
123 69 124 50 125 31 126 144* 127 117 128 34
0.61 0.61 0.65 0.67 0.67 0.67
129 83 130 127 131 97 132 150 133 146 134 81
0.75 0.80 0.84 0.88 0.88 0.88
135 87 136 138 137 121* 138 73* 139 124 140 82
0.92 0.93 0.93 1.01 1.02 1.02
141 120 142 102 143 49 144 118 145 119 146 140
1.10 1.11 1.11 1.14 1.19 1.33
147 96 148 133 149 134 150 128 151 26
1.33 1.39 1.43 1.43 1.49

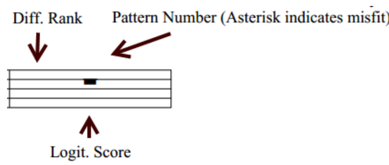
152 130
1.49
153 125*
1.53
154 147
1.60
155 132
1.72
156 123
1.75
157 85
1.84
158 145
1.86
159 129
1.86
160 126
1.95
161 165
2.08
162 137
2.22
163 139
2.26
164 136
2.53
165 131
3.46

Appendix G: Hierarchy of Rhythm Pattern by Item Number


150 60 -1.26
95 61* -0.20
124 62 -0.73
140 63 -0.97
134 64 -0.80
122 65 -0.67
100 66 -0.31
75 67 0.09
108 68 -0.48
43 69 0.61
110 70 -0.49
151 71 -1.26
57 72 0.37
28 73* 1.01
52 74 0.42
48 75 0.46
50 76 0.44
68 77 0.21
62 78 0.30
104 79 -0.39
90 80 -0.14
32 81 0.88
26 82 1.02
37 83 0.75
49 84 0.46
9 85 1.84
101 86 -0.33
31 87 0.92
139 88 -0.96
119 89 -0.61
72 90 0.15
142 91 -1.08
146 92* -1.20
128 93 -0.74
87 94* -0.08
120 95 -0.61
19 96 1.33
35 97 0.84
53 98 0.42
102 99 -0.36
149 100 -1.26
96 101 -0.20
24 102 1.11
158 103 -1.75
153 104 -1.32
79 105 0.05
58 106 0.32
152 107 -1.26
129 108 -0.74
123 109 -0.68
91 110 -0.14
59 111 0.32
80 112 0.05
143 113 -1.14
78 114* 0.08
64 115 0.28
82 116 0.02
39 117 0.67
22 118 1.14
21 119 1.19
25 120 1.10
29 121* 0.93

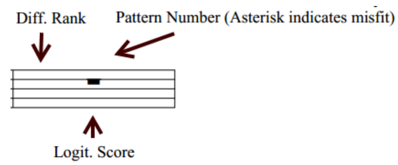
114 122 -0.55
10 123 1.75
27 124 1.02
13 125 1.53
6 126 1.95
36 127 0.80
16 128 1.43
7 129 1.86
14 130 1.49
1 131 3.46
11 132 1.72
18 133 1.39
17 134 1.43
45 135 0.60
2 136 2.53
4 137 2.22
30 138 0.93
3 139 2.26
20 140 1.33
54 141 0.42
11 142 -0.49
56 143 0.39
40 144* 0.67
8 145 1.86
33 146 0.88
12 147 1.60
94 148 -0.18
99 149* -0.30
34 150 0.88
76 151 0.09
60 152 0.32
46 153 0.60
65 154 0.23
85 155 -0.04
133 156 -0.79
162 157 -2.37
77 158 0.09
130 159* -0.74
84 160 * -0.01
74 161 0.12
131 162 -0.78
70 163* 0.18
157 164 -1.75
5 165 2.08

Appendix H: Hierarchy of Simple Duple Rhythm Patterns—Easiest to Most Difficult

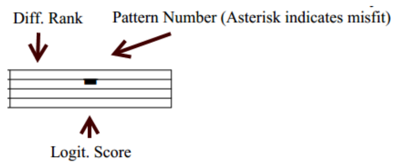


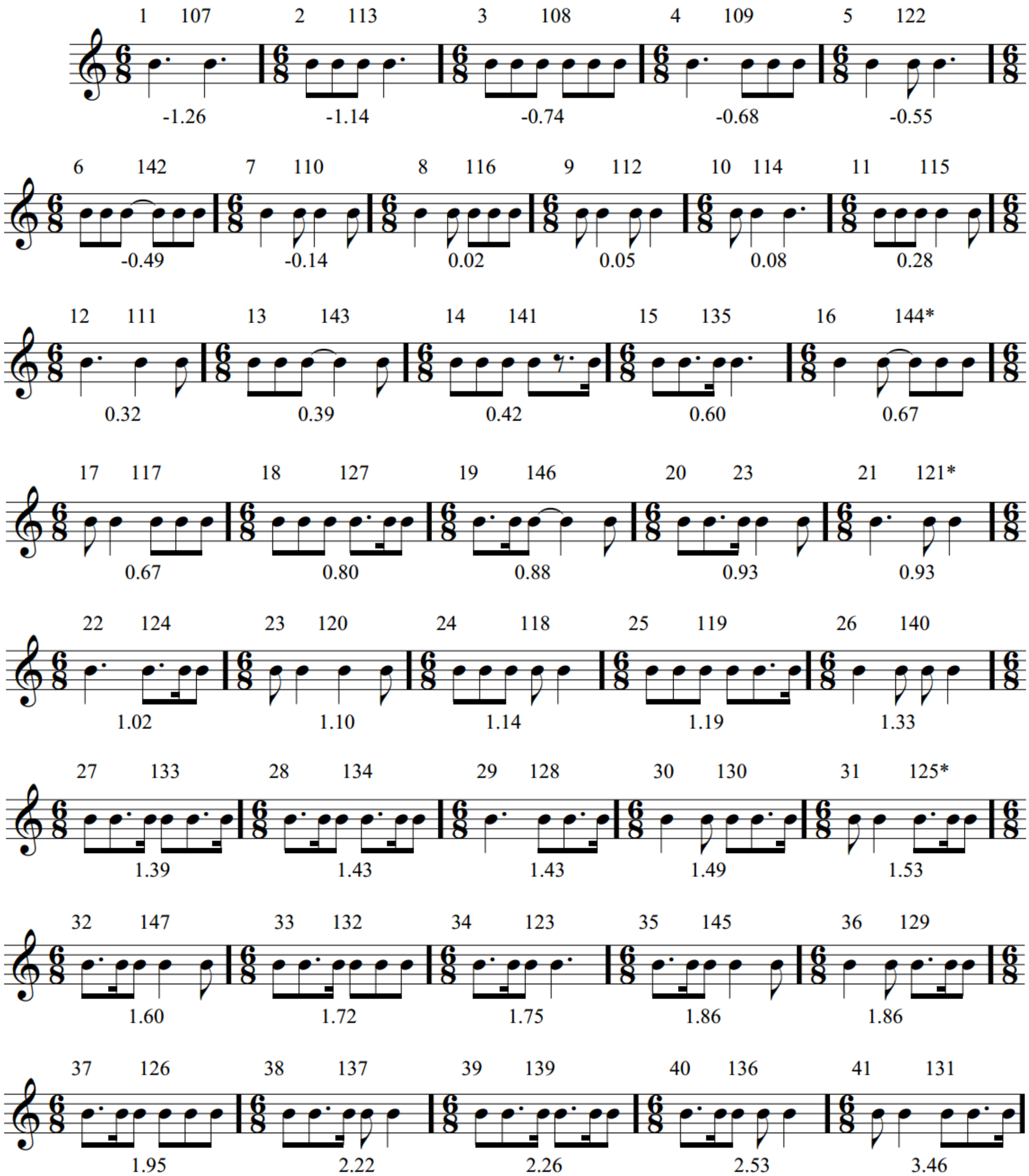

53 99 54 86 55 66 56 19 57 44 58 101
-0.36 -0.33 -0.31 -0.30 -0.24 -0.20
59 61* 60 35* 61 37* 62 80 63 58* 64 40
-0.20 -0.18 -0.17 -0.14 -0.12 -0.12
65 94* 66 16 67 22 68 8 69 105 70 67
-0.08 -0.05 0.01 0.02 0.05 0.09
71 29 72 30 73 27 74 42 75 77 76 56
0.12 0.15 0.15 0.18 0.21 0.21
77 32 78 18 79 78 80 51 81 106 82 72
0.21 0.28 0.30 0.30 0.32 0.37
83 36 84 98 85 74 86 25 87 76 88 84
0.39 0.42 0.42 0.42 0.44 0.46
89 75 90 57 91 38 92 69 93 50 94 31
0.46 0.52 0.60 0.61 0.61 0.65
95 34 96 83 97 97 98 81 99 87 100 73*
0.67 0.75 0.84 0.88 0.92 1.01
101 82 102 102 103 49 104 96 105 26 106 85
1.02 1.11 1.11 1.33 1.49 1.84

Appendix I: Hierarchy of Simple Quadruple Rhythm Patterns—Easiest to Most Difficult



Appendix J: Hierarchy of Compound Duple Rhythm Patterns—Easiest to Most Difficult





Appendix K: IRB Approval of Protocol

The University of Georgia

Phone 706-542-3199

Office of the Vice President for Research
Institutional Review Board

APPROVAL OF PROTOCOL

November 28, 2016

Dear Brian Wesolowski:

On 11/28/2016, the IRB reviewed the following submission:

Type of Review:	Initial Study- Exempt 2
Title of Study:	INVESTIGATION OF A HIERARCHICAL RHYTHMIC PATTERN DIFFICULTY IN THE CONTEXT OF HIGH SCHOOL INSTRUMENTAL MUSIC PERFORMANCE
Investigator:	Brian Wesolowski
IRB ID:	STUDY00004227
Funding:	None
Documents Reviewed:	Recruitment, Consent, Data Collection Material, Site Authorization

The IRB approved the protocol from 11/28/2016 to 11/27/2021.

In conducting this study, you are required to follow the requirements listed in the Investigator Manual (HRP-103).

Sincerely,

Dr. Gerald E. Crites, MD, MEd
University of Georgia
Institutional Review Board Chairperson

310 East Campus Rd, Tucker Hall Room 212 • Athens, Georgia 30602
An Equal Opportunity/Affirmative Action Institution

Appendix L: School System Approval of Study

FW: Study Proposal-Brian Toney
Baker, Craig
Sent: Thursday, November 10, 2016 7:04 AM
To: Toney, Brian

Good Morning,

It appears you have been approved. See stipulations below.

Congratulations.

Craig W. Baker
Principal
Grovetown High School
2010 Warrior Way
Grovetown, GA 30813
706.447.2102 Ext. 4409
cbaker@ccboe.net

Warriors Lead the Way!

From: Carney, Jeff
Sent: Tuesday, November 8, 2016 5:25 PM
To: Baker, Craig <cbaker@ccboe.net>
Subject: Re: Study Proposal-Brian Toney

It sounds good to me. Everything after school and voluntary.

Jeff Carney
Associate Superintendent
Columbia County School District

On Nov 8, 2016, at 3:58 PM, Baker, Craig <cbaker@ccboe.net> wrote:

> Dr. Carney,
>
> Below is a request I received today from my band director, Brian Toney. He is completing a doctoral program at the University of Georgia. Please let me know you thoughts in regards to his request.
>
> Thank you,
>
> Craig W. Baker
> Principal
> Grovetown High School
> 2010 Warrior Way
> Grovetown, GA 30813
> 706.447.2102 Ext. 4409
> cbaker@ccboe.net

Warriors Lead the Way!

From: Toney, Brian
Sent: Tuesday, November 8, 2016 2:02 PM
To: Baker, Craig <cbaker@ccboe.net>
Subject: Study Proposal-Brian Toney

Good Afternoon Mr. Baker,

I appreciate your support as I seek to do a research study in pursuit of a Ed. D. in music education from the University of Georgia.

The purpose of this study is to objectively explore and establish the hierarchy of performance difficulty of rhythm patterns in the context of high school band students. For a long time, music performance has been seen as a subjectively graded subject. This may be the case, but in some regards, it does not have to be nor should it be. Significant implications for teaching and learning, curriculum development, and understanding of cognitive processing may allow for me (and others) to more effectively sequence the instruction of rhythm patterns according to best practices of instruction of simple to complex and known the unknown based on this and other research and may be a step toward more objective and reliable music assessments and evaluations, similar to what English literature has with Lexile.

I anticipate asking our student to participate with parent permission outside of school hours. Each will take one of three versions of the tests—where they will perform each notational representation of a rhythmic pattern in a manner similar to what we do in band class. Each student's information will be held in confidence and attached to their results through the assigning of a number. Along with their performance on one of three versions of a test of rhythm patterns, information will be collected related to years of experience playing their instrument and their primary instrument. Students would be randomly assigned to one of the three versions of the test. No test will be purposely more difficulty or complex than the others.

To begin each item of the test, each rhythm pattern will be performed after a subject has the opportunity to preview the pattern for the time it would take to perform it at the given tempo. After that time, a full measure of guiding tones placed on the beat in tempo to prepare for performance will be given. Only the audio of this performance would be recorded. Each test will take roughly 15 minutes. To assess the performance of the subjects, a panel of three secondary instrumental music teachers each assessed each rhythmic pattern tested. This will be done individually on their own, not together with each other nor live. None of the panelist will know what the other panelist rated any item, nor will they be told who the other panelists will be. The panel will not know the name, age, gender, instrument, or school of any of the subject, but only the confidential random number assigned by myself.

I am happy to give any more information that may be requested and I appreciate your assistance in what I think could be an exceptionally relevant test and result that would certainly benefit our students and my teaching. Many of my colleagues are excited about this study and its implications and hope to have their students involved as well. Please advise on how I may proceed from here.

Brian M. Toney
Band Director
Fine Arts Department Chair
The Grovetown High School
2010 Warrior Way
Grovetown, Georgia 30813
(706) 447-2102 ex 4460

Appendix M: Rhythm Study Recruitment Letter

Rhythm Difficulty Study Opportunity

Dear High School Band Students:

I am Brian Toney, a graduate student under the direction of Dr. Brian C. Wesolowski in the Department of Music Education at The University of Georgia. I invite you to participate in a research study entitled Investigation of a Hierarchical Rhythmic Pattern Difficulty in the Context of High School Instrumental Music Performance. The purpose of this study is to explore and establish the hierarchy of performance difficulty of rhythm patterns in the context of high school band students. In simple terms, I am trying to find out what rhythm patterns are truly harder than other rhythm patterns.

You are eligible to be in this study because you are a high school band student. This is an exciting possibility to participate in a research study. Participation is voluntary and not tied to any aspect of elevated participation or success in band classes.

Your participation will involve taking one of three versions of the tests—where you will perform rhythm patterns by tapping, which may be in a manner similar to what is done in many band classes. Along with performing on one of three versions of a test of rhythm patterns, information will be collected related to your years of experience playing in a public school band program and your primary instrument. The test should only take about 20 minutes and would take place in a comfortable classroom outside of the school day where you would simply tap the given rhythms. Many really interesting things could come from this study. Significant implications for teaching and learning, curriculum development, and this understanding of how musicians think may allow for those in music education to more effectively teach rhythm patterns. This and other research and may be a step toward more objective and reliable music assessments and evaluations, similar to what English literature has with Lexile.

If you would like additional information about this study, please feel free to call me, Brian Toney at (706) 447-2102 ex 4460 or send an e-mail to bmtoney@uga.edu.

Thank you for your consideration!

Sincerely,

Brian Toney

Appendix N: Rhythm Study Parent Consent and Permission Form

UNIVERSITY OF GEORGIA
PARENTAL PERMISSION FORM

Investigation of a Hierarchical Rhythmic Pattern Difficulty in the
Context of High School Instrumental Music Performance

Researcher's Statement
I am asking your student to take part in a research study. Before you decide to allow your student to participate in this study, it is important that you understand why the research is being done and what it will involve. This form is designed to give you the information about the study so you can decide whether to allow your student to be in the study or not. Please take the time to read the following information carefully. Please ask the researcher if there is anything that is not clear or if you need more information. When all your questions have been answered, you can decide if you want your student to be in the study or not. This process is called "informed consent." A copy of this form will be given to you.

Primary Contact *Brian Toney*
Music Education
706-447-2102 ex 4460 or bmtoney@uga.edu

Purpose of the Study
I am doing a research study to explore and establish the performance difficulty of rhythm patterns for high school band students. I am asking your student to be in the study because they are a high school band student. If you agree to allow them to be in the study, they will take one of three versions of a test—where they will perform rhythmic patterns by tapping in a manner similar to what they may do band class. Along with their performance on one of three versions of a test of rhythm patterns, information will be collected about their years of experience playing their instrument and their primary

Study Procedures
If you agree to participate, your student will be asked to …

- *Identify:*
  - *How long they have been in a public school band program*
  - *Their primary instrument*
- The test should only take about 20 minutes and will take place in a comfortable classroom where test takers would simply tap given rhythms as shown on a computer screen. A digital recorder will record those taps for later evaluation.

Risks and discomforts

- I do not anticipate any risks from participating in this research.

Benefits

- I hope to use the information to help us understand how to more effectively teach rhythm pattern reading.
- This and other research and may be a step toward more what English literature has with Lexile.

Audio Recording

Audio recording devices will be used to record the performance of the tapping of rhythm patterns by the students. The test performances will be evaluated at a later time by music teachers that will not know anything about the student who is doing the tapping other than the number assigned to them by the researcher. These recordings may be kept for further study at the conclusion of this research, but the identity of the students and their schools will remain confidential.

Please provide initials below if you agree to have these audio recordings be able to be used in further research, reports, and/or presentations. You may still participate in this study even if you are not willing to have the audio recordings used beyond the current study.

_______I do not want to have the audio recordings used beyond the current study.
_______I am willing to have the audio recordings used beyond the current study.

Privacy/Confidentiality

Subjects (test takers) will be given an identification number which will be known only to the researcher and not shared with others; however, it may be reviewed by departments at the University of Georgia responsible for regulatory and research oversight. The identification number key will be stored on a private computer in an excel spreadsheet. Researchers will not release identifiable results of the study to anyone other than individuals working on the project without your written consent unless required by law.

Taking part is voluntary

Each participant's involvement in the study is voluntary, and they may choose not to participate or to stop at any time. Participation is voluntary and not tied to any aspect of their participation, grades or success in their band classes.

If your student chooses to not participate in the research at any time, no part of the participant's records or recordings will be retained or used in the study. If the participant decides to stop or withdraw from the study, the information/data collected from or about them will not be kept as part of the study.

If you have questions

The main researcher conducting this study is Brian Toney, a graduate at the University of Georgia under the direction of Dr. Brian Wesolowski. Please ask any questions you have now. If you have questions later, you may contact Dr. Wesolowski at bwes@uga.edu or 706-542-3737 or Brian Toney at bmtoney@uga.edu or at 706-447=-2102 ex 4460. If you have any questions or concerns regarding your rights as a research participant in this study, you may contact the Institutional Review Board (IRB) Chairperson at 706.542.3199 or irb@uga.edu.

Research Subject's Consent to Participate in Research:

To voluntarily allow your child to take part in this study, you must sign on the line below. Your signature below indicates that you have read or had read to you this entire Parental Permission Form, and have had all of your questions answered.

Your Student's Name: ____

Your Signature: ____ Date ______________

Your Printed Name: ____

Signature of Researcher: ______________________________________ Date ______________

Printed Name of Researcher: ___________________________________

Please sign both copies, keep one and return one to the researcher.

Appendix O: Rhythm Study Minor Assent Form

Assent Script/Form for Participation in Research
Investigation of a Hierarchical Rhythmic Pattern Difficulty in the Context of High School Instrumental Music Performance

I am doing a research study to explore and establish the performance difficulty of rhythm patterns for high school band students. I am asking you to be in the study because you are a high school band student. If you agree to be in the study, you will take one of three versions of a test—where you will perform rhythmic patterns by tapping in a manner similar to what you may do band class. Along with your performance on one of three versions of a test of rhythm patterns, information will be collected about your number of years of being in a public school band program and your primary instrument. The test should only take about 20 minutes and would take place in a comfortable classroom where you would simply tap given rhythms outside of school hours. A digital recorder will record those taps. I hope to use the information to help music teachers understand how to more effectively teach rhythm pattern reading. This and other research may be a step toward more what English literature has with Lexile.

The test performances will be evaluated at a later time by three music teachers that will not know anything about who is doing the tapping other than the number assigned to you. The digital recordings may be kept for further study at the conclusion of this research, but your identity will remain confidential. Really, we aren't actually grading you, but identifying what rhythms patterns are easy or hard though the results of all the students. We will only identify you by using a given number. Once we have everyone's results, we will be able to get a better idea of what rhythms are harder or easier than other rhythm patterns.

Please provide initials below if you agree to have the digital audio recordings be able to be used in further research, reports, and/or presentations. You may still participate in this study even if you are not willing to have the audio recordings used beyond the current study.

_______I do not want to have the audio recordings used beyond the current study.
_______I am willing to have the audio recordings used beyond the current study.

You do not have to say "yes" if you don't want to. No one, including your parents, will be mad at you if you say "no" now or if you change your mind later. We have also asked your parent's permission to do this. Even if your parent says "yes," you can still say "no." Remember, you can ask us to stop at any time. Your grades in school will not be affected whether you say "yes" or "no." Participation is voluntary and not tied to any aspect of your participation, grades or success in their band classes.

You can ask any questions that you have. If you have a question later that you didn't think of now, please contact Brian Toney at bmtoney@uga.edu or at 706-447-2102 ex 4460 at any time.

Name of Child: ______________________ **Parental Permission on File:** ☐ Yes ☐ No**
***(If "No," do not proceed with assent or research procedures.)*

***(For Written Assent)* Signing here means that you have read this paper or had it read to you and that you are willing to be in this study. If you don't want to be in the study, don't sign.**

Signature of Child: ______________________ **Date:** ______________

Signature of Researcher: ______________________ **Date:** ______________